SCENARIO PLANNING FOR A CIRCULAR FUTURE:
PETERBOROUGH CONTEXT

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This research was undertaken by Cranfield University and conducted in collaboration with the Peterborough City Council and Opportunity Peterborough.









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Chapter One: Introduction

1.1 Background

A famous saying attributed to Lavoisier, 'nothing is lost, nothing is created, everything is transformed', resembles the idea of a circular economy thinking (Institut Montaigne, 2016). Laurent Bigorgne (2016) states that the concept of the circular economy is based on two simple ideas: an understanding of 'waste' as a resource, and the need to decouple economic growth from natural resource use (Ellen MacArthur Foundation, 2017). Subsequently, the principal purpose of the circular economy is to efficiently use resources and prolong the life of materials through repair, recovery, reuse, and finally recycling.

According to Ellen MacArthur Foundation (2017), cities provide a hub for economic growth, as 85% of the global GDP is generated within metropolises. Furthermore, 54% of the world population currently reside in urban areas. Given the present innovation and growth within cities, they play a central role as drivers of the global economy. Nevertheless, this growth has consequences. Cities are at the core of natural resource depletion, being responsible for 75% of the global natural resource consumption, 50% of global waste production, and 60- 80% of greenhouse gas emissions (Ellen MacArthur Foundation, 2017). In coming decades, urbanisation is expected to rapidly increase, contributing towards significant investment within infrastructure development. This projected growth of cities, along with their geographically concentrated capital availability, talent and large use of resources, place cities in a unique position to drive the global transition towards a circular economy and reap the benefits from this.

1.2 Rationale for Research

Peterborough is host to a variety of businesses of all sizes. These businesses are crucial in serving both local residents and those from surrounding towns (New Hampshire Division of Historical Resources, 2010). Peterborough City Council values the importance of the businesses within the city and desires to change their resource impact through the Circular Peterborough Programme. The Circular Peterborough Programme is jointly delivered by Peterborough City Council and Opportunity Peterborough; the city's economic development company. The initiative aims to apply circular economy principles across urban systems, with the overall ambition to ensure that the city is operating as a truly circular city by 2050. The Circular Peterborough programme has generated a significant amount of interest from several local stakeholders, including key decision makers and local organisations. Examples of local engagement include Perkins Engines, Cross Keys Homes and even the Peterborough prison (Grinnell, 2018). However, the challenge remains in terms of moving interest into action on a large scale. Therefore, there is a need to develop a tool to motivate local stakeholders into action, through creating an enabling scenario within businesses to realise that the concept of circular economy is tangible and beneficial.

1.3 Overview of the Project and Research Objectives

The city of Peterborough aims to become the environmental capital of the UK. As part of this mission, they aspire to eliminate the linear concept business model of 'take-make-dispose.' Their vision involves the city functioning in a fully circular path by 2050. However, currently, the biggest challenge for the council is bridging the gap between generating the interest from individual businesses and transforming the interest into action within their businesses. This project focuses primarily on businesses with the aspiration to bridge the interest-to-action gap. This will be done through creating a visualisation tool to present 2050 scenarios demonstrating the consequences of following the linear pathway and the benefits of transitioning to a circular business model.

The project aims to apply the principles of the circular economy to various businesses within Peterborough with the purpose of transitioning their interest into action. The approach will provide an understanding as to how the business model is designed to benefit businesses, society, and the environment. Using a digital visual tool, the outcome will highlight that in contrast to the current linear model, the circular economy aims to disassociate economic growth from finite resource consumption and eliminate waste through maintaining assets at their highest value. To achieve these aims, several objectives have been set to guide the process of the project:

- Define at least 3 case studies alongside Opportunity Peterborough based on the local industries such as manufacturing, services and retail.
- Understand the barriers and challenges that are preventing businesses from transitioning into a full circular economy.
- To bridge the gap between interest and action within businesses with the view to alleviating current scepticism and reluctance from businesses within Peterborough, by demonstrating the consequences of a linear economy and the benefits of a circular economy.
- To create future scenarios within Peterborough depicting how in 2050 the city could move to a Circular Economy transition and its benefits and, in contrast, how it could continue on a linear model and what would be its consequences.
- To validate the future scenarios through a visual digital tool.
- Provide key recommendations to improve the circularity of Peterborough's economy in the future and beyond the scope of this project.

Chapter Two: Literature Review

2.1 Introduction

This chapter is going to analyse the fundamentals and characteristic of the circular economy paradigm. Moreover, a brief discussion will highlight both European and UK based strategies to progress towards this new economic model. Subsequently, the review will express what can be done on a city level to support this change and become fully circular.

2.2 The Circular Economy

The current economic system is based on the paradigm of the 'take-make-dispose' linear economy. This economic model involves a process for the extraction of raw materials to create new products. Ultimately, the products are disposed at the end of their lifecycle. In recent years, awareness has been generated regarding the consequences of a linear economic model. Climate change is now a major global concern. Its effects are felt across global societies. Research highlights that the use of finite resources is already higher than can naturally be replaced. Not only is this an environmental concern, however lack of resources also places stress upon the economic systems. These pressures are exemplified when considering the future of the planet if the business-as-usual approach is to be followed.

Presented in Figure 2.1, are results of research by the European Commission depicting what the world may look like by 2050. A rise in the world population to 9 billion people is expected. This will result in three times more of raw material usage than the current level, and a 70% increase in food, feed and fibre (Potocnik, 2014). This awareness has motivated the need to adopt a different but more sustainable economic system, the circular economy.



Figure 2.1. *A representation of the statistics presented by the European Commission for the future of the planet in 2050 (Authors Own).*

The idea of the circular economy is set within the broader paradigm of sustainable growth. The Brundtland Report defines sustainable growth as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). In 1992, at the United Nation conference on Environment and Development, the importance of the "beyond the limits" report was highlighted. The report underlines the concept of 'carrying capacity'

of the planet. The current rate of extraction of raw materials cannot be sustained within the limits of natural resources. Further to this, the current levels of emissions associated with this cannot be maintained by the environment (Meadows et al. 1987).

Murray et al. (2015) note that the concept of a circular economy is not new. In fact, the idea originated in 1848 when the president of the Royal Society of Chemistry (A. W. Von Hofmann) realised that a factory could achieve a sufficient profit through using their own waste. In recent years, many scholars have concentrated their studies on the circular economy. Although each scholar provides different definitions, each explanation maintains the same fundamental concept of a close circuit system (Murray et al. 2015). Greyson (2007), for instance, expresses that Boulding, the creator of the term 'circular economy', indeed used this term to describe his belief that the human being could not live without using energy, needs to integrate in a circular ecological system, and must be enabled to reproduce continuously. Boulding (1966) views a linear system as a 'cowboy economy,' meaning that it is a one-way system which lacks the understanding of scarcity related to the carrying capacity of the planet.

The concept of the circular economy aims to deviate from this linear attitude. Instead, the life span of the product is extended, not only through the production of durable goods, but through the activity of rethinking the goods and through the reduction of waste. Hu et al. (2011) define the approach to circular economy based upon the 4R's:

- Reduce: the need to lessen the quantity of products bought and the raw materials used during the design and manufacturing of goods. The aim of this concept is to have a smaller production of waste.
- Reuse: this concept of using a product without transformation. Increasing the efficiency of goods increases the ability to reuse them for a longer period and therefore avoid the loss of value.
- Recycle: this step follows when the raw materials of a product are reused rather than the original product.
- Recover: all unavoidable waste throughout the product life cycle can be used in a different form, such as through creating electricity.

Inspired by the concept of the natural biological cycle, the model of circular economy aims to maintain the usefulness and the value of a product, its components and their raw material. This can be achieved by the management and the optimization of resources through technical and biological cycles to reduce system risks. Such innovation in business models is indispensable to achieve all the benefits of the recycling process and other 'green' innovation of products (Linder and Williander, 2015). As a result, this will support the growth of the circular economy.

According to Linder and Williander (2015), the concept of a circular business model is to offer new goods that retain value at the end of their life. Hence, the products operating in a circular supply chain will provide a return flow to the manufacturer, involving the consumer within a reverse logistics process. Furthermore, it is possible to identify 5 different types of circular business models (Pesso, 2015):

- The 'circular supply chain' business model is dominated by the companies that deal with renewable, recyclable or biodegradable raw materials that aim to substitute products that currently have a single life-cycle.
- Another type of business model oriented in circularity is focused on resource salvage, material recycling and industrial symbiosis techniques. The main characteristics of this

model are that the companies are grounded on recovery of materials within their production process, for example using waste as a resource.

- Some companies apply circularity through extending the life of a product. This new approach is based on a mechanism that prolongs the life-time of products through component regeneration and restoration. The aim of the business is not production maximisation, but the performance and service of the product.
- A circular business model could follow the principles of a sharing economy, such as sharing platforms. These principles define an economic model based on exchange and sharing practices. This includes products, services and even knowledge. A sharing economy has the aim of reducing environmental impact and benefit from economies of scale. At present, many goods are underutilised, however web platforms present the opportunity to increase the utility of these products quickly and easily.
- The functional economy is another type of business model for circularity. It is based on a particular service type: 'pay-per-use'. In this system, the consumers pay exclusively for the use of a good. This is also referred to as 'de-ownership'. This different approach between ownership and paying for the access to a product affects the entire value chain.

Moreover, another way to apply a circular business model is focusing on the use of the value coming from the biological activities such as agriculture, livestock and food consumption. There are numerous examples of companies that try to obtain value from these biological flows, taking advantage of that to create energy, fertilizers or biofuels.

2.3 *Circular Economy in EU and UK Policy*

The European Commission (2015) focused their attention on the new business opportunity as well as the innovative and efficient method of production and consumption. The aim of the document of the European Commission is both to defend the economy of the Union from the progressive shortage of resources and the resulting volatility of price, and to create new workplace at the local level with the opportunity to increase integration and social cohesion. Furthermore, the EU circular economy policy plan aspires to limit irreversible damage caused by over extraction of natural resources primarily through energy saving. Finally, the plan presented by the European Commission follow the priority of the EU in all the crucial areas.

Regarding the United Kingdom, the government released a document in November 2014 to promote circular economy principles. Nevertheless, the principles were never approved to lead to any programmed action (Murray et al. 2015). Recently the Department for Transport released the 'HS2 Circular Economy Principles' (Gov.uk, 2017). The UK is therefore beginning its transition towards encompassing a circular economy system.

2.4 *Circular Economy in the City*

According to Sukhdev et al. (no date), cities play an important role in shaping the global economy and should be considered as breeding grounds for circular economy. Cities concentrate high populations, economic activity, resource consumption, emissions and waste generation. Hence, the principles of circular economy are extremely relevant to them.

Challenges such as growing urbanisation and climate change are putting pressure on cities to redirect their development towards more sustainable pathways. At the same time, local authorities

have a deep and accurate knowledge of their areas of influence. Therefore, they have the authority to make important decisions on many issues such as water and waste management, mobility, local transportation and urban planning (Prendeville et al. 2016).

Urban Mining is a new term to describe the resource loops closed by reutilisation. Cities concentrate large stocks of materials that can be reused, such as biomass, packaging and end-of-life products (Li, 2015). This is particularly successful when the different agents involved in this process are geographically close to each other. The local distribution allows for easier collaboration and close loops (Prendeville et al. 2016). The Ellen MacArthur Foundation stresses the necessity to implement innovative technology (such as Urban Mining) to enable the change towards a circular economy. These technologies mainly aim at big data management, geospatial information, asset tagging and connectivity. All these technologies would provide better understanding of current resource flows, allowing the identification of new economic opportunities. This is special relevant to businesses, which according to Ritzén and Sandström (2017), require a decrease in the resources used and consumed by their products while still allowing them to obtain revenues from their activities, in order to follow sustainable development paths. Merli et al. (2018) argue that the majority of studies published about circular economy are particularly relevant to the industrial sectors of waste, metallurgy and agri-food. Given the concept of circular economy, most of the work focus in reducing and mostly valorising waste from specific industries in order to keep them longer in the loop.

Prendeville et al. (2016) found that the most relevant aspects to cities when developing circular economy are political leadership, creating adaptable future visions, utilising demonstration examples and engaging with a variety of stakeholders. On the other side, several barriers are still in place preventing businesses and institutions from switching to circular economy. Ritzén and Sandström (2017) conclude that these barriers are mainly financial, structural, operational, attitudinal and technological. According to these authors, financial barriers arise due to the doubts regarding the value increase derived from the application of circular economy, as well as the magnitude of the investments required. Many stakeholders and decision-makers have scarce knowledge about circular economy, and this along with inertia and low risk appetite constitute another barrier. Structural barriers refer to the difficulties to manage organisational changes and the responsibilities within businesses to address circular economy. In terms of operational challenges, complex supply chains, resource flows and ownership changes are seen as barriers for the implementation of circular economy, especially given the rigidity of these to change and the numerable stakeholders involved. Lastly, technology can also be a barrier in terms of the availability of required technological advances and the related costs.

2.6 *Conclusion*

This section began by stating that the circular economy is an economic paradigm founded on the concept of the biological cycle. It was highlighted that the aim of a circular economy is to achieve a complete sustainable system in contrast with the linear model. Furthermore, circular economy was then introduced on a policy level. It was pointed out that the European Union released legislation to regulate and promote circular economy. Moreover, the United Kingdom is also promoting circular economy principles. The review then considered circular economy at a city level. The issues that cities face as a consequence of the linear economic model were discussed. Finally, main barriers and challenges preventing the implementation of circular economy are discussed.

Chapter Three: Methodology

3.1 Introduction

According to Brown and Wyatt (2010), initiatives often fail when they are not tailored specifically to the needs of their audience. The final tool for this project aims to alleviate this problem using a design thinking approach (Figure 3.1). The design thinking method allows us to interact closely with local stakeholders to ensure that the final product is suitable for the needs of customers. Therefore, to gain a personal and updated understanding of what is needed from local businesses within Peterborough, various primary methods of research were undertaken. Nevertheless, in some instances secondary data collection was also relevant. Therefore, both qualitative and quantitative methods are adopted. According to Bryman and Bell (2015), the mixed methods approach is very common with business research. The use of several research methods used within one research project is named triangulation. The triangulation of methods can support research by cross-checking findings and therefore making the study more credible (Bryman and Bell, 2015). This chapter will explain how a mixed-methods approach was utilised throughout the design thinking process.

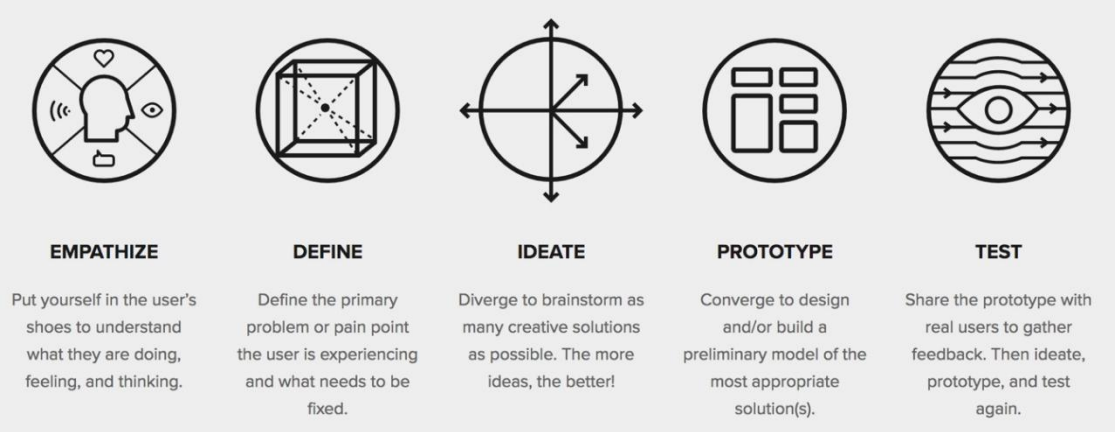


Figure 3.1. *A representation of the design thinking tool that was followed throughout the duration of the project (Andrews, 2017).*

3.2 Empathise

The initial phase of design thinking is to empathise. During this phase we were able to create a comprehensive mind map to explore and visualise the links and flows between resources within Peterborough. This process is divergent, therefore a full picture of what is currently happening within Peterborough was established, alongside more generic circular economy principles and typical city resource flows. From this, the main relationships and resource flows were detected. This allowed the project scope to be narrowed and the deliverables to be defined. The development of the project scope and deliverables were also achieved by setting SMART targets. These targets were important in ensuring that we produce high quality work during the strict time-frame of the project.

3.3 Define and Ideate

Throughout the define and ideate phases, primary and secondary data collection techniques were utilised. The data obtained from these include both qualitative and quantitative information. The research outcomes could then be aggregated and synthesised into tangible ideas.

Initially, questionnaires were distributed at the 'Innovation in Manufacturing' circular economy workshop in Peterborough (Appendix A). This survey was later sent as an online version after the workshop within a follow-up email to participants. The aim of the questionnaire was to engage local stakeholders with the project and to depict initial trends through distributing a standard set of questions. The questionnaire consisted of four sections, the purpose of these were to understand the respondents' current knowledge of circular economy, whether their business is practicing circularity, what attracts them to the business model and whether they believe their business will impact Peterborough in the future. Although steps were taken to promote a high response rate, only 8 participants completed and returned the survey. While this is a poor response, it provided the project with initial insight to inspire the tool outcome and a base-line of information that could be developed upon. Furthermore, this survey can be used as a pilot to ensure better responses from the questionnaire that will be distributed at the tool presentation workshop.

The initial questionnaire was also helpful in beginning to engage interest with local businesses. As a result, interviews were arranged to formulate individual case study research. The workshop engagement, accompanied by follow-up interactions, led to three businesses agreeing to an interview. A greater participation from local stakeholders would provide the project with a greater quantity of high quality data to analyse. The aim of the interviews is to gain information of the resource flows from different businesses within various sectors that operate within Peterborough (Figure 3.2). These individual studies can then be used alongside citywide resource flow data to depict the future scenarios presented within the final tool. Therefore, the interviews are separated into three sections (see Appendix B for interview guideline). The purpose of the first two sections is to gather information about the businesses to suggest circular economy improvements to their business model. The final section is to gain quantitative data to understand their resource flows.

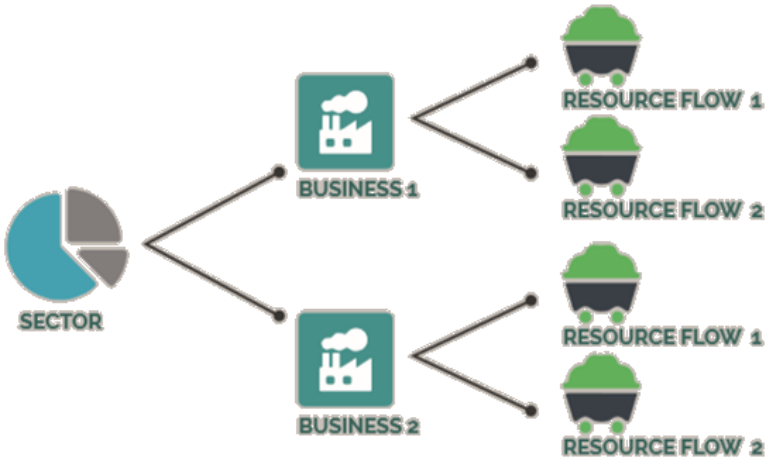


Figure 3.2. *A visual flow chart to represent the breakdown of data collection intended from the interviews (Authors Own).*

The style of the interview is semi-structured. Therefore, each leading question has various sub-questions that follow. Legard et al. (2003) and Bryman and Bell (2015) express that semi-structured are similar to a conversation. As a result, the interviewee can tailor the interview to follow the most relevant information (Longhurst, 2010). Furthermore, the interviews are being conducted through WebEx. This platform can automatically record the conversations; therefore, full attention can be paid to the interviewee and adapting the questions to their responses. From the recordings, transcriptions of the interviews are made which are later coded to establish the deductive and inductive themes that emerge from the interviews. The case study research is further assisted using secondary data collection.

Secondary data research supported the interviews by gathering information about the background of each business. Secondary data collection was also used to populate the quantity of individual case-study research, due to only three businesses agreeing to an interview. Furthermore, online resources were used to gather citywide data of the resource flows operating within Peterborough. These data will be aggregated alongside the interview data. The benefit of secondary data collection is the abundant quantity of information available online. It is also very time and cost efficient (Lefever et al. 2007). Nevertheless, barriers occurred when conducting secondary data research. It was found to be difficult to discover data that is specific and useful for the project. Furthermore, sometimes it is problematic to evaluate the quality of online data (Hox and Boeije, 2005). As a result, where appropriate, the data was collected from respectful sources such as the Office for National Statistics. Subsequently, the triangulation of the data from the questionnaires, interviews and secondary data research were able to direct our findings to provide the most appropriate foresight scenarios for Peterborough.

3.4 Prototype

During the prototype phase, foresight techniques were used to develop the future scenarios. According to Bezold (2010), scenarios can be created either quantitatively or qualitatively, depending on the approach and resources of the organisation creating them. This project employs a mixed methods approach to create the scenarios. Scenario planning is the most basic concept in future studies. It refers to the description of possible future states and/or developments. There is no consensus for the different possibilities of scenarios, although many of them refer to possible, probable or preferable futures (Börjeson et al., 2006). Scenarios can vary depending on aspects such as their objectives or the psychological preferences of the audience.

The future remains unpredictable, yet different approaches can be used to foresee different alternatives. Due to the nature of the technique, these futures have varying levels of likelihood. Traditionally, scenario planning has focussed on estimations and predictions about the future. On the other hand, foresight goes further and is closer to planning, involving the effects and implications derived of the future scenarios in the decisions that are made today. In this sense, it includes the possible outcomes of policies and decisions and how these can help determine likely future scenarios (Cuhls, 2003). Bezold (2010) argues that foresight is used because organisations pursue benefits such as avoiding potential problems, improving opportunities and dealing with

problems when these are easier to solve. Therefore, within the prototype phase, this project aims to utilise foresight techniques to allow businesses of Peterborough to gain these benefits of presenting future scenarios. The prototype phase also consists of various amendments being made to the digital tool, resulting in the best possible outcome ready to be tested.

3.5 Test

The final stage of this project involves the testing phase. During this phase, the final tool will be explained and presented at a workshop in Peterborough. The attendees of the workshop will include those companies that were involved in contributing towards our research, as well as local businesses within Peterborough that are interested in circular economy. The purpose of this workshop is to validate the tool with real stakeholders. Subsequently, important information will be gained surrounding whether the tool has achieved its aim to bridge the gap from interest into action, and in providing details of improvements that can be made to the final product. As a result, the outcome of this project will be representative of the needs of the stakeholders within Peterborough.

Chapter Four: Initial Findings (City-Wide Secondary Data)

4.1 Introduction

Peterborough City Council's environmental vision for 2050 is invested in embarking on a new sustainable economic model called the Circular economy. The objective is to efficiently manage environmental activities and resource flows while achieving improvements in productivity and economic efficiency in various industrial sectors. The city's vision is to successfully apply a circular economy in its industrial sectors to ensure that it meets its 2050 environmental targets. Supporting the successful implementation of the Circular economy in Peterborough is efficient management of the resource flows as described below.

4.2 Peterborough Transport Energy Consumption

Peterborough City Council's economy is supported by sustainable transport systems driven by public transport, privately owned vehicles, and both heavy and light goods freight vehicles. Periodically, the City compiles data for energy resource flows for the transport sector for monitoring purposes. The road vehicles energy consumption data is derived from the inventory of National Atmospheric Emissions, (Khan and Gregory, 2014). This data set informs a range of users such as local authorities to keep track on energy consumption and use within their administrative local authorities.

Five vehicle types are considered for the compilation of data. Consideration is based on two fuel types, diesel and petrol. The vehicle classes included in the inventory in the United Kingdom are small passenger cars, buses, motorcycles and heavy and light freight goods vehicles. Fuel consumption by these vehicles is also considered based on whether the road is a motorway, minor road or an A road. Peterborough has a combination of the three types of road networks under consideration.

In 2016, passenger vehicles to include buses and personal vehicles consumed a total of 88176 tonnes of energy equivalent compared to 42211 tonnes of energy equivalent consumed by freight transportation sector. Total energy consumption for Peterborough in 2016 was 130387 tonnes of energy equivalent. Data for 2017 will be released in December 2018.

4.3 Peterborough Electricity Consumption

Regional consumption data of electricity and gas is compiled by the Office of National Statistics and used by local authorities to monitor periodic consumption patterns. A 2018 report by the department of Business, Energy and Industrial Strategy (BEIS) 2018, indicates that nationally, in the UK, there was a 3.6 % reduction in electricity consumption in 2016 compared to 2015. The (BEIS) 2018 report indicate that a total of 21 local authorities experienced a reduction in electricity consumption in 2016. Local Authorities in the eastern region where Peterborough is located saw a 2.5% reduction in electricity consumption.

Electricity consumption is classed as domestic and non-domestic consumption. Domestic consumption refers to households, where as non-domestic refers to industrial consumption. In

Peterborough Local Authority, domestic consumption of electricity accounted for 295 (GWh) in 2016 while non-domestic or industrial use accounted for 593 (GWh) of electricity consumption in the City in 2016. Data for 2017 consumption has not yet been released to show a comparison. Total electricity consumption for Peterborough City in 2016 was 888 (GWh).

4.3 Peterborough Gas Consumption

Data for gas and electricity consumption was obtained from a sub- national electricity and gas statistics analysis tool. Using the tool, domestic gas consumption for Peterborough was 916 (GWh) in 2016 compared to 377 (GWh) accounted for by industrial consumption, giving a total of 1293 (GWh) of gas consumed in Peterborough Local Authority in 2016. Data for 2017 is yet to be published.

4.4 Peterborough Local Authority Population

The data for Peterborough Local Authority population were obtained from the Office of National Statistics (ONS) using the population projection pyramid visualisation tool. The tool enables the user to select an area of interest and the population data for the selected area will be populated. Peterborough has a population of 197095 of which 98795 are males and 98300 are females. The number of people in various age groups can be populated using the pyramid visualization tool.

4.5 Peterborough Waste Data

Waste data for Peterborough Local Authority were obtained from the ONS and Waste Data Flow (WdF) database. Based on the statistics obtained, in 2016, from January to December, Peterborough City Council received a total of 221444 tonnes of different waste types from various waste disposal companies. The waste was a mixture of both domestic and industrial waste. During the first quarter of 2017 the period between January and March, residual waste collected from Peterborough households was 11057 tonnes compared to 468 tonnes of industrial waste. Total waste collected amounted to 11525 tonnes.

Data compiled by the office of national statistics for materials collected for recycling and reuse in Peterborough shows the following details. From January 2016 to March 2017, 18194 tonnes of waste were collected from households for recycling. In addition, a further 38 tonnes were collected by kerbside methods and a further 6894 tonnes was brought from other sites for recycling. Peterborough City council also collected 11 tonnes of waste materials through kerbside for reuse and a further 1354 tonnes of waste was received from other sites for recycling. Industrial recycled waste amounted to 863 tonnes and industrial waste collected for reuse totalled 427 tonnes. See attachment for appendix of types of materials received for recycling and reuse.

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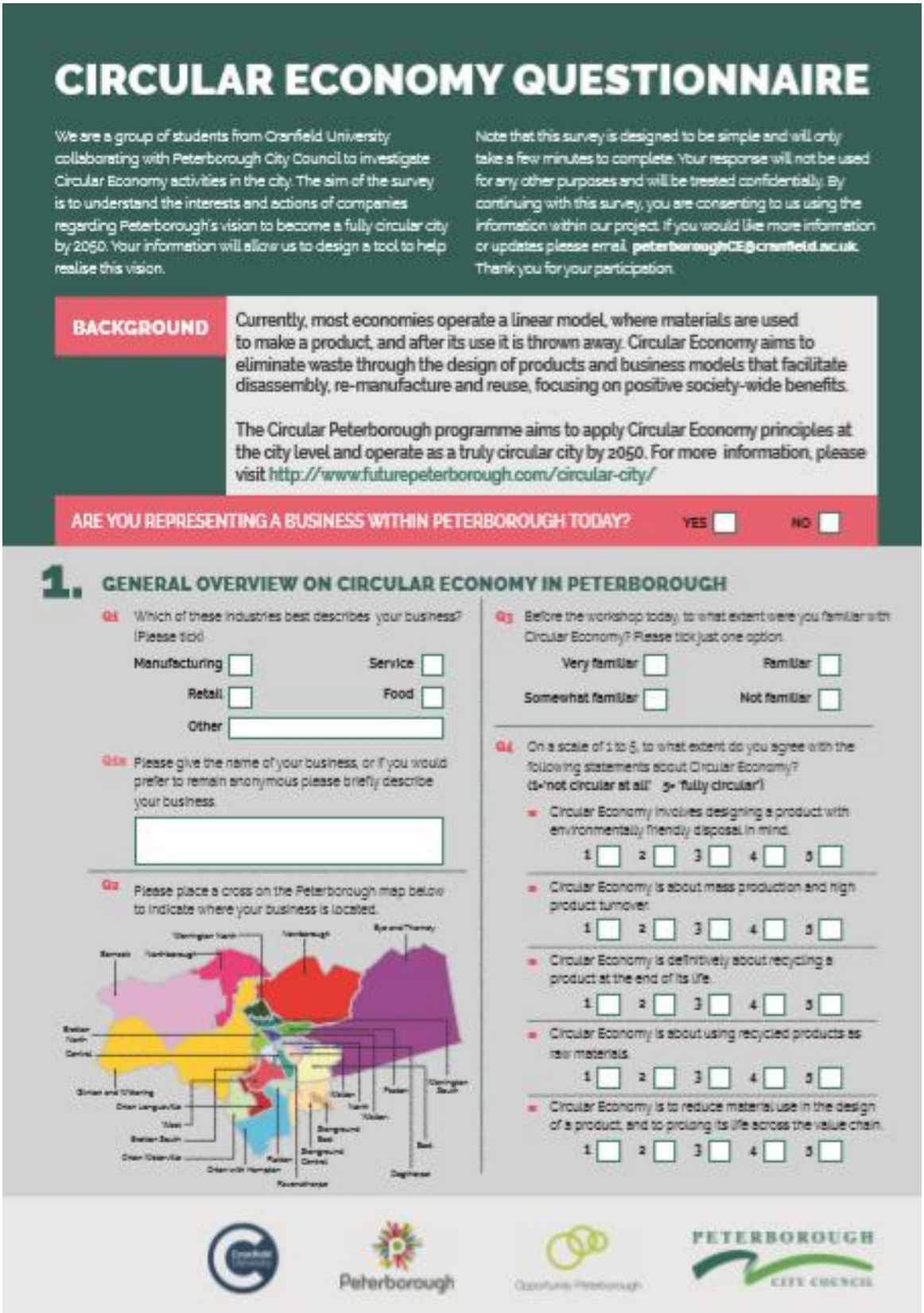
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Appendices

Appendix A: The questionnaire that was distributed at the 'Innovation in Manufacturing' workshop.



CIRCULAR ECONOMY QUESTIONNAIRE

We are a group of students from Cranfield University collaborating with Peterborough City Council to investigate Circular Economy activities in the city. The aim of the survey is to understand the interests and actions of companies regarding Peterborough's vision to become a fully circular city by 2050. Your information will allow us to design a tool to help realise this vision.

Note that this survey is designed to be simple and will only take a few minutes to complete. Your response will not be used for any other purposes and will be treated confidentially. By continuing with this survey, you are consenting to us using the information within our project. If you would like more information or updates please email. **peterboroughCE@cranfield.ac.uk**. Thank you for your participation.

BACKGROUND

Currently, most economies operate a linear model, where materials are used to make a product, and after its use it is thrown away. Circular Economy aims to eliminate waste through the design of products and business models that facilitate disassembly, re-manufacture and reuse, focusing on positive society-wide benefits.

The Circular Peterborough programme aims to apply Circular Economy principles at the city level and operate as a truly circular city by 2050. For more information, please visit http://www.futurepeterborough.com/circular-city/

ARE YOU REPRESENTING A BUSINESS WITHIN PETERBOROUGH TODAY? YES ☐ NO ☐

1. GENERAL OVERVIEW ON CIRCULAR ECONOMY IN PETERBOROUGH

Q1 Which of these industries best describes your business? (Please tick)

Manufacturing ☐ Service ☐

Retail ☐ Food ☐

Other ☐

Q1a Please give the name of your business, or if you would prefer to remain anonymous please briefly describe your business

Q2 Please place a cross on the Peterborough map below to indicate where your business is located.

Q3 Before the workshop today, to what extent were you familiar with Circular Economy? Please tick just one option.

Very familiar ☐ Familiar ☐

Somewhat familiar ☐ Not familiar ☐

Q4 On a scale of 1 to 5, to what extent do you agree with the following statements about Circular Economy? (1='not circular at all' 5= 'fully circular')

- Circular Economy involves designing a product with environmentally friendly disposal in mind.
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
- Circular Economy is about mass production and high product turnover
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
- Circular Economy is definitively about recycling a product at the end of its life
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
- Circular Economy is about using recycled products as raw materials
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
- Circular Economy is to reduce material use in the design of a product, and to prolong its life across the value chain.
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Peterborough

PETERBOROUGH CITY COUNCIL

2. CIRCULAR ECONOMY BUSINESS MODEL

Q1 Do you believe your business is practicing Circular Economy? (Please tick)

Yes ☐ No ☐ I don't know ☐

Q1b If yes, how? ☐

Q1b If no, would you be interested in employing Circular Economy principles?

Yes ☐ No ☐ Maybe ☐

Q2 Were you aware of any of the following Circular Economy programmes within Peterborough before the workshop today?

PROGRAMMES	WAS AWARE	WAS NOT AWARE	ALREADY PARTICIPATING	INTERESTED	NOT INTERESTED
SHARE PETERBOROUGH	☐	☐	☐	☐	☐
CIRCULAR CITY CHAMPIONS SCHEME	☐	☐	☐	☐	☐

3. APPEAL FACTOR

Q1 On a scale of 1-5, how important are these benefits of Circular Economy to your business? (1='not at all important' 5= 'very important')

- Product life extension 1☐ 2☐ 3☐ 4☐ 5☐
- Waste reduction 1☐ 2☐ 3☐ 4☐ 5☐
- Increased business opportunities 1☐ 2☐ 3☐ 4☐ 5☐
- Reduced raw material dependency 1☐ 2☐ 3☐ 4☐ 5☐
- Reduced cost of production 1☐ 2☐ 3☐ 4☐ 5☐
- Increased job opportunities 1☐ 2☐ 3☐ 4☐ 5☐
- Improving community cohesion 1☐ 2☐ 3☐ 4☐ 5☐
- Improving community fortune 1☐ 2☐ 3☐ 4☐ 5☐

Q2 Are you aware of any other Circular Economy benefits?

4. THE FUTURE OF CIRCULAR ECONOMY IN PETERBOROUGH

Q1 The role of my business will be instrumental in realising Peterborough's vision 2050 (link on page 1). Please select just one option.

Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree ☐

Q2 How do you envisage the Circular Economy program will transform Peterborough by 2050?

Which part of the workshop did you find most useful and why?

Would you like further support in transitioning to a Circular Economy business model?

Yes ☐ No ☐ Maybe ☐

If yes, how would you like to be supported?

Please feel free to contact us at **peterboroughCE@cranfield.ac.uk** if you have further enquires. Thank you for participating.

Appendix B: Guideline of the interviews that was used as a structure and sent prior to interview.

SCENARIO PLANNING FOR A CIRCULAR FUTURE: PETERBOROUGH CONTEXT

INTERVIEW GUIDELINE

Introduction

- Explain our familiarity with the company (what they do, what their operations are, dimensions, characteristics)
- Explain how we will use this interview within our project (use as an example of a business within a sector and utilise details of their resource flows to guide our future city scenarios) and clarify aims and objectives.

Section one: circular economy overview

- Are you familiar with the Circular Economy business model?
    - Yes? In your opinion, what do you believe a circular economy involves?
    - No? [briefly explain what it is]
- Do you believe your business undertakes any Circular Economy practices?
    - Yes? What are the details of circular economy practices within your business? Do you see any areas of improvement?
    - No? Do you think that employing circular economy principles could be an opportunity for your business? Is it something you are trying to engage with already, or would be interested in adopting within the future? (especially as Peterborough aims become 'fully circular' by 2050).
- Are you aware of any of the Circular Economy programmes within Peterborough? (e.g. Share Peterborough/ Circular City Champions).
    - Are you involved with any of these programmes?

- THOSE PRACTICING CIRCULARITY
    - What were the main challenges in employing circularity? What are the challenges that you are still facing or can envision for the future?
    - What have you noticed have been the benefits of practicing circularity?

- THOSE **NOT** PRACTICING CIRCULARITY:
    - What are the challenges or barriers stopping you employing a circular economy business model?
    - What do you believe could be the benefits for your business in adopting a circular economy business model?

Section two: business model

- We would like to gather an understanding of your value chain. Could you briefly describe your value chain from the production to consumption? (tailor this question to each individual business).
- Do you see any areas of opportunity within your value chain to improve your efficiency, or to employ circular economy principles? (provide example if prompt is needed).

Section three: resource flows

- Could you provide us with information or data regarding your **water** consumption?
    - E.g. Where does your water come from?
    - How much water do you as a business consume?
    - Where does your waste water go?
    - Do you currently operate any 'sustainable' or 'circular' actions regarding your water usage?
- Could you provide us with information or data regarding your **energy** consumption?
    - Where does your energy come from?
    - How much energy does your business consume?
    - Do you have any information regarding a breakdown of your energy flows?
    - Do you currently operate any 'sustainable' or 'circular' actions regarding your water usage? (e.g. renewable energy sources).
- Could you provide us with any information or data regarding your **waste stream**?
    - What waste streams do you have?
    - What is your waste policy? (Do you have recycling/ food waste etc? Incentives?
    - What sort of waste do you have? Do you have a breakdown of this?
    - How do you manage your waste?
    - Where does your waste go?
    - Do you currently operate any 'sustainable' or 'circular' actions regarding your waste?
- Could you provide us with information or data regarding your **transport** activities?
    - Do you have any policies concerning transportation?
    - Do you have any information regarding the transport emissions of your company? E.g. information regarding how your workers commute into the company/ the footprint of your business supply chain?

Section four: conclusion

- We have reached the end of our questions for you; do you have any further questions or points that you would like to add?
- If the business has offered to email us with further data or statistics: Please be in touch as soon as possible with the following data sets that you have agreed to send us (name them).
- Are you aware of any other businesses that we could contact for a similar interview?
- Remind the business that they are invited to attend a workshop on the 18th April to showcase the digital visual tool and that we would appreciate their feedback. Formal invitation for this will be sent via email.
- Thank you very much for your time. Please be in touch if you have any further questions or queries.