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"How can blockchain technology enable circular procurement?"

Master Thesis by:

Synne Nøss Døsen

Jørgen Skramstad Guttelvik

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We sincerely hope that this master's thesis provides readers with profound knowledge and an enjoyable reading experience.

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Synne Nøss Døsen

Jørgen Skramstad Guttelvik

Abstract

Over the course of the previous decade, blockchain technology (BCT) has undergone remarkable exponential growth, with procurement gradually emerging as a prospective application within the realm of supply chain management (SCM). BCT holds the potential to enhance procurement processes and contribute to the advancement of circular economy (CE) principles. However, the understanding of blockchain applications and how it can enhance the CE within procurement processes remains insufficient, diffuse, and fragmented, despite the immense promise it holds. Only a minority of business professionals possess a comprehensive understanding of how BCT functions and the potential benefits it offers to procurement. This study addresses these gaps by providing a comprehensive analysis of the applications and advantages of BCT in circular procurement (CP). We have therefore conducted a qualitative study interviewing twelve individuals representing five distinct consultancy companies. The function of consulting firms necessitates that they collaborate with a wide variety of organisations across multiple industries. This diversity in experience enables consultants to offer a more extensive, cross-sectoral perspective on BCT implementation in different contexts. Their position also requires them to remain current on the most recent developments and trends, including emerging technologies such as blockchain. Based on this, our research question is; *How can blockchain technology enable circular procurement?* To answer this research question, we first examined today's landscape with regards to CE practices, procurement and BCT. Following this, we studied blockchain´s impact on the CE, before finally addressing the challenges of blockchain implementation within procurement.

The potential of BCT to enable CP is indeed intriguing. While the study concludes that BCT is still in its early stages of development, it is worth noting that a majority of experts hold a positive perspective on its potential to enhance CP. However, further investigation is warranted to explore its potential applications and enhance CP practices. It would be beneficial to conduct an in-depth case-study to demonstrate the relevance of BCT for companies and supply chains. Such research endeavours would help shed light on the viability and practicality of adopting BCT in advancing CP initiatives.

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List of Abbreviations

AI – Artificial Intelligence

BCT – Blockchain Technology

CE – Circular Economy

CP – Circular Procurement

CSC – Circular Supply Chain

DLT – Distributed ledger technology

ECTD – Economic Cooperation and Trade Division

IoT – Internet of Things

ML – Machine Learning

SC – Supply Chain

SCM – Supply Chain Management

UNEP – The United Nations Environment Programme

UNECE – United Nations Economic Commission for Europe

1.0 INTRODUCTION AND PROBLEM STATEMENT

Our research aims to examine how blockchain technology (BCT) can support procurement in enabling the circular economy (CE). We have chosen this investigational topic as we are curious to learn more about the CE and how the use of BCT in procurement can contribute to resource optimisation, reduction in raw material use, and waste recovery. In this introductory chapter, we will first discuss the justification and context for researching this topic, followed by the research question and purpose of the investigation. Following that, we are going to discuss the research contribution, and then, finally, we will offer the structure that the thesis will adhere to.

1.1 Motivation and Contextual Background of the Thesis

In the past half-century, the world has experienced unprecedented economic development and swift transformation. High economic expansion has been linkedwith a growing global population and rising consumption. Increasing global material use is already primarily driven by increased consumption and the global material consumption has tripled over the past three decades (UNEP, 2016). The need for energy- and resource-efficient, and risk-free material cycles has emerged as a result of growing concern about climate change, resource depletion, and pollution on a global scale (Alhola et al., 2019). The CE is getting more attention on policy agendas in many nations to combat unsustainable production and consumption practices while also enabling economic growth and resource efficiency (Geissdoerfer et al., 2017). The Norwegian government outlined a revised plan for CE practices on the 16th of June 2021, in light of the growing importance of environmentally favourable practices (Klima- og Miljødepartementet, 2021). The objective of this strategy is for Norway to become a leader in the development of CE strategies, which will decrease the need to extract new resources and contribute to a smaller environmental lasting effect. In order to minimise waste production, CE seeks to maintain the value of goods, materials, and resources for as long as possible in the circulating economy. Also included in CE's objectives are closing the gap between production and consumption activities and turning waste into resources (Witjes & Lozano, 2016). Within its mandate, the Economic Cooperation and Trade Division (ECTD) of the United Nations

Economic Commission for Europe (UNECE) has identified five entry points for promoting circularity, one of which is innovation and sustainability-enhancing procurement (UNECE, 2023).

National action plans have set goals that encourage circular procurement (CP), such as targets for waste reduction and recyclability, and EU-wide policies have supported this goal as well (Neubauer et al., 2017). One of the most significant developments is the EU Directive on procurement, which now permits price and procurement criteria to be defined based on a life cycle perspective. This could make it easier to include environmental standards in every stage of a product's life cycle and guarantee that the external costs of environmental deterioration are considered. Procurement is widely viewed as a significant opportunity to advance the transition to the CE (Xu et al., 2022). For instance, it could promote novel ideas and develop markets for environmentally friendly solutions, particularly those focusing on waste minimisation, resource efficiency, and recycling (Neessen et al., 2021. Examples of such solutions include intelligent waste management systems, the reuse of materials, and the production of goods from recycled raw materials. Along with the development and interest in CE, multi-stakeholder technology, such as BCT, is gaining traction (Khan et al., 2022).

BCT is a highly disruptive innovation that has the potential to revolutionise a multitude of industries (Nicoletti, 2017).). In the procurement process, Blockchain can offer a secure method for tracking products or transactions from sourcing to payment. BCT has emerged as a promising solution for monitoring and managing materials and components throughout the SC, with scholars increasingly highlighting its applications in the CE (Khan et al., 2022). By tracking materials and components on blockchain, companies can ensure reuse, remanufacture, recycling, or composting of products, and contribute to the revitalization of nature. Suez, a company specialising in water and waste management, has successfully employed blockchain to document all the steps involved in transitioning sludge from wastewater to agricultural soils (Murphy, 2022). While the primary application of blockchain in the CE has been monitoring non-biological materials, it can be linked to a GPS system or Internet of Things (IoT) sensors to monitor and record movements and adaptations of products in real-time. This can allow each user in the supply chain (SC) to make informed decisions regarding the

management of materials, assisting manufacturers in locating components that have been documented as recycled or remanufactured, and enabling businesses to quantify their reductions in the use of virgin materials (Ntsondé & Aggeri, 2021. Furthermore, BCT may help end-users determine the optimal method for repairing or disposing of a product and its components, thus sharing the responsibility for its material flows across the SC. By storing information about materials on blockchain, companies can future proof the recoverability procedure for components that are not presently viable for recovery, allowing for the possibility of reuse or recycling once new methods are developed. According to a study by Khan et al. (2022), the use of blockchain in the CE can lead to increased material circulation, with each 1% increase in the use of blockchain corresponding to a 0.341% increase in the use of remanufacturing and recycling, according to a study of 290 manufacturing companies in the China-Pakistan Economic Corridor. Motivated by the potential disruptive nature of BCT, this thesis aims to analyse the various aspects of BCT and their effects on SCs, specifically procurement, and how this can contribute to procurement practices and enhance circular business processes. We believe that the implementation of blockchain in procurement could aid the transition to more circular practices.

1.2 Research Gap and Research Question

This thesis aims to understand the role of BCT in facilitating circular behaviour in procurement. While scholars have tried to examine the implications of BCT in procurement (Härer, 2018; Nicoletti, 2017), limited attention has been directed towards its interrelation with the CE paradigm. To address this, we have linked blockchain's support in procurement to the CE and formulated the following research question:

How can blockchain technology enable circular procurement?

To address this question, we have conducted an exploratory study based on expert interviews and will be thoroughly explained to provide a comprehensive understanding of the research approach and design. The data collection for this study primarily comprises qualitative interviews with experts from five distinct consultancy companies and a comprehensive review of the existing literature. The study employs a systematic combining approach, aiming to investigate and enrich

the knowledge of how BCT could enable a CE in procurement, which is essential for promoting the circular utilisation of materials. In pursuit of our research objectives, we have identified a significant sub-question that complements our primary research question. This sub-question seeks to explore the transformative potential of a new procurement technology:

How can blockchain technology shape the future of procurement?

The utilisation of digitalisation presents procurement processes with a diverse range of advantageous opportunities, whereby blockchain emerges as a prominent digital tool. Consequently, it is natural to investigate the challenges, enablers, and opportunities associated with the adoption of BCT, with a particular focus on the transition to a CE. Its ability to improve SC traceability and transparency may accelerate procurement and help transition to more sustainable practices, linking procurement with CE concepts. Existing literature has made initial endeavours into the investigation of the topic, yet there exists a noticeable research gap in exploring the intersection of BCT and CE in the context of procurement (Figure 1). Consequently, this research void is the reason for our study, which focuses on how BCT can be leveraged to facilitate CP practices, thereby promoting sustainability and optimising value across the value chain.

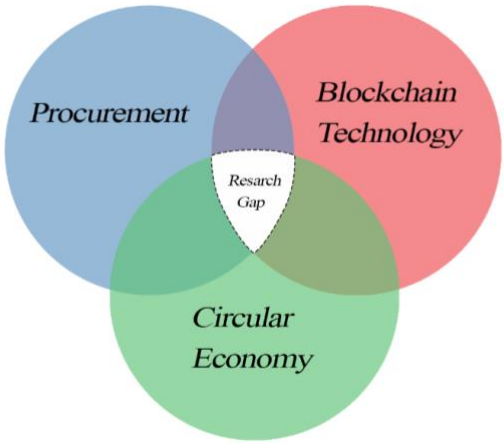

Figure 1: Research Gap

1.3 Research Justification

In order for a research study to be significant, the research question must meet three key criteria. Firstly, it should be of general interest to engage a broad audience.

Secondly, it should contribute to academic understanding in a specific field. Lastly, the research question should be driven by the researcher's personal motivation and hold practical implications for important stakeholders. We evaluate our study question against these criteria in the following paragraphs.

Practical relevance

Our research investigates how BCT can shape the future of procurement and its impact on the CE. Procurement, as a critical aspect of SCM, plays a significant role in driving sustainable practices and achieving circularity (Bag et al., 2020). Our thesis aims to provide practical insights and support stakeholders by exploring the functions of BCT, its potential to enhance procurement processes, and its implications for fostering a CE. In today's business environment, the transformative potential of BCT in the domain of SCM, as well as in procurement processes, is becoming increasingly apparent (Nicoletti, 2017). Our research contributes to this by examining how BCT can enhance procurement practices to facilitate circularity. By exploring the integration of BCT in procurement processes, we aim to identify opportunities for optimising resource utilisation, reducing waste, and fostering circular supply chains (CSC). Additionally, we address implementation challenges and provide recommendations for stakeholders to effectively embrace BCT in their procurement strategies while aligning with CE principles. Moreover, we aim to highlight the possible positive impact of BCT on the CE. By enabling transparency, trust, and data integrity, BCT may have the potential to facilitate the efficient tracking and tracing of materials, support sustainable sourcing practices, and promote the transition to a more circular and regenerative economic model (Adams et al., 2018; Khan et al., 2022).

Theoretical contribution

To address the research question at hand, our study will delve into the three distinct areas that form its foundation: procurement, CE, and BCT, while also exploring their interrelationships. By establishing connections among these areas, we aim to shed new light on an underexplored academic discipline. It is noteworthy that the widespread adoption of BCT beyond the financial industry is still nascent, and corresponding research on BCT remains in its early stages. Over the past decade, however, scholarly literature has witnessed a surge in various BCT-related topics, encompassing aspects such as BCT governance, adoption dynamics, and novel

business models. (Crosby et al., 2016; Francisco & Swanson, 2018; Iansiti & Lakhani, 2017.)

The fusion of BCT, procurement and the CE lacks substantial academic theorisation, and research concerning BCT's interface with CE is deemed scarce, with limited publication output. Consequently, our thesis endeavours to address this scholarly gap by investigating the integration of BCT and procurement and its implications for the CE. In pursuing this objective, our master's thesis aims to contribute to theoretical knowledge through three primary approaches. CE

Firstly, we will conduct a comprehensive review of prior research conducted within the three subfields and the areas where they converge, forming the basis of our research question. This analysis will enable us to identify key findings and perspectives that have emerged from the existing literature. Secondly, we seek to bridge the identified gap in the literature pertaining to the implementation of BCT in procurement to enable a CE by developing novel insights in the form of a conceptual framework. This framework will aim to elucidate how BCT can potentially enhance a CE in procurement processes. Lastly, we aim to integrate our research discoveries with the existing body of knowledge, thereby enriching the overall understanding of the subject matter and establishing a solid foundation for future investigations in this field.

Personal.interest

Personal drive and interest are fundamental factors in academic inquiry that significantly contribute to the successful completion of a thesis or dissertation. While the formulation of a research question and its contribution to the existing knowledge base is critical aspects, they often fall short of sustaining the researcher's commitment throughout the demanding journey that lies ahead. Thus, the presence of intrinsic motivation rooted in personal fascination and curiosity becomes imperative. Genuine personal interest in the subject matter enhances our approach to the work with enthusiasm, determination, and eagerness for knowledge. This internal drive enables us to delve deeper into the complexities of our chosen field, continually seeking to expand our understanding and make meaningful contributions. Moreover, personal interest serves as a driving force for consistent effort and dedication. It instils a genuine passion that transcends the external expectations and pressures associated with academic research. When researchers

possess a sincere interest in their chosen topic, they are more willing to invest the necessary time, effort, and resources to overcome challenges and yield valuable results.

Additionally, the contextual relevance of the research topic plays a crucial role in motivation. By establishing connections between the research endeavour and broader societal or practical implications, motivation is enhanced by emphasising the potential impact of the findings. For example, aligning the research with pressing concerns in resource scarcity, sustainability, or optimised efficiency infuses the work with a sense of purpose, highlighting its applicability beyond the academic realm. Ultimately, personal drive and interest in academic research serve as catalysts for intellectual growth and the pursuit of knowledge. They fuel our curiosity and sustain our commitment and resilience throughout the research process. By nurturing intrinsic motivation and cultivating a genuine passion for our chosen field, we are well-positioned to make substantial contributions not only to the existing academic knowledge base but also to the advancement of society as a whole.

1.4 Thesis Structure

Our master's thesis consists of six chapters. In the first chapter, a concise overview of the study's context is provided. The research objective and concerns have been outlined, as well as the rationale for utilising BCT to enhance procurement's circularity. In chapter two, the research methodology and instruments used for data collection and analysis are described. In chapter three, a literature review on concepts related to CE, BCT, and purchasing and supply management has been conducted to lay the foundation for the knowledge pertaining to the subject of this research. The following part will also describe our theoretical foundation. In chapter four, the findings obtained from these purposeful interviews, as well as the perspectives of the experts on various aspects of this research, are presented and analysed. In the fifth chapter, the results of the data analysis section are contrasted with those of the literature review section. In the final chapter, the conclusion, the research concerns are addressed, as well as the research contribution, the limitations of the study, and recommendations for future research.

2.0 METHODOLOGY

In this chapter of the thesis, we will discuss the methodology used in order to address our research question; *"How can blockchain technology enable circular procurement?"* First, we will discuss the qualitative research strategy that was selected and the justification behind it. Furthermore, we will explain the research design in which we have opted to conduct a qualitative study involving expert interviews. Next, we will go through our data collection, using both sampling and semi-structured interviewing techniques and describe how we analysed the gathered data using thematic analysis. Then, we will go over our strategy for ensuring the reliability and authenticity of this research.

2.1 Research strategy

Bell et al. (2019, p.35) elucidate the concept of a research strategy as "a general orientation to the conduct of business research", which guides researchers through the planning and execution of a study."

2.1.1 Scientific Approach

In the realm of research methodologies, quantitative research is often aligned with a deductive approach, while qualitative research tends to advocate for an inductive approach, as posited by Bell et al. (2019). The deductive approach entails formulating hypotheses based on pre-existing theories, whereas the inductive approach involves generating theories from empirical data and specific observations. Additionally, Dubois & Gadde (2014) propose a third research strategy known as systematic combining or abductive strategy, where theoretical and empirical frameworks dynamically interact. This approach necessitates a hermeneutic loop, involving a constant iterative process of data and theory integration, as highlighted by Bell et al. (2019).

Dubois & Gadde (2014) liken the systematic combining approach to the inductive technique, wherein data collection and analysis occur concurrently, allowing for iterative modifications to the research framework as data is gathered and analysed. In our study, we employed systematic combining, as it offered the most suitable methodology for addressing our research question, given its inherent characteristic of constant interaction between empirical data and theory. This iterative approach

facilitated the modification and refinement of our generated theory and framework in response to new data during the data analysis process.

2.1.2 Research Method

Bell et al. (2019) assert that a research methodology serves as a data gathering tool that can be employed in conjunction with diverse study designs. Thus, it is imperative to differentiate between research methodology and research design, as the former significantly impacts the research process, including data collection and analysis. Håkansson (2013) identifies three distinct research methodologies: quantitative, qualitative, and mixed methods. Wheeldon & Ahlberg (2011) argue that a qualitative research approach is preferable when investigating complex subjects, as it affords particular attention to language and meaning. Furthermore, qualitative research allows researchers to explore issues that may not be amenable to a quantitative approach (Sale & Thielke, 2018). In light of our objective to construct theory rather than verify hypotheses, we deemed the qualitative research approach suitable. The emergence of blockchain and other cutting-edge technologies has garnered significant attention and enthusiasm in various domains. However, from an academic perspective, the discourse on these technologies has predominantly remained at a theoretical or conceptual level, as evidenced by the work of Lohmer & Lasch (2020). Conversely, qualitative research approaches hold notable importance in offering comprehensive and nuanced insights into complex subjects (Eisenhardt, 1989). Consequently, our research has opted to adopt a qualitative approach. A qualitative approach appears to be the ideal approach if we are to achieve our goal of gaining a thorough understanding of how blockchain might influence procurement in order to promote circular behaviour. Due to the absence of standard norms for evaluating and reporting sustainable efforts, it would be difficult to locate sufficient quantitative data. In addition, the relatively immature state of BCT complicates matters further, emphasising the need for our chosen qualitative research strategy.

2.2 Research Design

The research design serves as a comprehensive framework that guides researchers in the collection, analysis, and interpretation of data, providing a detailed description of the empirical study’s conduct (Bell et al., 2019). Additionally, the research design delineates the type of study to be undertaken and the level of

analysis to be employed, as emphasised by Ghauri et al. (2020). Ghauri et al. (2020) classified research designs into three categories: exploratory, descriptive, and causal. These categories are not mutually exclusive. The research design adopted for this study is exploratory, in line with the research questions and topic under investigation. Exploratory research is characterised by an attempt to understand the subject of study and generate new ideas. Furthermore, it often involves qualitative methods, as it is often associated with theory formation and follows a loosely structured research procedure (Bell et al., 2019). Given that BCT, particularly its application in procurement, is a relatively new area that has not yet been widely implemented in practice, this research design was selected to provide readers with a comprehensive understanding of the subject. Collecting data on the inner workings of BCT and the CE, as well as their key enablers, challenges, and opportunities, is essential for delving into this topic and learning more about the concept and how it may be implemented in procurement. Literature reviews and various interview formats are among the methods that can be employed in conducting exploratory research (Saunders et al., 2016). To establish the theoretical backdrop for our study, we employed various search strings, with a particular emphasis on the terms "blockchain" and "circular procurement." Our primary sources for articles included Google Scholar, Oria, and the BI library database. Furthermore, we extensively utilised academic databases such as Emerald, ScienceDirect, and Wiley. To ensure the inclusion of high-quality papers, we focused primarily on peer-reviewed articles published in foreign journals. Nevertheless, we also incorporated relevant papers from reputable sources such as the Harvard Business School. The decision to include a wide range of publications in the theoretical backdrop was motivated by our aim to provide comprehensive research and relevant data for our study.

Therefore, chapters three of this study consist of a comprehensive review of the relevant concepts and theories associated with the research topic. According to Bryman (2012), the existing literature is a crucial component of any investigation. Similarly, Saunders et al. (2016) argue that the literature review provides the foundation for the research framework, which is also the case for this thesis. Following the establishment of the research framework, data were collected through expert interviews, which will be discussed in detail in the data collection section.

The purpose of this study is to acquire a general understanding of how BCT affects the procurement function from a CE perspective, so it does not focus on a specific industry. This is because talking to influential people with experience in different sectors may help clarify the research question and emphasise their perspective, which can then be contrasted with their own in the thesis's results and debate. While a case study approach would have been suitable, the immaturity of the blockchain field and limited research availability hindered its feasibility. By engaging with experts and gathering their perspectives, this study aims to overcome these limitations and contribute valuable insights to the understanding of blockchain's impact on procurement in the CE.

2.3 Data Collection & Sampling

We will outline the methodology for gathering data for this thesis in this part. Any research must gather data in order to be considered capable of answering the research question, according to Bell et al. (2019). In qualitative research, data collection is an integral component of the study, with researchers frequently conducting interviews or questionnaires as primary data and collecting data from external literature and reports as secondary data. The collection of data affords the chance to gain direct knowledge and comprehension of the research issue.

2.3.1 Primary Data Collection

Primary data refers to information obtained for an initial occasion by the researchers and possessing an originality level (Kothari, 2004). Primary data collection was conducted through semi-structured interviews. This method of interviewing, as described by Bell et al. (2019), allows the researcher to have a predetermined set of questions to ask but also allows for flexibility in the interviewee's responses. Furthermore, when the participants brought up relevant and interesting subjects, we asked follow-up questions to explore these angles, which uncovered new and unexpected issues. In contrast to questionnaires, where queries are more superficial, interviews enable researchers to gain a deeper understanding of the matter (Bell et al., 2019).

This method allows for the collection of large quantities of data from various individuals, from which one can gain an understanding of views, behaviours, as

well as experiences (Bell et al., 2019). However, having guiding questions related to the main subjects turned out to be crucial for ensuring that we could uncover information that was relevant to the research question. We developed open-ended, semi-structured interview questions to create an opportunity for discussion with the respondents and allowed for the interviewees to explain the topic and provide answers in their own words.

Prior to our interviews we developed three distinct interview guides, each tailored to capture essential insights pertaining to the domains of CE, BCT, and procurement (Appendix 1,2,3,4). In order to better understand the phenomenon, the questions for these interviews were more narrowly focused on each participant's area of expertise. These were developed to guide us when interviewing experts about BCT and how its features can enhance CE in procurement, the factors that encourage businesses to use BCT, and potential obstacles that stand in their way. Applications of BCT in procurement, and blockchain´s facilitation of the CE transition were the main categories into which the interview questions fell. Each category's questions were created so that we could conduct interviews to obtain the pertinent responses. All the interviews were recorded and converted into text, and open-ended and semi-structured interview questions were used to provide the interviewers with the opportunity to create additional questions as they went along depending on the interviewees' responses and the interview's flow. The interviews were conducted through a combination of physical meetings and online meeting platforms such as Zoom and Teams with an average duration of 25 to 45 minutes. To facilitate an in-depth discussion and allow the interviewer to adapt to the interviewee's responses, all the questions were open-ended and semi-structured. It is imperative to collect data on the intricacies of BCT and the CE in order to further explore this topic and learn more about its applications in procurement, particularly since there are relatively few studies that combine these concepts with a stronger emphasis on procurement.

2.3.2 Sampling

The process of sampling refers to the selection of a group of individuals that are relevant to the research question for the purpose of data collection. According to scholars, probability and non-probability approaches are utilised for sampling. Non-probability approach involves the selection of some population units with a

higher likelihood of being selected compared to others (Bell et al., 2019). Bell et al. (2019) advocate for the non-probability method of purposive sampling, which carefully selects participants based on their relevance to the research subject, for qualitative research. Purposeful sampling, also known as judgmental sampling, is commonly used to identify highly informative cases (Bell et al., 2019). Researchers acknowledge the possibility of bias in human judgement. However, Eisenhardt (1989) argues that random selection is neither necessary, nor recommended in certain circumstances.

While Bell et al. (2019) acknowledges that there are other types of purposive sampling, they emphasise that snowball sampling is one alternative that could be used in certain instances. The qualities of networking and recommendation are critical to the snowball sampling method, which is one of the most popular qualitative sampling techniques (Parker et al., 2019). In this case, researchers often begin with a limited number of initial contacts who meet the research requirements and are invited to participate in the study. The willing participants are then asked to propose additional contacts who meet the research requirements and who may also be willing participants, who in turn refer to more possible participants (Parker et al., 2019). Our supervisor facilitated our initial contact with the first interviewee. While this person did provide us with additional contacts for potential interviews, those individuals did not respond to our outreach. However, as we proceeded with our interview process, other experts within the field connected us with relevant individuals from the specific company for further interviews, essential to our investigation.

For this study, twelve individuals representing five distinct consultancy companies, all of whom were somewhat involved with BCT, CE and/or procurement, were selected through purposive-expert sampling, which is a non-probability technique used when adequate knowledge or understanding of a topic or event is elusive (Etikan, 2016). The function of consulting firms necessitates that they collaborate with a wide variety of organisations across multiple industries. This diversity in experience enables consultants to offer a more extensive, cross-sectoral perspective on BCT implementation in different contexts. Their position also requires them to remain current on the most recent developments and trends, including emerging technologies such as blockchain. In order to guarantee the relevance and

competence of our interviewees, we established three fundamental criteria: (i) proficiency in BCT, (ii) expertise in procurement, and (iii) familiarity with CE principles. However, locating interviewees who fulfilled all three criteria proved to be challenging. As a result, we decided to also conduct separate interviews with experts in each field to gain a more comprehensive understanding. To ensure confidentiality, we have assigned identifying codes to the participants in our study (Table 1). These codes will be used to protect their anonymity throughout the research.

Date of Interview	*Field of Specialization*	*ID Code*	*Company ID*
26.01.2023	Procurement	P1	ID-1
21.03.2023	Procurement	P2	ID-2
21.03.2023	Procurement	P3	ID-5
06.04.2023	Procurement	P4	ID-4
12.04.2023	Procurement	P5	ID-1
15.05.2023	Procurement	P6	ID-3
17.03.2023	Blockchain Technology	B1	ID-2
22.04.2023	Blockchain Technology	B2	ID-4
23.03.2023	Blockchain Technology	B3	ID-3
14.03.2023	Circular Economy	CE1	ID-3
11.05.2023	Circular Economy	CE2	ID-2
07.04.2023	Blockchain in Supply Chain Management	BS1	ID-4

Table 1 – Overview of Expert Interviewees

2.3.3 Secondary Data Collection

In order to supplement the data collection, we have done through expert interviews, we have collected data from published documents. One of the advantages of secondary data is that it allows for a larger sample size than is typically feasible in interview or survey research, thereby facilitating the evaluation of a broader range of variables (Bell et al., 2019). The key benefit of using these data is that it takes less time to obtain them because they have already been gathered (Bell et al., 2019). But we always verified the material using interviews or a different data source to ensure high-quality data.

2.4 Data analysis

According to Bell et al. (2019), the two most commonly employed qualitative data analysis methods are thematic analysis and grounded theory. To analyse the data obtained from expert interviews in a rigorous manner, this study utilised the thematic analysis method, which involves the systematic identification and categorization of themes from qualitative data by the researcher (Saunders et al., 2016). This method was selected for its adaptability and practicality in analysing qualitative data. We conducted a thematic analysis with a colour-coding method for data classification in order to identify similarities and differences between the experts (Bell et al., 2019). This indicates that every theme is assigned a distinct colour for use in interview transcription. Table 2 provides an illustration of the themes addressed in the interview guide along with relevant quotations. Both extant theory and actual terms mentioned in interviews were sources of information in this study.

Various objectives were addressed during the interviews conducted with specialists from multiple consultancy companies. Initially, we sought to obtain the participants' general opinions about procurement, CE, and BCT and its most utilised features. To facilitate this, interviewees were prompted to discuss blockchain characteristics such as decentralisation, tamper-resistance, immutability, transparency, and traceability before being questioned about the impact of blockchain on their respective firms. The provided responses were analysed to identify the most valued aspect of blockchain by the interviewees. Subsequently, the participants were asked to discuss the effects of blockchain implementation in procurement on the CE, and it was found that they generally agreed on the positive impact of the implementation of blockchain. Additionally, the interviewees expressed their opinions on the potential of BCT and the difficulties associated with its implementation in the workplace, and there was a consensus among them regarding the major challenges of this new technology. However, it is important to acknowledge the inherent challenge in identifying experts with extensive knowledge and experience across all three relevant fields. Consequently, this limitation necessitated reliance on certain assumptions provided by experts, as well as conducting in-depth investigations within each field in a relatively isolated manner.

Topic	*Sub-Topic*	*Relevant Quotes*
General Perspectives	General Perspectives on Procurement and its current state	*"What was once considered primarily transactional now plays a strategic role within organisations. Today, it has far-reaching effects on essentially all aspects of a business."* -P2 *"We anticipate that digital technologies like Artificial Intelligence and Blockchain will play a revolutionary role. Predictive and strategic decision-making, increased efficiency, and more innovation are just some of the benefits that will come from it."* -BS1 *"The energy sector has been very profitable and has been needing more people. This has resulted in some companies tripling their procurement team and an increased focus on sustainability."* -P1 *"The economic situation has a huge impact on what must be prioritised (...) This creates a more contextual approach".* -P3. *"Retail and construction are two industries where cost-cutting measures have been particularly concentrated."* – P4. *"While it is true that in modern procurement, it is crucial to take into account rising trends such as sustainability… However, procurement's primary purpose still lies in achieving cost reductions and efficiency."* -P6 *"I think it is important to not look at it as just a challenge, but also a great opportunity. Procurement teams have a greater chance than ever to prove their worth.".* -P4 *"To me, it's clear that procurement can lead the charge to make the organisation more sustainable. There is a clear indication that we need to play a more central role in the organisation, and not simply in terms of reducing cost. We are certain that procurement will play a pivotal role in guiding the company's sustainability activities."* – P2
	General Perspectives on Blockchain Technology and its current state	*"If you were to ask the CEO's of the 100 biggest companies in the world about blockchain, there would only be a handful of them that fully understands it."* -P1 *"I only know of one company in Norway that has fully integrated the technology in its operations"* -P1 *When creating a product, you get it stamped and tokenized on the blockchain before sending it off to the next part in the supply chain. Now, when we're talking about environmentally -friendly supply chains, it becomes crucial for every party involved to show that they've received the information and acted upon it. The thing about blockchain is that it's immutable, so the actions remains tamper-proof and trustworthy"* – BS1 *"Blockchain technology enables seamless real-time data sharing. Imagine a global trade scenario where shipping documents, customs clearances, and payment confirmations are instantly shared among parties. This streamlines transactions, making them more efficient and reducing unnecessary administrative burdens which leads to efficient capacity planning and cost-effective transportation."*- B2 *"It has been used in the acquisition of goods in shipping but is still in very early development."*-B1

	General Perspectives on Circular Economy and its current state	*"It bears a huge amount of promise in this regard. We have seen a substantial growth in companies' willingness to dive into circular practices. We are entering in a new age of sustainable economic development, which takes care of the planet's resources while simultaneously allowing businesses to succeed. Just consider the potential effects of this opportunity."* – CE2 *"Profit and growth are the primary goals of most businesses, and the sale of more items inevitably increases resource consumption. However, the circular economy places greater importance on minimising consumption and reusing materials. I think that this is one of the most significant challenges for the Circular Economy."* – P4 *We have gotten trapped in this idea of use and throw away. In a Circular Economy we require technology that is capable of keeping pace with our aspirations. Also, let's not overlook the fact that it's essential to work on the legal front, because this is also an important area. Another concern is that those who are entering the Circular Economy may need an initial investment that is quite costly, particularly for the smaller companies*. -CE1 *"I think it's important when companies are considering circular initiatives that they also look at the potential financial gains. If you can be more resource efficient, it can result in a reduction in operational costs. It's very important to not look at the environmental aspect, but also the economy."*-P3
Blockchain, Procurement & Circular Economy	Transparency	*"It has a huge potential in purchasing with more complex supply chains. Almost everyone still sits on their own data."* -B2 *"Blockchain can give more information on a micro level, giving it a more precise approach than what is used now."* -B1 *"Once we achieve transparency in the supply chain, everyone can witness and even contribute to actions related to energy conservation, recycling, waste management, and more. It's not just a matter of companies reporting what they're doing in isolation, it's all interconnected and accessible for others to observe and engage with."*-CE2 *"Using blockchain can be used to track carbon emissions more effectively, where every supply chain is seen as emissions. This can be used to find out where emissions are coming from."* -P1
	Decentralisation	*"If we had a decentralised supply chain solution where suppliers could easily connect and consumers could see and purchase from them, we could rank suppliers based on factors beyond just the product's price. In this case, considerations like environmental friendliness could carry more weight. Decentralisation plays a key role in combating greenwashing practices and has the potential to enhance sourcing efficiency."*-P5 *"With blockchain's decentralised nature, everyone gets a copy of the data, which means everyone can see and verify transactions. It's like a shared ledger where everyone has a say. Think of it as a sup'ly chain where farmers, manufacturers, and consumers collaborate and have visibility into each step, ensuring fair and responsible practices."*-B3
	Smart Contracts & Information Sharing	*"Huge and complex contracts can be unclear. That is where blockchain comes in."*- P1 *"By using smart contracts, it can automatically complete certain steps by the conditions set at the start".*-B3 *"I don't think smart contracts will have the biggest impact compared to other features we discussed. But speed-related issues might indirectly affect the environment."* -B2 *"Smart contracts and their automation skills can actually have a positive impact on the environment. They can reduce the need for labour and speed up the movement of goods. That means we can use our workforce more efficiently and burn less fuel along the way."*-CE2

	Immutability, Security & Tokens	*"By using blockchain, you can be certain that the inventory levels that you are seeing are the actual quantity."*-P2 *"Because of security, it is possible to eliminate workload. As the sequence of events cannot be altered."*-P3 *"One of the most significant advantages with Blockchain is efficiency. However, it is not necessarily that only blockchain can be used."*-B2 *The ability of blockchain tokens is to incentivize wanted behaviour. Tokens can be created to incentivize companies or individuals to engage in sustainable practices.* – P6
Challenges	Financial, Technological & Operational	*"Implementing blockchain technology in supply chains does require some initial investment, but it's all about seeing the bigger picture. This includes setting up the technology infrastructure and integrating into existing data systems. However, I think it should be viewed as a long-term investment with the potential to revolutionise supply chain operations, leading to cost savings and operational improvements."* -BS1 *"I still think that a good number of businesses are still hesitant to implement this. This is because there is a high level of uncertainty, in addition to the associated high costs of investment."*-P5 *"Blockchain's immaturity brings both challenges and opportunities. The current'limitations of blockchain restrict the use in situations with high volume. However, there are ongoing efforts to overcome these limitations through projects"* -B2
	Regulatory, Legal & Privacy	*"All transactions will be visible, and it is difficult to control who does what."*-B1 *"Legal requirements are a crucial aspect to consider when implementing blockchain technology in supply chains. Organisations need to comply with various regulations, including data privacy, intellectual property, and cross-border transaction laws."* -B3 *"For implementing a technology, there is often a legal background."*-P1

Table 2 – Thematic Analysis

2.5 Validity of Scientific Research & Methodological Limitations

In this section, the criteria that have been applied to ensure the quality of this study are presented. Lincoln & Guba (1985) recommended that the quality standards of internal and external validity, reliability, and objectivity be replaced with more appropriate criteria while doing a qualitative study. Therefore, we will review the suggested criteria, authenticity, and trustworthiness, in order to gauge and guarantee the quality of this qualitative research. There are four components of trustworthiness: *credibility, transferability, dependability, and confirmability* (Guba & Lincoln, 1985). Consequently, the subsequent subsections will be split up into the various categories

2.5.1 Trustworthiness

Making sure the gathered information and conclusions are *credible* is essential to ensuring credibility (Bell et al., 2019). In the present study, rigorous measures have been implemented to uphold credibility, including adherence to best practices, data triangulation, and reliance on interview results to support findings. This deliberate approach is crucial, as it directly impacts the readability and acceptance of the research outcomes by the scholarly community. Triangulation, which involves utilising data from multiple sources to validate findings, has been employed (Bell et al., 2019). The primary data was obtained through semi-structured interviews, while secondary data was collected from relevant documents and previously published studies.

It is important to acknowledge certain limitations that have influenced the research process. Firstly, the relatively small sample size of only 12 interviews may be considered insufficient in capturing the full breadth of perspectives within the domains of blockchain, procurement, and the CE. The scarcity of experts possessing comprehensive knowledge in all three fields further restricted the ability to gather diverse viewpoints and insights. Consequently, there may be inherent limitations in the generalizability of the findings, given the limited representation of experts and the immaturity of the scientific discourse surrounding the research topics.

Nonetheless, the variety of the interview objects can also be considered an advantage of the study. Each of the interviewed experts provides a unique perspective and comprehension to the table, as a result of their diverse professional backgrounds. This scope of knowledge and insight from various domains enables the construction of a multifaceted and exhaustive narrative. If all of the experts hailed from the same background, it would have been more difficult to identify new opportunities or challenges and to identify distinct connections between the areas. Furthermore, it is worth highlighting that despite these constraints, the study has employed rigorous methods to ensure credibility. Through the implementation of diverse primary sources, the research aims to minimise potential biases and bolster the reliability of the findings. The utilisation of data collection methods and sources helps to alleviate the reliance on a singular perspective, thereby reducing the likelihood of skewed or unrepresentative information.

In the realm of quantitative research, the concepts of *transferability* and external validity are closely intertwined and pertain to the ability of research findings to be generalised beyond the specific context in which they were obtained. This is a critical consideration when evaluating the utility of research results for application in other settings. Conversely, qualitative research, with its more localised and in-depth focus, is often characterised by a relatively narrow scope, which can raise concerns about the external validity of findings. The concern is whether the findings would still be applicable if the situation or time were to change. As such, Lincoln and Guba (1985) have emphasised the importance of ensuring that qualitative research findings are transferable across different settings and contexts. To address this issue, in our study, we will adhere to the recommendation of Geertz (1973) and provide a rich and detailed description of the research situation in order to enhance the transferability of our findings and facilitate the assessment of the generalizability of our results by other researchers.

Dependability, as conceptualised by Guba and Lincoln (1994), is a crucial dimension of research that is imperative for establishing trustworthiness and for creating a parallel with reliability. To ensure dependability in our study, we have maintained systematic and detailed records and documentation of the research process, including problem formulation, selection of participants, notes, and transcripts. This will facilitate an external review, auditing, and critique of our methodology, thus increasing the credibility of our study (Bell et al., 2019). Additionally, an inquiry audit, which is a systematic examination of the research process by an independent and objective third party, may be conducted. The inquiry audit will involve a thorough examination of the data collection, analysis, and final results, ensuring that our findings are consistent with the data collected and enhancing the dependability of our study.

Confirmability, as put forth by Bell et al. (2019), is a fundamental aspect of research that pertains to the objectivity of the study, specifically, whether the researcher's values, opinions and biases have affected the findings of the study. While complete objectivity is acknowledged as an unattainable ideal, it is still essential to strive for it to ensure confirmability. To this end, we will engage in reflexive journaling, a process of critical self-reflection, throughout the research process. This will enable

us to examine and acknowledge our personal connections and affiliations to the topic and minimise their potential impact on the findings. This approach aligns with the established principle of confirmability in qualitative research, which is a critical aspect of establishing the trustworthiness of the study and making the findings more generalisable.

2.5.2 Authenticity

According to Bell et al. (2019), ensuring authenticity in research involves considering the wider social and political impact of the study and responsibly representing diverse viewpoints within the relevant social context. In light of the immature nature of the research topics and the challenge in finding experts with comprehensive knowledge across the intersecting fields of blockchain, procurement, and the CE, maintaining authenticity becomes particularly crucial in this study. Furthermore, the research aims to have practical implications for multiple stakeholders with diverse backgrounds. By conducting the study in a manner that promotes the improvement of procurement and, ultimately, the CE, the research seeks to serve the interests of various stakeholders involved in the SC.

3.0 LITERATURE REVIEW

This chapter's objective is to analyse significant prior literature and theories that serve as a basis for the research question, *"How can blockchain technology enable circular procurement?"*. The evaluation and discussion of current literature will serve as the foundation for developing knowledge regarding relevant research conducted on the subjects. First, we will introduce the CE and discuss why its principles need a shift in corporate strategy toward circular systems both within and outside of existing organisations and supply networks. Second, we will introduce procurement, assessing the topic's significance, present state, trends, and obstacles. In addition, we will discuss SC visibility, which is crucial to the success of circular business models, and its concepts have been linked with BCT. Following that, we will cover blockchain, including its history, current state, and future possibilities. We will then discuss the intersection between BCT, CE and procurement. In conclusion, the conceptual framework of this study will be determined by the theoretical background.

3.1 Circular Economy

The necessity for businesses and their SC to enhance their focus on sustainability and environmental friendliness has been evident over the previous decades. The CE business model aims to sustain the economic value of goods, materials, and resources by decreasing waste production and closing material loops (Alhola et al., 2019). By putting three fundamental concepts into practice: reduce, reuse, and recycle, this approach aims to utilise waste, prolong product life cycles, and over time, create a more effective and sustainable business model (Figure 2).

Figure 2:Circular Economy, (United Nation Industrial Development Organization, 2021)

The concept of CE is grounded in General Systems Theory and Industrial Ecology, as highlighted by Geissdoerfer et al. (2017). Policymakers, businesses, and scholars alike are increasingly interested in the CE due to its potential as a viable framework for achieving sustainable growth, as noted by Murray et al. (2017). In contrast to the linear economy paradigm, which prioritises continuous expansion, the CE posits a closed-loop system that operates within the ecological boundaries of the planet, as emphasised by Merli et al. (2018).

Geissdoerfer et al. (2017) define the CE as a *"Regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling."* The fundamental principles of the CE, as outlined in the literature, are reduce, reuse, and recycle (Kirchherr et al., 2017). Reduced consumption is encouraged through increased manufacturing efficiency and reduced use of energy, raw materials, and waste (Ghisellini et al., 2016). This involves promoting eco-friendly manufacturing techniques, lighter and smaller products, and a minimalist lifestyle. Reusing refers to using a product or component again for the same purpose, while maintaining its original form or making only minor improvements (Ellen MacArthur Foundation, 2013). Examples of reusing in practice include

extending the life cycles of products, stimulating consumer demand for used goods, providing take-back incentives, and utilising waste or by-products in business processes (Ghisellini et al., 2016). Recycling aims to reduce the use of virgin materials by maximising the recycling of materials (Su et al., 2013). However, there are challenges to recycling, such as natural limitations, product and material complexity, material contamination, and increased energy requirements (Stahel, 2013). Additionally, phasing out fossil fuels in favour of renewable energy sources is crucial to maintaining a robust circular system (Ellen MacArthur Foundation, 2013).

With an emphasis on industrial economics, Stahel & Reday (1976) developed some aspects of the CE. They created the concept of a loop economy to explain industrial waste reduction, local job creation, resource efficiency, and dematerialisation tactics. The best applicable sustainable business model for a loop economy, according to Stahel (1982), emphasises selling utilisation rather than ownership of products. This approach enables enterprises to make money without externalising costs and hazards related to waste.

The literature surrounding the concept of the CE is often met with criticism for its alleged disregard for established scientific knowledge (Corvellec et al., 2022). One principle commonly cited as being overlooked is the first law of thermodynamics, which states that energy cannot be created or destroyed, only converted from one form to another. This principle has important implications for the feasibility of a true CE, as it suggests that the use of resources will inevitably lead to the generation of waste and emissions. As such, it is argued that the goal of achieving closed material loops and endless product recycling needs to be revised. Furthermore, the energy requirements of a CE would necessitate a transition to renewable energy sources in order to be sustainable.

The successful implementation of the CE typically requires active participation from various stakeholders and a common ground for collaboration, although the concept is still evolving (Ghisellini et al., 2016). According to Kalmykova et al. (2018), there are two main implementation strategies for the CE: top-down initiatives driven by government policies and bottom-up initiatives driven by businesses, environmental groups, and civil society (Ghisellini et al., 2016).

Policies such as tax incentives for renewable resources can promote the transition to a CE, and public awareness campaigns and educational initiatives can help raise awareness about the CE concept. Innovation plays a crucial role in enabling new circular business models, improving product quality, extending product life cycles, and facilitating systemic integration (Vogel et al., 2019). In the literature, various terms such as eco-innovation, green innovation, environmental innovation, and sustainable innovation are used interchangeably to describe relevant forms of innovation.

The sustainable transition perspective has emerged as a conceptual framework to investigate the shift towards a CE (de Jesus et al., 2018. According to Köhler et al. (2019), sustainability transition research centres on socio-technical systems encompassing energy, transportation, production, and consumption, and emphasises that the transition process is not a linear pursuit solely focused on profit maximisation. Instead, it is recognized as a dynamic, co-evolving, and multi-actor process that has far-reaching impacts on social, environmental, and economic aspects of development (de Jesus et al., 2018). In light of the collective nature of sustainability as a societal good, and the lack of inherent incentives for commercial entities to engage in sustainability transitions, active policy participation and institutional support are deemed essential for facilitating and enabling such processes (Köhler et al., 2019).

The drivers and barriers of transitioning to a CE have been extensively studied in sustainability transition research, with factors such as political, market-related, economical, and cultural influences being considered (Kirchherr et al., 2018). de Jesus et al. (2018) differentiated between "softer" aspects (institutional/regulatory, social/cultural) and "harder" aspects (technical, economic/financial/market) in their analysis of the drivers and impediments of the CE transition. Their findings indicated that harder issues, such as the lack of technological solutions and financial obstacles such as high investment costs and linear lock-ins, pose significant challenges to the shift towards a CE. On the other hand, softer variables, such as effective public policies, consumer awareness of environmental issues, and demand for environmentally friendly products, play a crucial role in driving the transition.

Prieto-Sandoval et al. (2018) emphasised the importance of eco-innovation determinants, including regulatory and policy frameworks, supply-side activities,

and demand-side requirements, in relation to the concept of CE, highlighting the role of innovation in facilitating the transition. Their analysis revealed that while changes in consumer behaviour (demand side) are considered essential for embracing eco-innovation and accelerating the transition, supportive legal and policy frameworks provide the necessary foundation for circular supply. Furthermore, Cainelli et al. (2020) underscored the significance of demand-side factors and public policies as catalysts for innovation. Their quantitative analysis of data from European Union industrial and service firms demonstrated the critical roles played by demand-pull mechanisms and environmental policy considerations in driving the adoption of clean technologies. The barriers to CE were investigated empirically by Kirchherr et al. (2018), who surveyed 208 respondents and conducted 47 expert interviews in the EU. Their findings concluded that cultural barriers represent the main challenges to the adoption of CE principles. In recent years, the role of procurement has been recognised as a significant, but as of yet underutilised, possibility by governments and companies in their transition toward circular economies (Alhola et al., 2019).

3.2 Procurement

Purchasing and Supply Management (PSM) plays a pivotal role in today's organisations. It is defined as a "strategic approach to planning for and acquiring the organisation's current and future needs through effectively managing the supply base" (Wynstra, 2016, p.200). The procurement function consists of purchasing, supply management, and the administration of incoming and outgoing logistics. This section will examine the fundamental principles underlying PSM, the introduction of Procurement 4.0, the concept of CP, and the significance of SC visibility within the context of modern procurement practices.

3.2.1 Fundamental Principles of Purchasing and Supply Management

The origins of PSM may be traced back to the earliest days of commerce when merchants travelled to other marketplaces to acquire items for their firms. Nevertheless, it was not until the industrial revolution that PSM gained a more official function inside organisations (Spina et al., 2013).One of the first definitions was provided by Webster & Wind (1972, p. 2), who defined it as "the decision-making process by which formal organisations establish the need for purchased products and services and identify, evaluate, and choose among alternative brands

and suppliers." Porter (1998) divides organisational activities for value creation into primary and supporting activities, with "procurement" being one of the supporting operations.

Purchasing and procurement are commonly used as synonyms. However, there are some differences. Van Weele (2018) and Monczka et al. (2020) highlight that the terms seem to have an unclear distinction. Thus, the theoretical framework in our thesis will alternate the terminologies. Both words pertain to the entire purchasing procedure, from determining specifications through securing delivery to evaluating suppliers. Van Weele (2018, p.7) defines procurement as *"The management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities are secured at the most favourable conditions covering the materials, information and money flows up to the point of consumption"*. Before the 21st century, buyers requested competitive bids from suppliers, awarded short-term contracts based on price, and satisfied non-demanding performance requirements (Monczka et al., 2020). However, the ease of the purchasing field has been called into question, much as in many other industries, and it has been subject to several technological shifts.

In recent years, there has been a transition away from procurement's traditional transactional function, which consisted primarily of ensuring that the company's operations did not run out of supply elements with an emphasis on cost (van Weele, 2014). One of the first publishing's of the strategic role of procurement was by Peter Kraljic in 1983. Kraljic (1983) argued that procurement should not be considered a distinct, tactical function, but rather should be incorporated into a strategic approach to supply management. One of his most notable contributions is the Kraljic Matrix (Figure 3), a framework for assessing the supply risk and profit effect of a company's various product purchasing methods for each of the sourcing categories (Vitasek , 2016). Kraljic's logic lent credibility to the procurement profession and left an indelible mark on the field.

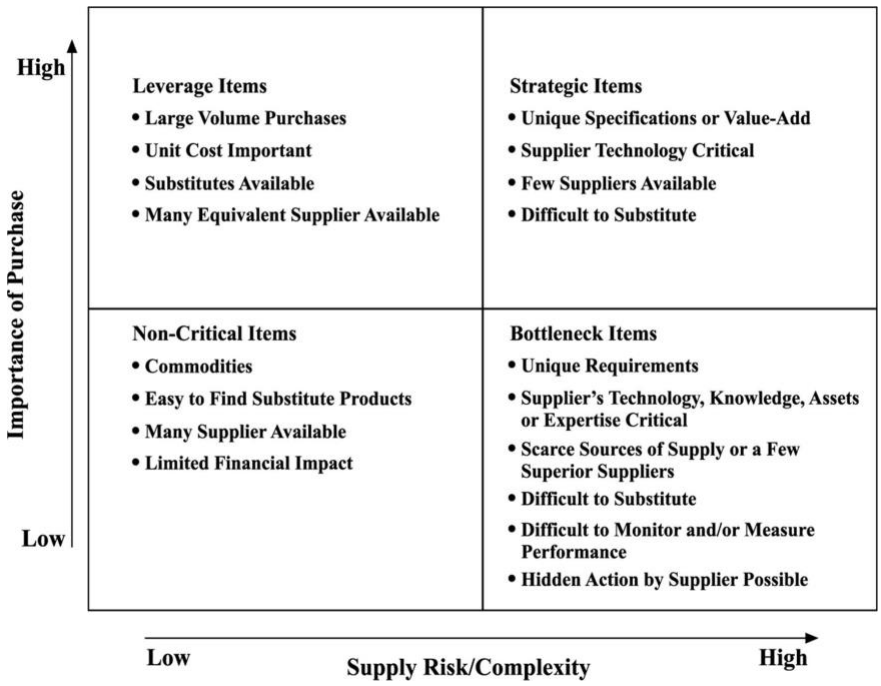

Figure 3: Kraljic Matrix, (Montgomery et al., 2018)

However, it has been highlighted that the relationship between procurement and the company's corporate strategy differs over time, industries and among nation groupings (Bag et al., 2020). The concrete example used by Kraljic, all of these resources are provided by the same fuel supplier, and they should be considered one supply market rather than three distinct goods. Hespin & Schiele (2015) emphasised the last point as particularly crucial as materials and services are not coded and grouped according to technical features, legal and tax classifications, countries, rather, their categorisation is based on adhering to a supply market logic, where sourcing categories make up a single supply market. In simpler terms, purchasing may create specialised plans for homogeneous supply marketplaces or groups of acquired goods and services. As a result, the term category strategy has been adopted to characterise the category level of strategy development (Horn et al., 2013). Instead of "one supplier, one part," sourcing categories describe "multiple suppliers, multiple similar parts" interactions. With the passage of time, this perspective was supplanted by one that promoted more collaborative and long-term relationships with suppliers (Håkansson, & Snehota, 2017). One effect of cooperative value creation through collaborative activities is the growing emphasis on supplier participation in innovation.

One of the key justifications for a category-based approach to sourcing is the potential for developing unique strategies in light of particular contextual variables

of various supplier markets (Dubois et al., 2021). Category methods may also aid in achieving broad functional purchasing objectives while simultaneously taking functional purchasing strategy into account. For instance, a company plan can include quick responses to shifting consumer preferences as a key competitive differentiator. As a result, by identifying specific overarching goals, the procurement function can be encouraged to reduce the lead time for bringing on new suppliers (Hespin & Schiele, 2015). As emphasised by Yang et al. (2013) , there is stronger evidence of a connection between corporate strategy and procurement strategy in companies with European or American headquarters .

3.2.2 Modern Procurement: Evolution, Challenges and Opportunities

Due to growing competition, cost constraints, specialisation, and rapid technical advancement, the literature suggests that businesses in today's globalised corporate landscape focus on core skills and outsource those that do not (Bygballe & Persson, 2015; Knight et al., 2014). To that end, the PSM role is gaining recognition as an essential management function for securing a long-term competitive advantage. The importance of PSM's function in transcending organisational boundaries and managing their external networks has increased as organisations spend up to 80% of their entire expenses on acquired products and services from suppliers (Bals et al., 2019). In today's business landscape, PSM is argued by scholars to be one of the most important management tasks for firms to remain competitive and fulfil their goals since it can essentially dictate what the organisation can do inside its network (Bartezzaghi et al., 2016). In the modern day, the need for strong supply security and the capability of supply networks is in high demand, compared to historical measurements such as prices and quality (Bag et al., 2020). This has been further emphasised by Patrucco & Kähkönen (2021), which have highlighted new capabilities for PSM in a post-pandemic world. Numerous organisations were caught off-guard, and it became clear that they lacked the capabilities necessary to react and respond rapidly to the effects. According to research conducted by the Institute for Supply Management, "sustainability has become a key focus for purchasing and supply management professionals" (Institute for Supply Management, 2019). What was formerly considered to be a voluntary responsibility is now one that must be fulfilled. With increased concern for environmental preservation, choosing a supplier is now a crucial decision for procurement

practitioners and will impact the qualities of the finished product (Pagell et al., 2010).

The fourth industrial revolution, also known as Industry 4.0, brings in a new era for numerous business functions, procurement included (Ghobakhloo, 2020).This new concept, known as Procurement 4.0, represents the evolution of procurement practices in the context of digital transformation and advances in technology. Artificial Intelligence (AI) and Big Data have been identified as crucial catalysts for the digital transformation of businesses in order to increase their profitability and competitiveness (Bienhaus & Haddud, 2018). For example, a grid presenting two kinds of digitalization technologies utilised by today's businesses in the procurement function has been presented (Srai & Lorentz, 2019) as a tool to aid the knowledge of digitalization. The Internet falls under the first group, which includes fundamental technologies, while the second category includes advanced technologies, such as IoT, AI and machine learning (ML), big data analytics, and BCT. Due to enhanced communication and information flow, the widespread use of the internet and other technology-related advancements has enabled businesses to extract information in real-time (Bag et al., 2020).

The technological advancements have produced new and improved procedures that have contributed to substantial cost reductions, exponential quality gains, and unprecedented reductions in the time required to produce new goods (Monczka et al., 2020). The usage of digital tools such as blockchain and AI to increase efficiency and decision-making is becoming more widespread but is still in its early stages for many organisations and industries (Ghobakhloo, 2020). Bag et al. (2020) argued that when businesses and their suppliers work together, both parties may reap the benefits of information sharing facilitated by digital tools. However, Prior research revealed that companies encountered obstacles when technological advanced systems, which resulted in a concentrated view on strategic sourcing and supplier relationship management for successful implementation (Huang & Handfield, 2015). In addition, the creation of technologies that are compatible with Procurement 4.0 is not necessarily a straightforward effort. Bienhaus & Haddud (2018) compiled a list of the obstacles that stand in the way of the development of new procurement systems with these obstacles being located in current practices, competences, and capabilities. Furthermore, according to Srai & Lorentz (2019),

extensive empirical data on the more sophisticated applications of practical implementation in PSM is still lacking, making it challenging to make conclusions regarding performance connections or even causalities associated with PSM-digitalization.

3.2.3 Procurement's Role in the Circular Economy

As the concept of CE receives more attention, SCM practices are incorporating more circular initiatives (Xu et al., 2022). Due to this, a concept of CSC, as defined by Guide & Van Wassenhove (2009), has emerged: *"Design, control, and operation of a system that maximises value creation over the entire life cycle of a product with the dynamic recovery of value from different types and volumes of returns over time.*

Procurement, as one of the most important functions in SCM, has been identified as playing a crucial role in assisting organisations in achieving CE-related goals by several scholars (Neessen et al., 2021; Zaidi et al., 2019). Its effects on a company's operations, finances, and the environment are all significant as previously mentioned. The term CP refers to the approach to buying that governments and commercial companies use in their quest for a CE. As defined by The United Nations Environment Programme (UNEP) (2021), *"Circular procurement occurs when the buyer purchases products or services that follow the principles of the circular economy, supporting the assessment of designing, making, selling, re-using and recycling products to determine how to get the maximum value from them, both in use and at the end of their life."*

Xu et al. (2022) demonstrated that CP strategies can be classified as either internal or collaborative. Internally practices refer to buyers' individual CP strategies, whereas collaboratively practices refer to buyers' cooperation with non-firm members. While the performance of CPs affects expenditures, performance in the market, and competitiveness (Ntsondé & Aggeri, 2021), Mazet & Dontenwill (2012) argue that the legitimacy of an organisation's CP is determined by whether stakeholders believe it has achieved each of the three elements of sustainability: environmental, social, and economic performance.

Evidently, innovation in technology, integration, and implementation are indispensable for CP (Bag et al., 2020). Despite the fact that the emergence of Industry 4.0 has brought some potential digital technologies to CP practitioners, it is difficult to accomplish the operational implementation of technology to generate benefits for CE , resulting in numerous technical challenges (Xu et al., 2022). Several researchers have shown that an improvement in the implementation of CP may be made possible by the utilisation of technology that provides end-to-end visibility, traceability, and the capacity to make accurate forecasts (Sandvik & Stubbs, 2019; Werning & Spinler, 2020).

3.2.4 Supply Chain Visibility

SC visibility refers to the extent to which an organisation has access to and can openly communicate information on its SC strategy and the activity of its SC partners (Caridi, 2014). In the SCM and logistics communities, the term "SC visibility" is frequently used. However, there is some debate over its exact definition. All definitions in the literature link SC visibility to information sharing, but the idea of SC visibility goes beyond straightforward access to specific information flows connected to SC operations. There are numerous definitions that discuss the characteristics of the shared information, and the usefulness of the shared information, which should be pertinent and significant, is viewed by several authors as being highly correlated with SC visibility. SC visibility, as defined by Kaipia & Hartiala (2006), is "*the sharing of all relevant information between SC partners, even over echelons in the chain."*

The concept of SC visibility has been widely acknowledged as a means to enhance the performance of business operations (Caridi, 2014). This is achieved through the provision of real-time data and information, which allows for more informed decision-making and a greater understanding of SC dynamics. Furthermore, the integration of SC visibility into various initiatives, such as Quick Response, Efficient Consumer Response, Vendor Managed Inventory, and Continuous Replenishment, has been demonstrated to improve key performance indicators, including cost, quality, service level, flexibility, and time. As such, it is recommended that businesses assess the advantages of implementing SC visibility in order to achieve these performance improvements.

When addressing visibility in the SC, terms like transparency and traceability are sometimes used interchangeably, despite their distinct definitions (Monczka et al., 2020). Transparency, in the context of the SC, refers to the availability of information to supply network participants (Francisco & Swanson, 2018). Traceability comprises a vast array of organisational procedures and technology systems required to improve information integration. Research suggests that organisations with a holistic perspective on SC transparency can obtain significant competitive benefits (Sodhi & Tang, 2019). By exchanging information amongst critical players, materials may be made more available to the customer, hence enhancing the chain's transparency and communication. According to Awaysheh & Klassen (2010), SC transparency drives suppliers to embrace socially responsible practices, which in turn affects customers' purchasing decisions and creates conditions in which rivals are compelled to follow suit.

Traceability in the SC refers to the ability to track the origin, purpose, or location of an item using its unique identifier at any point in the SC (Bechini et al., 2008). This means that the SC is aware of the origins of their raw materials, the components that make up the components they buy, and how those components perform environmentally throughout the manufacturing and distribution processes (Hastig & Sodhi, 2020). Powered by visibility and traceability, SC transparency initiatives direct businesses toward achieving the proper amount of disclosure, boost internal and external inspection, and improve stakeholder perceptions of openness (Montecchi et al., 2021). Leveraging the potential offered by modern innovations, academics are investigating new methods and tools to further improve SC visibility and transparency. The decentralised, irreversible, and transparent properties of blockchain, which are gaining academic traction , may transform SCM and SC visibility (Francisco, K., & Swanson, 2018.;Venkatesh, et al., 2020).

3.3 Blockchain

3.3.1 A conceptual overview of BCT

The initial blockchain concepts were put forth in 2008 by someone going by the pseudonym Satoshi Nakamoto, who explained how cryptography and an open distributed ledger could be merged into a digital currency application (Nakamoto, 2008). BCT can be defined as an online, open-source distributed ledger where transactions between different stakeholders can be recorded and updated simultaneously and in real-time (Iansiti & Lakhani, 2017). A blockchain refers to a distributed ledger that contains information on transactions or events, which is duplicated and distributed among the network participants (Nakamoto, 2008). Blocks are added to the chain by utilising a hash function to chain them to the preceding block, resulting in the continuous growth of the chain. Cryptographic hash functions, such as SHA-256 for Bitcoin, are commonly used to generate the hash (King, 2013). This hash function enables quick confirmation of the input mapping to a specific hash value, making it highly improbable for two distinct inputs to yield the same hash. One key feature of blockchain is that it operates without the need for a central authority or mediator. Instead, the ledger is validated and stored by network nodes (users) in accordance with a consensus mechanism, which comprises a set of rules that enable users to reach mutual agreement. Each node maintains an exact duplicate of the full ledger, thereby eliminating the need for a single point of control or verification.

3.3.2 Classification of blockchain systems

Presently, the utilisation of BCT encompasses three primary categories or types of systems. A fundamental distinction exists between public blockchains, private blockchains and consortium blockchains (Zheng et al., 2017).

A preeminent instance of a public blockchain, also referred to as permissionless blockchains, is the Bitcoin network. Public blockchains are characterised by the absence of access restrictions, thereby enabling all network participants to add new blocks. (Sharples & Domingue, 2016). Transactions can be appended to the blockchain by any user provided that they comply with the blockchain's regulations

(Sheth & Dattani, 2019). Furthermore, these blockchains are transparent, and their contents can be inspected by any interested party at any given time.

Private blockchains, also known as Permissioned blockchain, are often employed in scenarios where stringent access control is essential to restrict entry and contributions to the network. They operate as closed environments where users must be authorised to join the blockchain network, access transaction history, or submit a transaction (Sheth & Dattani, 2019). These blockchains are typically owned by a private individual or organisation, where a centralised authority manages authorization. Unlike public blockchains, private blockchains may or may not use the consensus method of the public blockchain.

The implementation of blockchain by consortiums or federations serves to eliminate the concentration of power in a single individual, instead distributing it among a group of authorised individuals (Zheng et al., 2017). The consortium, which comprises multiple entities that agree to work together towards a common goal, functions as a closed network where permission is required to join and conduct transactions. Examples of blockchain consortiums include Hyperledger, Corda, and Quorum.

3.3.3 BCT characteristics

Seebacher & Schüritz (2017) assert that BCT is characterised by two critical attributes, namely its decentralised nature and its ability to inspire trust (Figure 4).

Decentralisation:

Decentralisation contributes to creating a private, reliable, and versatile environment as discussed in greater depth below. This privacy is supported by the technology's peer-to-peer foundation and its use of public-key cryptography to secure communications between two users, with identities being concealed by pseudonyms (Hull et al., 2016). Two primary factors contribute to reliability within the system. Firstly, because transactional data is shared and stored redundantly across the network (Sharples & Domingue, 2016). Secondly, the technology's foundation on data and code enables the introduction of automated measures, thereby reducing the possibility of individual errors since manual intervention is less necessary (Guo & Liang, 2016). Moreover, BCT promotes an open and

versatile system that allows users to integrate their own programs, produce and distribute their code, and shape their environment (Ølnes, 2016).An example of this capability is the "smart contract," which functions as a programmed contractual agreement between two parties.

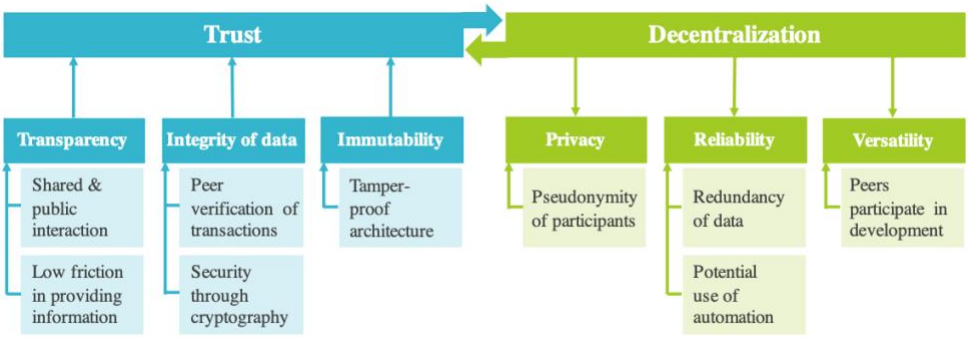

Figure 4: Characteristics of blockchain technology, according to Seebacher & Schüritz (2017)

Trust:

The trust-enabling concept of BCT can be indirectly described through the establishment of transparency achieved via transactions across the peer-to-peer network and the maintenance of data integrity within the blockchain. Through BCT, individuals can establish an openly and publicly disclosed connection with complete disclosure of system operations, as all completed and ongoing transactions are shared among participants (Seebacher & Schüritz, 2017). As there is no central controller of the system, new transactions are broadcasted throughout the entire network, and users can communicate directly with one another, reducing friction (Sun et al., 2016). Moreover, trust can be facilitated by the technology's inherent characteristic of ensuring the integrity of data and the use of public-key cryptography, which enables direct interaction while allowing every user to verify broadcasted transactions based on predefined rules. This feature ensures the integrity of the data stored in the database itself (Delmolinino et al., 2016). The database's immutable nature, which prevents changes to committed transactions once they are added to a block and subsequently placed on the blockchain, further enhances confidence (Cucurull & Puiggalí, 2016). The consensus mechanism, such as the computation of a proof-of-work, facilitates this process. The proof-of-work involves solving a difficult computational challenge that can be verified easily by others. The proof-of-work algorithm's crucial component is that the puzzle a user is

attempting to solve depends on the previously acknowledged and agreed-upon blocks of the blockchain. This interdependence implies that changes in the blockchain would produce diverse solutions, indicating misuse or manipulation because numerous players are attempting to create and add new blocks to the blockchain (Seebacher & Schüritz, 2017).

3.3.4 Current adoption of BCT

The purpose of this study is to investigate how BCT can enable circular behaviour in procurement. To contextualise this research, it is necessary to examine the global adoption of BCT. Although BCT is still in its early stages, corporate executives may consider adopting new technologies early to gain a potential competitive advantage. A study by IBM's Institute for Business Value revealed that 33% of C-suite executives are either evaluating or already utilising BCT (IBM Institute for Business Value, 2017). The open-source HyperLedger project, initiated by the Linux Foundation and supported by prominent corporations in the finance and technology industries, aims to advance BCT across various sectors and establish an open-source standard for distributed ledger initiatives (Cachin, 2016).

Presently, most of the adoption of BCT is being driven by start-ups that develop their business models solely around addressing problems with BCT. However, it is anticipated that there will be a rise in the number of hybrid business models that incorporate BCT alongside their existing operations. (Crosby et al., 2016). Iansiti & Lakhani (2017) have introduced a two-dimensional, four-by-four matrix to depict the evolution of use cases for new foundational technologies (Figure 5). The matrix divides the four phases into single-use, localization, substitution, and transformation categories based on the novelty and complexity of the application. Single-use cases, such as payments, are typically characterised by low novelty and complexity and aim to replace an existing service, as is the case with Bitcoin for payments. The localization phase is focused on applications with high levels of originality but a smaller user base, exemplified by a private online ledger. In the substitution phase, novelty is low, but complexity is high, addressing existing problems such as third-party services that enable cryptocurrency payments (Iansiti & Lakhani, 2017). The fourth phase of technological evolution is when new technologies are utilised to fundamentally transform the nature of existing systems. Typically, existing systems undergo transformation after a technology has been

proven and evaluated in earlier phases. This transformation could include self-governing smart contracts for BCT, which has the potential to alter the character of human transactions. As traditional companies are established based on written and verbal contracts, the adoption of BCT could potentially revolutionise how businesses operate. (Iansiti & Lakhani, 2017). In analysing Blockchain adoption, it is imperative to examine how businesses intend to either replace or supplement their current operations by incorporating this technology. Hence, the goal is to attain the transformational phase of technological evolution.

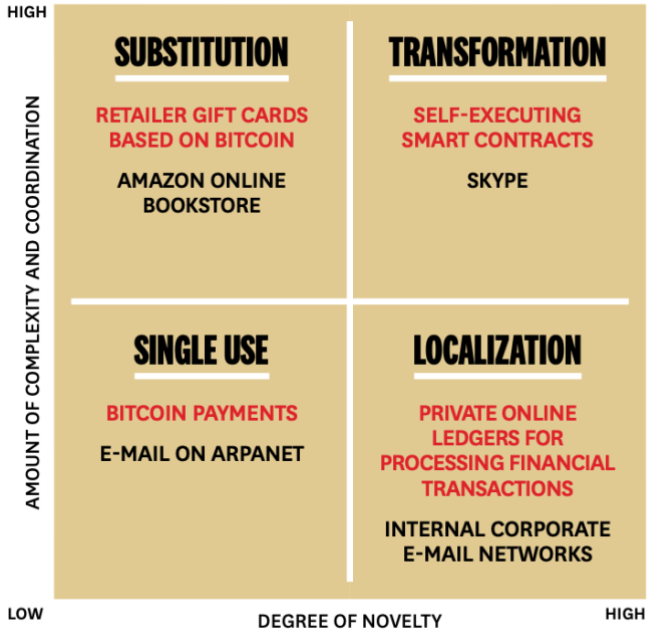

Figure 5: The evolution of use cases for new foundational technologies, (Iansiti & Lakhani, 2017)

3.3.5 Smart contracts

The term "smart contract" was initially introduced by computer scientist and cryptographer Szabo in the mid-1990s. Szabo defined smart contracts as *"a set of promises, specified in digital form, including protocols within which the parties perform on these promises* (Szabo, 1996)." He illustrated the concept using the analogy of vending machines, which accept coins and dispense goods based on predefined rules. However, smart contracts extend beyond vending machines by proposing the digital incorporation of contracts in various types of properties (Szabo, 1997). Szabo anticipated that smart contracts would be more useful than traditional paper-based contracts due to their logical structure, cryptographic protocol verification, and enforcement capabilities.

Although the concept of smart contracts was introduced by Szabo, their realisation became possible with the emergence of BCT. The consensus process and the use of public and append-only distributed ledger technology (DLT) in blockchain enable the execution of smart contracts in their truest sense. Smart contracts are computer protocols that leverage blockchain to facilitate, verify, and execute agreements between multiple parties. Their implementation on the blockchain provides several distinct features. Firstly, the source code of a smart contract is recorded and verified on the blockchain, ensuring its immutability and resistance to tampering. Secondly, the execution of a smart contract occurs among anonymous and trustless individual nodes without the need for centralised control or coordination from external authorities. Finally, similar to intelligent agents, smart contracts may possess their own cryptocurrency or digital assets, which they can transfer based on predetermined conditions (Stark, 2016).

It is important to highlight that Bitcoin is recognized as the first cryptocurrency that enabled fundamental smart contracts, where transactions are only accepted if specific requirements are met. Due to the limitations of the Bitcoin programming language, which supports only basic arithmetic, logical, and cryptographic operations, the development of complex smart contracts were previously deemed not feasible (Nakamoto, 2008). However smart contracts have gained substantial prominence in recent years and are automated and deterministic program units that are capable of processing various modules in a predetermined manner and initiating corresponding events (Mohanta, 2018).

3.4 Blockchain Technology in a Circular Economy

This section will highlight blockchain as a possible enabler for aiding a transition to a CE. Blockchain has emerged as a potential catalyst for the transition towards a CE, attracting considerable attention from both academia and industry (Adams et al., 2018; Khan et al., 2022). Its transformative potential lies in its ability to revolutionise existing economic and institutional structures, fostering new business models and ushering in an era of openness and economies of trust. Recent research has explored the application of blockchain in promoting environmental sustainability, with particular emphasis on product-service systems, product deletion, and the broader CE paradigm (Böhmecke-Schwafert et al., 2022).

Blockchain may support the core principles of the CE, namely reduce, reuse, and recycle. By enabling the provision of accurate and transparent information, blockchain-based SCM systems enhance traceability in complex SCs, facilitating responsible purchasing practices (Agrawal et al., 2021). Furthermore, the integration of smart contracts within BCT has been identified as a possible enabler for waste exchange marketplaces and recycling programs to streamline waste management processes (Khadke et al., 2021). Additionally, BCT may facilitate the adoption of renewable energies through peer-to-peer energy trading platforms and source verification systems (Yildizbasi, 2021). The exploration of blockchain's potential in supporting CE principles showcases the promising avenues for its application in promoting sustainability and circularity across various sectors. The use of BCT in the context of CE has also been explored in other areas. For example, Mengelkamp et al. (2018) proposed using a blockchain network to operate a smart grid, while Shojaei et al. (2020) discussed the use of blockchain as a platform for an extensive Life Cycle Assessment database for the built environment. Additionally, the potential for interoperability between different blockchain networks used in CEs could facilitate communication and information sharing (Mengelkamp et al., 2018).

In the domain of SCM, BCT presents significant potential (Venkatesh et al., 2020). SC continually seek to enhance efficiency and reduce waste, and the integration of BCT to interconnect databases, distributed ledgers, and stakeholders across the entire SC can contribute to these objectives, ensuring time and cost savings (Xu et al., 2019). By capturing crucial data within the blockchain, the entire journey of a product, starting from its raw material source to the manufacturer and ultimately reaching the end consumer, can be easily and efficiently tracked (Upadhyay et al., 2021). This process fosters product quality and cleaner production practices by bridging geographical boundaries and ensuring transparency (Iansiti & Lakhani, 2017).

Moreover, The Ellen Macarthur Foundation argues that BCT aligns SCs with the sustainability principles of the CE, promoting the reduction of paper consumption, encouraging the utilisation of renewable energy sources, and significantly minimising waste (Ellen MacArthur Foundation, 2013). The immutable records stored within the blockchain facilitate the establishment of cyclical processes in SCM since blockchain transactions cannot be reversed. Furthermore, these records

enable the monitoring and demonstration of the environmental sustainability of manufactured goods to clients, while also ensuring that ethical standards, such as the exclusion of child labour and the upholding of human rights, are maintained throughout the SC and production process (Dierksmeier & Seele, 2020). By fostering cooperation and knowledge exchange through BCT, scholars argue that it can advance the CE and achieve sustainability and social responsibility objectives (Upadhyay et al., 2021). Through the utilisation of blockchain's capabilities, SCs can enhance efficiency, promote responsible practices, and establish a transparent and accountable framework that aligns with CE principles.

3.5 Blockchain Technology in Procurement

Hong & Kwon (2012) argues that the competitive market's rapid changes have contributed to the increasing difficulty and complexity of procurement procedures. Consequently, innovative approaches are required to enhance efficiency in procurement. Nicoletti (2017) anticipates that procurement will require greater agility and faster response times in the foreseeable future. This is particularly relevant in light of the emerging "Industry 4.0" project's digital transformation, which will give rise to "Procurement 4.0" that will revolutionise procurement procedures. The integration of information and communication technology (ICT) and automation across all procurement procedures is likely to be a crucial feature of "Procurement 4.0. (Bag et al., 2020).

In recent years, there has been a notable surge in the use of blockchains, particularly within the financial sector. However, Zheng et al. (2017) posit that there are emerging use cases for blockchains in diverse fields beyond finance. The authors highlight that traditional sectors can also harness the potential of blockchains to enhance system performance. According to Hileman & Rauchs (2017), the current focus of DLT is still largely centred around the utilisation of money. This may be attributed to the fact that early blockchain applications were predominantly designed for currency-related purposes. Nevertheless, Nicoletti (2017) suggests that shared databases facilitated by blockchains can offer benefits to organisations, clients, suppliers, partners, regulatory bodies, and others, by enabling a dependable and seamless procurement process.

Härer (2018) argues that the implementation of a decentralised plan for the purchase order process can allow suppliers without long-term ties to readily participate using the data stored in the blockchain-secured process model. This highlights the potential of blockchains to enable greater transparency and efficiency in procurement processes, even for suppliers who do not have established relationships with the organisation. This has been further emphasised by Tapscott & Tapscott (2017) which argue that blockchain will enable businesses requiring specific competencies to acquire superior information about potential suppliers compared to many conventional procurement approaches. However, Nicoletti (2017) argues that the blockchain's applications are applicable in all facets of procurement, ranging from supplier selection to contract management (Figure 6).

Figure 6: Blockchain and the procurement processes, (Nicoletti , 2017)

3.6 Conceptual Framework

The conceptual framework we have built is presented in this chapter (Figure 7). After reviewing the literature and presenting background information on our topic of interest, we have developed a conceptual framework that encompasses the main themes. We developed the research design, interview guide, and data analysis with the help of the framework, which incorporates important concepts discovered in the literature review and indicates what we sought to examine in further detail.

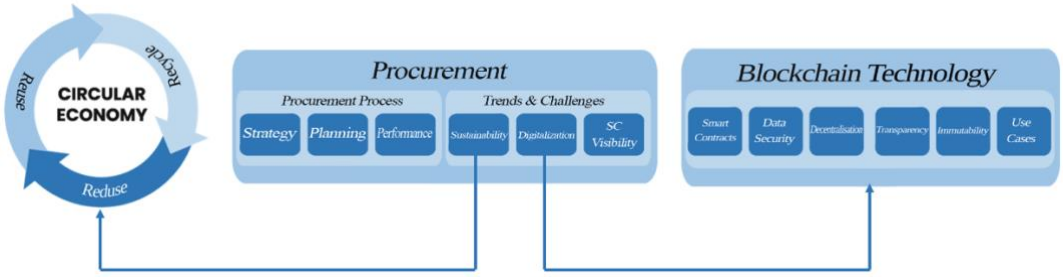

Figure 7: Conceptual Framework

In order to address the research question, *"How can blockchain technology enable circular procurement?"* The theoretical framework emphasises a number of factors that were deemed crucial to investigate. The aim of this study is to investigate the adoption of BCT in relation to procurement as well as the possible advantages of BCT in enhancing a CE. Additionally, the challenges, enablers and opportunities involved in implementing this technology in the procurement process so that we may draw conclusions about the possible effects of BCT.

4.0 RESULTS

Our research aims to investigate how BCT can potentially facilitate CP practices. Given the nature of our study, investigating how the fundamental features of BCT can influence and affect the procurement process, particularly in the transition to a CE, has been our primary focus. Naturally, our investigation also examines the challenges associated with the adoption of BCT, with a focus on the transition to a CE. To accomplish this, we opted for a qualitative study with expert interviews and conducted semi-structured interviews to gain a deeper understanding of the topic.

In the subsequent chapter, we will present the findings of our research. We have used thematic data analysis to organise our interviews and identify primary themes and sub-themes, drawing upon the theoretical framework and literature research presented in the previous chapter. We will provide detailed explanations and quotes to support our findings. The first part of our research will provide an overview of today's business landscape to get a better understanding of the current perspective on our subjects. The subsequent section will examine blockchains' role in advancing CE in procurement and the conditions necessary for its successful implementation. Finally, we will analyse the challenges and opportunities that may impede its adoption. To ensure confidentiality, we have assigned identifying codes to the participants in our study. These codes will be used to protect their anonymity throughout the research. These IDs identify procurement (P), blockchain(B), circular economy (CE), and blockchain in SCM (BS) experts. In addition, it is important to note that these interviews were conducted in Norwegian. As a result, there may be minor variations in context or meaning when translating the responses into English.

4.1 Today's Landscape: Current Perspectives on Procurement, Blockchain, & the Circular Economy

In order to be able to answer our research question, it is important to get an overview of current trends, opportunities, and challenges in procurement, blockchain and the CE. The section begins by exploring the landscape of procurement in the digital age, as observed, and analysed through the perspectives of the interviewed experts. Their insights shed light on the current challenges and opportunities that arise in this rapidly evolving digital environment. The expert opinions provide a

comprehensive understanding of the trends, technological advancements, and emerging practices that impact procurement processes. Furthermore, general opinions on blockchain were addressed, discussing its relevance, difficulties, and potential for reshaping conventional procedures. The general viewpoint on CE is presented in the last section, to examine the transformative potential and complexities of the CE, as well as the emergence and implications of the concept. These issues are complex and diverse, resonating throughout a wide range of industries. We aim to provide a comprehensive understanding of these topics and their future impact, as perceived by the experts who were interviewed.

4.1.1 Perspectives on Procurement

Our findings show that there is a mutual agreement among the interviewees on what procurement has evolved into. The recognition of procurement's current position as a business function in a more historical context confirms that it has evolved into something more than simply a cost-cutting function. When asked about how procurement has evolved through time, and how it differs from previous practice, one of the experts stated:

> *"What was once considered primarily transactional now plays a strategic role within organisations. Today, it has far-reaching effects on essentially all aspects of a business." -P2*

When discussing the current procurement practices, most of the interviewees agreed that it moves in accordance with the business environment that it operates in. "*The economic situation has a huge impact on what must be prioritised (...) This creates a more contextual approach".* -P3. An intriguing point relating to this topic was that the experts were using examples of a variety of business environments, each of which had their own distinct take on what the trends were. "*Retail and construction are two industries where cost-cutting measures have been particularly concentrated*." - P4. While cost-cutting was mentioned as the common practice in certain industries, another expert mentioned:

> "*The energy sector has been very profitable and has been needing more people. This has resulted in some companies tripling their procurement team and an increased focus on sustainability ." -P1.*

The disparity in procurement patterns between industries demonstrates the adaptability of the procurement teams to their respective business environments and limitations. As the experts have experience from different industries, the examples given give insight on different procurement methods and the importance of context. As a result, a variety of approaches are being emphasised. This leads to P1's insightful assessment that the procurement environment is "small and polarised." This is most likely due to the industry-specific expertise of procurement methods, as well as how procurement is adjusted to handle unique difficulties and possibilities. However, as one of the experts mentions, the polarisation creates a sense of excitement in the procurement landscape by offering fresh viewpoints, challenges, and innovations, transforming it into a dynamic and ever-changing area. As a result, industry-specific and larger cross-sectoral innovations continue to affect the future of procurement. The contrasting practices highlight the ability to adapt procurement teams according to their distinct business environments, constraints, and industry-specific requirements. However, despite this diversity, a consistent theme emerges regardless of the evolving role of procurement there is still focus on cost reduction

> "*While it is true that in modern procurement, it is crucial to take into account rising trends such as sustainability… However, procurement's primary purpose still lies in achieving cost reductions and efficiency." -P6*

The findings suggest that procurement teams across industries are juggling two competing priorities: they are aware of and adjusting to developments inside their own sectors, while also remaining committed to their traditional function of reducing costs. Despite an increasingly complex and swiftly changing business landscape, the experts highlighted the critical role procurement plays in preserving and enhancing a company's efficiency. The increased degree of complexity was also viewed as one of the greatest obstacles in procurement when discussing challenges. Rapid technological advancement, evolving legal frameworks, and change in consumer needs were most commonly mentioned as contributors to the complexity. While the level of complexity in the current business environment was seen as a challenge, it was additionally pointed out as an opportunity:

> "*I think it is important to not look at it as just a challenge, but also a great opportunity. Procurement teams have a greater chance than ever to prove their worth.". -P4*

As both P1 and P5 highlight, procurement is changing its outlook for the future, anticipating a large transition from its current roles and responsibilities to a more strategic one. Digitalization and sustainability were both mentioned as the future of procurement, in accordance with discussing the most prominent trends. Widespread adoption of digital technologies such as AI, ML, and data analytics is anticipated to have a significant impact on procurement. This can be summed up by the following statement:

> "*We anticipate that digital technologies like Artificial Intelligence and Blockchain will play a revolutionary role. Predictive and strategic decision-making, increased efficiency, and more innovation are just some of the benefits that will come from it". -BS1*

The interviews revealed that sustainability is expected to play a major role in procurement strategies in the future. There was an agreement that new regulations are pushing businesses to adopt more sustainable and ethical procurement practices. On the other hand, it was also underlined that increased expectations from customers and other stakeholders are a driving force in this transformation. When questioned about the role of procurement in a sustainability sense, one of the experts stated:

> "*To me, it's clear that procurement can lead the charge to make the organisation more sustainable. There is a clear indication that we need to play a more central role in the organisation, and not simply in terms of reducing cost. We are certain that procurement will play a pivotal role in guiding the company's sustainability activities." - P2*

4.1.2 Perspectives on Blockchain Technology

The viewpoints expressed by the interviewees indicate their belief in the substantial impact of BCT across various domains and industries. Additionally, the consensus among the experts highlights a prevailing sentiment characterised by uncertainty and confusion surrounding the implementation and potential of BCT. This recognition underscores the necessity for heightened awareness, education, and clarification to address the existing gaps in understanding BCT. In particular, P1 provides an insightful perspective as follows:

> *"If you were to ask the CEO´s of the 100 biggest companies in the world about blockchain, there would only be a handful of them that fully understands it." -P1*

This observation indicates a relatively limited understanding of blockchain among top executives, implying that blockchain remains relatively unfamiliar at the executive level, and only a select few individuals possess an encompassing understanding of its intricacies and potential applications. Furthermore, P1 continues to express his perspective by the following statement:

> *"I only know of one company in Norway that has fully integrated the technology in its operations" -P1*

This statement highlights the limited extent of blockchain integration within organisations, emphasising that widespread adoption and integration are still in nascent stages. The interviews reveal a consensus among the interviewees regarding the potential transformative impact of BCT. However, there is a prevailing sentiment of uncertainty and limited understanding of blockchain among CEOs of major companies. Additionally, the integration of BCT into operational processes remains relatively uncommon. These insights underscore the ongoing need for education, awareness, and exploration to further comprehend and unlock the full potential of BCT.

The experts engaged in discussions regarding the fundamental characteristics of BCT that they deemed crucial. Among these aspects, immutability emerged as particularly intriguing, as highlighted by multiple experts. The inherent immutability of blockchain instils a higher level of trust in the recorded data, fostering accountability among all participants involved in transactions. This aspect

promotes transparency and contributes to the establishment of trust among the actors as stated by BS1:

> *When creating a product, you get it stamped and tokenized on the blockchain before sending it off to the next part in the supply chain. Now, when we're talking about environmentally friendly supply chains, it becomes crucial for every party involved to show that they've received the information and acted upon it. The thing about blockchain is that it's immutable, so the actions remain tamper-proof and trustworthy" - BS1*

Decentralisation, identified as the second crucial aspect, enables data visibility for all, as each participant possesses a copy of the complete transaction history. Decentralisation is initially recognized as a crucial component by B1, who states that by reducing monopolies and promoting equal access, decentralisation contributes to the fairness, sustainability, and quality of processes within SC operations. B3 emphasises decentralisation by understating the importance of the shared ledger:

> *"With blockchain's decentralised nature, everyone gets a copy of the data, which means everyone can see and verify transactions. It's like a shared ledger where everyone has a say. Think of it as a supply chain where farmers, manufacturers, and consumers collaborate and have visibility into each step, ensuring fair and responsible practices."-B3*

Another noteworthy feature emphasised by one expert is the capacity of BCT to facilitate real-time data sharing, especially relevant in international commerce where document exchange is prevalent. Rather than simply exchanging data, blockchain enables immediate data sharing, ensuring precise tracking of document transfers, such as ownership transfer of goods or services. B2 emphasises this by the following statement:

> *"Blockchain technology enables seamless real-time data sharing. Imagine a global trade scenario where shipping documents, customs clearances, and payment confirmations are instantly shared among parties. This streamlines transactions, making them more efficient and reducing unnecessary*

administrative burdens which leads to efficient capacity planning and cost-effective transportation"- B2

The expert highlights the transformative potential of BCT in enabling seamless real-time data sharing. By instantly sharing shipping documents, customs clearances, and payment confirmations, blockchain streamlines international transactions, leading to efficient capacity planning and cost-effective transportation. The secure and decentralised nature of blockchain ensures data integrity and fosters trust among trade participants, paving the way for more efficient and reliable global trade processes.

While blockchain has shown promise in the acquisition of goods in shipping, B1 noted that its implementation is still in the early stages, stating, *"It has been used in the acquisition of goods in shipping but is still in very early development."* BCT has the potential to improve traceability, streamline logistics procedures, and reduce fraud. However, challenges related to mass adoption and integration into existing systems need to be addressed for its full utilisation in the shipping industry.

4.1.3 Perspectives on the Circular Economy

Over the past decade, the idea of a CE has developed significantly, with interviewees finally agreeing on a definition that encompasses the ideas of designing out waste and pollution, prolonging the use of products and resources. According to the interviewees, the concept of moving from linear business models appears to hold interesting potential to promote long-term economic growth while tackling critical environmental issues. Its promising potential can be highlighted by CE2´s statement:

> *"It bears a huge amount of promise in this regard. We have seen a substantial growth in companies' willingness to dive into circular practices. We are entering in a new age of sustainable economic development, which takes care of the planet's resources while simultaneously allowing businesses to succeed. Just consider the potential effects of this opportunity." - CE2*

Yet, certain experts are more sceptical of the concept than others. Given the extensively established systems and mentalities that sustain the current linear

model, the experts question the viability of a total transition to a CE. It is believed that one of the most significant challenges lies in the conflict that arises between the need for businesses to increase their revenue and profits and the CE's focus on the preservation of resources and the reduction of waste. This goes against the CE's principles, which advocate for a reduction in consumption, reuse of materials, and conservation of resources. The task of finding a balance among these competing goals is demanding, as highlighted by P4.

> "*Profit and growth are the primary goals of most businesses, and the sale of more items inevitably increases resource consumption. However, the circular economy places greater importance on minimising consumption and reusing materials. I think that this is one of the most significant challenges for the Circular Economy." -P4*

In light of the views obtained from the experts, it is evident that adopting a CE is not an easy task. It requires a fundamental reconsideration of economic systems, social norms, and established behaviours. The experts contended that even with the best intentions, the transition to a CE confronts several challenges. Technological constraints, legal obstacles, and a lack of public knowledge each contribute to the transition's difficulty.

> *We have gotten trapped in this idea of use and throw away. In a Circular Economy we require technology that is capable of keeping pace with our aspirations. Also, let's not overlook the fact that it's essential to work on the legal front, because this is also an important area. Another concern is that those who are entering the Circular Economy may need an initial investment that is quite costly, particularly for the smaller companies. - CE1*

Expert P3 offers a helpful point of view on the potential economic benefits that may be obtained from transitioning to a CE as we get deeper into the intricate process of moving toward a CE. In light of this idea, it is important to investigate the economic benefits that are promised by the concept of the CE. These advantages are sometimes ignored in conversations that are largely focused on the positive effects that it has on the environment.

> *"I think it's important when companies are considering circular initiatives that they also look at the potential financial gains. If you can be more*

resource efficient, it can result in a reduction in operational costs. It's very important to not look at the environmental aspect, but also the economy."- P3

4.2 Blockchain´s Impact on Circular Procurement

To examine the impact of blockchain on CP, it is essential to understand the current trends, challenges, and opportunities in both BCT and CP practices. This section delves into the transformative potential of blockchain in reshaping conventional procurement procedures, and also within the CE. By analysing the perspectives of experts and their insights on the subject, we aim to provide a comprehensive understanding of how blockchain can enhance CP practices and contribute to sustainable and efficient SCs.

4.2.1 Transparency

In the context of procurement within complex SCs, B2 highlights the potential of blockchain´s transparent nature , stating, *"It has a huge potential in purchasing with more complex supply chains. Almost everyone still sits on their own data."* Information silos and a lack of transparency hinder coordination and operational efficiency in complex SCs. However, as B2 points out, the shared ledger of a blockchain can provide all parties with a uniform view of data, promoting improved collaboration, reducing duplication, and enhancing overall SC effectiveness. Moreover, the capacity of blockchain to provide more precise and granular information was emphasised by B1 who stated, *"Blockchain can give more information on a micro level, giving it a more precise approach than what is used now."* Traditional systems can struggle with data openness and granularity concerns, making it challenging to gain insights or address specific problems. With its transparency and decentralisation, blockchain allows for the recording of granular data, offering a more detailed understanding of processes, transactions, and SC activities. This may lead to improved decision-making, optimised resource allocation, and enhanced quality control efforts. The shared ledger of the blockchain, which allows for a uniform view of all data, has the chance to improve procurement efficiency by getting rid of duplication and speeding up transactions.

Transparency is consistently recognized as a crucial element facilitated by BCT in the context of circular economies within SCs, as emphasised by all the respondents. According to CE2, the extent to which sustainability is enhanced through greater transparency depends on the specific use case or industry, as the effectiveness of transparency relies on the availability of contributions from all actors within SC networks:

> *"Once we achieve transparency in the supply chain, everyone can witness and even contribute to actions related to energy conservation, recycling, waste management, and more. It's not just a matter of companies reporting what they're doing in isolation, it's all interconnected and accessible for others to observe and engage with."-CE2*

The centrality of transparency in BC technology is underscored by B3, who highlights its potential as one of the most significant advantages for addressing environmental concerns within SCs. However, it is important to acknowledge that transparency can also present challenges if not appropriately managed. For instance, the unrestricted sharing of confidential information among network members can hinder collaboration and pose operational difficulties for businesses. Both the positive and negative aspects of transparency are acknowledged by B1, who recognizes its dual nature. Similarly, CE2 identifies transparency as a complex issue that holds the promise of increasing consumer awareness regarding environmental matters while simultaneously introducing risks associated with the disclosure of classified corporate tactics, potentially leading to the exclusion of enterprises from competitive markets. When it comes to tracking carbon emissions, blockchain was described as a powerful tool. According to an expert,

> *"Using blockchain can be used to track carbon emissions more effectively, where every supply chain is seen as emissions. This can be used to find out where emissions are coming from." -P1*

This highlights the potential of blockchain in developing a transparent and traceable system for monitoring emissions. Storing emissions data on the blockchain at each stage of the SC allows stakeholders to accurately identify and manage environmental consequences. Overall, the consensus among the respondents highlights transparency as a fundamental component brought forth by BCT in the

realm of CP. While transparency offers valuable benefits, its proper management is crucial to mitigate potential drawbacks and ensure optimal outcomes for sustainability and market competition. This highlights the significance of achieving transparency in the SC and how it can be enhanced through the use of BCT. By leveraging blockchain, all stakeholders witness and actively participate in actions related to energy conservation, recycling, waste management, and other sustainability efforts.

4.2.2 Decentralisation

P5 emphasises the potential benefits of a decentralised SC solution that enables seamless connections between suppliers and consumers, ultimately leading to an expanded range of factors influencing supplier rankings. In such a scenario, factors beyond the product's price, such as environmental friendliness, could be given greater consideration.

> *"If we had a decentralised supply chain solution where suppliers could easily connect and consumers could see and purchase from them, we could rank suppliers based on factors beyond just the product's price. In this case, considerations like environmental friendliness could carry more weight. Decentralisation plays a key role in combating greenwashing practices and has the potential to enhance sourcing efficiency."-P5*

The introduction of decentralised systems in SCs can serve as a powerful tool in combating greenwashing practices. Greenwashing refers to the deceptive marketing or communication of a product or company as environmentally friendly, when in reality, it may not be. By enabling transparency and traceability through decentralisation, stakeholders gain increased visibility into the environmental practices of suppliers. This promotes accountability and helps ensure that sustainability claims are supported by verifiable evidence. According to the experts, decentralisation has the potential to enhance sourcing efficiency. It decreases the complexities connected with traditional SCs by speeding up the process of interconnecting suppliers and buyers. This streamlined approach can result in more effective procurement, thereby reducing delays and enhancing the overall performance of the SC.

Overall, the adoption of a decentralised SC solution has the potential to revolutionise supplier rankings, shifting the focus beyond price considerations and towards factors like environmental friendliness. It also acts as a powerful tool in addressing greenwashing practices and improving sourcing efficiency, ultimately driving positive environmental impacts and operational improvements within the SC.

4.2.3 Smart Contracts & Information Sharing

Large and intricate contracts may not be understandable. As P1 emphasised, “Huge and complex contracts can be unclear. That is where blockchain comes in.”. BCT offers a decentralised and transparent solution that can make contracts more clear and less ambiguous. By documenting contract terms in a tamper-proof and transparent manner, blockchain can enable all parties involved to have a shared understanding. This enhances comprehension and minimises disputes, according to P1. In addition, B3 highlighted the potential of blockchain to provide a much better overview, stating, “Blockchain can give a much better overview. The challenge today is that everyone is hoarding their own data”. This underscores the current issue of data silos and fragmentation, which can hinder effective cooperation and analysis. Through its decentralised nature, blockchain can enable data sharing and synchronisation among multiple parties, resulting in a transparent and uniform view of information. As several experts highlight, it can be used to get further insights when evaluating suppliers. As B2 highlights, this may lead to better decision-making, increased effectiveness, and greater stakeholder trust.

Smart contracts were also mentioned as an efficiency measure for the procurement process. As highlighted by B3: “By using smart contracts, it can automatically complete certain steps by the conditions set at the start”. This can eliminate the need for time-consuming manual verification and auditing procedures, streamlining workflows, and boosting productivity. According to P1, smart contracts' automation capabilities can potentially bring positive environmental impacts by reducing labour requirements and potentially expediting the movement of goods. This may lead to more efficient labour utilisation. While B2 expects a relatively lesser impact from smart executions compared to other features mentioned earlier, it acknowledges that speed-related issues may still indirectly affect the environment.

"I don't think smart contracts will have the biggest impact compared to other features we discussed. But speed-related issues might indirectly affect the environment." -B2

CE2 anticipates some degree of influence through the adoption of automation promised by smart contracts but stresses the importance of new models of corporate transformation that necessitate aligned process management. This is emphasised by the following statement:

"Smart contracts and their automation skills can actually have a positive impact on the environment. They can reduce the need for labour and speed up the movement of goods. That means we can use our workforce more efficiently and burn less fuel along the way."- CE2

B3 highlights how BCT can support expanding market access, which may be related to the development of incentives for environmentally friendly applications due to increased network responsibility. In contrast to the focus of B3, BS1 draws attention to the potential of BCT to prevent greenwashing through increased transparency in SCs. This may be because businesses are inspired to adopt sustainable practices when their actions are made public. BS1 also highlights the growing importance of consumer choices in judging sustainability and how corporations contribute to a more CE, emphasising the need for businesses to make a more rigorous and open commitment to circular practices. From a logistical perspective, CE2 emphasises the importance of delivery schedules and circumstances in recycling and waste management, emphasising the need to prioritise load sizes and capacity utilisation to reduce transportation costs.

In turn, B2 assesses the potential of BCT in environmentally sustainable use cases, focusing on the current lead times for raw material movement between networks. This highlights the expanding opportunities offered by BCT to improve SCM of raw materials acquisition. Both B1 and B2 conclude that BCT has significant advantages for CE in SCs, with potential positive effects on both economic and social aspects. Furthermore, its suggested that social impact may increase significantly over time with the development of public BCTs through SC networks.

4.2.4 Immutability, Security & Tokens

The advantages of BCT for workload elimination and security were also discussed with several experts, and can be highlighted by P3 who stated, *"Because of security, it is possible to eliminate workload. As the sequence of events cannot be altered."* Blockchain's immutability and cryptographic security may ensure that data stored on the blockchain cannot be altered or tampered with. This was also underlined by P2, when talking about the immutability nature of blockchain and how it can impact the procurement process:

> *"By using blockchain, you can be certain that the inventory levels that you are seeing are the actual quantity."-P2*

The benefits of efficiency associated with BCT were acknowledged. As B2 pointed out, *"One of the most significant advantages with Blockchain is efficiency. However, it is not necessarily that only blockchain can be used.* «Blockchain's decentralised and transparent nature can streamline workflows and reduce inefficiencies. However, as B3 highlights, it is essential to thoroughly assess individual needs and weigh the advantages and disadvantages of potential alternatives in terms of technology and strategy. While many of blockchain's characteristics and features, including decentralisation, transparency, and immutability, are mentioned when discussing either procurement or CP, one characteristic may stand out more when discussing the latter. These are the blockchain tokens. As highlighted by P6:

> *The ability of blockchain tokens is to incentivize wanted behaviour. Tokens can be created to incentivize companies or individuals to engage in sustainable practices. - P6*

P6 further explains in detail how these tokens work. These tokens might possess financial worth or be redeemed for benefits such as savings on future orders. While none of the interviewed experts has any prior experience with this instance when discussing utilising these tokens for sustainable practices, B1 mentioned that these tokens has been used to create mini-insurances in the aviation industry.

In summary, these quotes emphasise the potential advantages of BCT, including improved contract clarity, better data sharing and overview, increased security,

precise information granularity, simplified purchasing procedures, and improved SC efficiency. While BCT holds tremendous potential, further advancements, fusion, and cooperation are required to fully realise its capabilities across various industries and overcome challenges related to adoption and implementation.

4.3 The Challenges of Blockchain Implementation in Procurement

To comprehensively address the challenges of implementing BCT in procurement, it is crucial to explore both financial, technological, and operational concerns, as well as privacy, legal, and regulatory concerns. By examining these areas, we aim to gain a holistic understanding of the obstacles that organisations face when adopting blockchain-based solutions. Financial, technological, and operational concerns encompass the initial investment required, scalability limitations, and the integration of blockchain into existing systems. Privacy, legal, and regulatory concerns, on the other hand, focus on issues such as data privacy, transaction visibility, and compliance with relevant regulations. By delving into these challenges, we aim to provide insights into the process of implementing blockchain in procurement and offer guidance on navigating these complex landscapes.

4.3.1 Financial, Technological & Operational concerns

When considering the barriers and challenges of implementing BCT, it is essential to take a holistic view. One significant aspect to consider is the initial investment required. While several experts noted the costs of implementing BCT as a challenge, BS1 gives a more nuanced view :

> *"Implementing blockchain technology in supply chains does require some initial investment, but it's all about seeing the bigger picture. This includes setting up the technology infrastructure and integrating into existing data systems. However, I think it should be viewed as a long-term investment with the potential to revolutionise supply chain operations, leading to cost savings and operational improvements." -BS1*

BS1 underscores the significance of allocating resources towards the implementation of BCT in SCs. It acknowledges the initial investment required to

establish the necessary technological infrastructure. As BS1 states, this investment should be viewed as a strategic long-term commitment that has the potential to bring about transformative changes in SC operations. As we explore deeper into the obstacles that stand in the way of its broad implementation, it is clear that many companies are still reluctant to implement the technology. This is despite the fact that blockchain offers several advantages. While P5 asserts that blockchain will undoubtedly be central in the future, the interviewee states:

> *"I still think that a good number of businesses are still hesitant to implement this. This is because there is a high level of uncertainty, in addition to the associated high costs of investment."-P5*

While widespread implementation is still in its nascent stages, B2 emphasises the dual nature of BCT, showcasing its inherent immaturity as both a hindrance and a catalyst for development. While the scalability limitations of current blockchain networks have impeded their widespread adoption, such as global SCs, it is important to recognize the ongoing efforts to overcome these obstacles.

> *"Blockchain's immaturity brings both challenges and opportunities. The current limitations of blockchain restrict the use in situations with high volume. However, there are ongoing efforts to overcome these limitations through projects" -B2*

4.3.1 Privacy, Legal and Regulatory concerns

Transparency is a critical factor to weigh when deciding between public and private Blockchains. It is acknowledged that transparency plays a pivotal role in SCs. However, B2 underscores a notable challenge associated with public blockchains, namely the issue of privacy. Public blockchains, characterised by their inherent transparency, present concerns regarding the confidentiality of sensitive information. This concern holds particular relevance within SCs, where organisations handle proprietary data, including pricing details, contractual agreements, and customer-related information. The unrestricted accessibility and lack of centralised control inherent in public blockchains pose challenges in safeguarding data privacy and regulating access to sensitive information.

Public Blockchains face additional hurdles, such as transaction visibility and control. As expressed by B1 who states that "*all transactions will be visible, and it is difficult to control who does what."* This emphasises a notable limitation of public blockchains, namely the difficulty in controlling user actions and the visibility of all transactions. In SC contexts where transactional confidentiality is vital, the transparency inherent in public blockchains poses challenges. The open nature of public blockchains makes it challenging to regulate and monitor participant activities effectively. When considering the implementation of BCT, it is crucial to recognize the significance of legal requirements. As stated by B3

> *"Legal requirements is important to consider when implementing blockchain technology in supply chains. Organisations need to comply with various regulations, including data privacy, intellectual property, and cross-border transaction laws" -B3*

This highlights the importance of considering legal obligations when adopting BCT. It emphasises the need for companies to adhere to relevant legal frameworks to safeguard sensitive information and ensure compliance with data protection and privacy laws. This aligns with the privacy concern mentioned in the previous quote, as privacy regulations are often a key legal requirement. Understanding the contextual factors that influence technology adoption is just as important as being aware of the legal requirements, or how these even correlates. This can be underlined by a statement by P1, who states: "For implementing a technology, there is often a legal background". Regulations have been mentioned by the experts as a possible enabler and challenge for both blockchain implementation and CP initiatives.

4.4 Summary

This chapter presents the key findings of our qualitative study, focusing on procurement, BCT, and the CE. The study reveals a noteworthy shift in the role of procurement within organisations, transitioning from a cost-cutting function to a strategic one. This evolution is attributed to several factors, including regulatory changes, heightened expectations from customers and stakeholders, and the continued emphasis on cost reduction across industries.

The findings also highlight the potential transformative impact of BCT. The study identifies the fundamental characteristics of blockchain, such as immutability, decentralisation, and real-time data sharing, as crucial aspects that require attention. BCT facilitates the creation of a reliable and auditable purchase record, thereby mitigating the risks associated with fraud and manipulation. Its decentralised nature, achieved through distributed nodes, ensures that data control is not concentrated in a single entity. This decentralisation enhances security, minimises the chances of data leaks, and enables secure and transparent interactions between buyers and suppliers, streamlining procedures and reducing costs by eliminating intermediaries. Furthermore, BCT can enable rapid and efficient data sharing within procurement networks. Participants can access and update shared data in real time, resulting in enhanced openness, accuracy, and synchronisation of information. This capability significantly improves SC visibility, thereby optimising inventory management, enabling more precise demand forecasting, and fostering effective collaboration among stakeholders.

Our research findings reveal a notable lack of knowledge and uncertainty among CEOs of prominent companies regarding the disruptive potential of BCT. This underscores the importance of educational initiatives and raising awareness regarding the potential applications and benefits of blockchain. Furthermore, the findings underscore the consensus among experts regarding the significant potential of the CE in fostering long-term economic growth and environmental sustainability. Experts identify the CE as a viable solution to address urgent environmental challenges such as resource depletion, pollution, and waste generation. Through the implementation of circular practices, businesses can optimise resource utilisation, minimise waste generation, and reduce their overall environmental impact. Furthermore, the CE is seen as a catalyst for innovation,

offering new business opportunities and contributing to economic growth while simultaneously preserving ecosystems and safeguarding natural resources. However, it is important to acknowledge the existence of scepticism among experts regarding the feasibility of a complete transition to a CE.

Addressing these conflicting objectives and attaining widespread adoption of the CE requires a comprehensive approach. This entails the development of economic incentives and regulatory frameworks that encourage circular practices, fostering collaboration among diverse stakeholders, and raising awareness among consumers about the benefits of sustainable consumption. Additionally, advancements in technologies and the exploration of innovative business models that support circularity can help overcome some of the challenges associated with the transition. Despite the presence of scepticism, the study underscores the importance of ongoing dialogues and concerted efforts to overcome these barriers and fully unlock the potential of the CE. By striking a balance between economic growth and environmental sustainability, the CE offers a promising pathway towards a more sustainable and resilient future.

5.0 DISCUSSION

This section provides a comprehensive discussion of the study's findings, focusing on the intersection of procurement, BCT, and the CE. We have decided to focus on the most pertinent and intriguing findings that might potentially answer our research question; *How can blockchain technology enable circular procurement?* It begins by highlighting the evolution of procurement from a transactional activity to a strategic function. The CE is examined regarding its opportunities and challenges. The potential of BCT in enhancing the procurement process is then explored. Then, the current perspectives on BCT, emphasising its decentralisation, immutability, and transparency as key features. Furthermore, the potential benefits of incorporating BCT in procurement processes and its contribution to CP are examined. Finally, the potential challenges and limitations of BCT are also addressed. Overall, this discussion sheds light on the evolving nature of procurement, the potential of BCT, and the complexities and opportunities of the CE, and forms the basis for answering our two research questions.

5.1 Revisiting the General Perspectives

This section provides a discussion of the current state of procurement, blockchain, and the CE. Through the perspectives of interviewed experts, we explore the dynamic landscape of procurement in the digital age, uncovering emerging practices and technological advancements. We also discuss the relevance and transformative potential of blockchain, along with its associated difficulties. Lastly, we examine the complexities and transformative possibilities of the CE, as perceived by the experts. By synthesising these insights, we aim to offer a nuanced discussion that delves into the intricate dynamics, interdependencies, and potential synergies among procurement, blockchain, and the CE.

5.1.1 Investigating the Development of Procurement

The combined results of the literature study and the interviews provide light on the history and current state of procurement. Our findings clearly correlate with the literature, which describes the origins of procurement as a straightforward transactional activity that, over the course of time, has developed into an essential strategic component of businesses (Spina et al., 2013; Monczka et al., 2020). As an

expert noted, procurement now has far-reaching effects on essentially all aspects of a business (P2). The expert interviews performed for this study have demonstrated how adaptable procurement processes are to different corporate settings and restrictions. The examples from the retail, construction, and energy sectors emphasise how adaptive procurement is in the face of different business settings and constraints. These findings reaffirm previous academic research, augmenting our comprehension of procurement as an adaptable, industry-specific function. In this regard, our interviews mirrored previous academic findings about the retail- (Chopra, 2018) and the construction- (Ruparathna & Hewage, 2015) industry's purchasing strategy characteristics. As P1 mentioned, the disparity in practices may contribute to the observed small and polarised procurement environment, in which procurement teams develop specialised abilities and strategies to address industry-specific.challenges.and.opportunities.

Despite this, our findings show the ever-present relevance of cost reduction, which at its core can be seen as the purpose of procurement. Even in the face of advances that are particular to the business as well as bigger changes that affect several industries, the dedication of procurement to efficiency and cost reduction remains constant. Thus, despite the fact that procurement has become more strategic, cost remains the most significant factor in certain industries. According to conventional definitions of procurement (Monczka et al., 2010), this is consistent with such definitions. The increasing significance of sustainability in procurement is clear. This evolution is driven not only by regulatory pressure and consumer expectations, but also by the growing awareness of procurement's role in promoting sustainable business practices within organisations (P1). This can also be interpreted as being consistent with the growing strategic role that procurement plays in organisations already mentioned by Kraljic (1983), owing to the fact that environmentally responsible practices are a central focus of virtually every business strategy. This trend is highlighted by the emergence of CP strategies (Neessen et al., 2021; Zaidi et al., 2019; UNEP, 2021). However, incorporating sustainability into procurement practices can be a difficult endeavour that requires a comprehensive comprehension of the SC.

With the increasing complexity of the business environment, procurement encounters new challenges, such as rapid technological advancements, changing

legal frameworks, and fluctuating consumer demands. However, procurement experts viewed these complexities not only as obstacles, but also as opportunities to demonstrate their value and adaptability. According to P4, procurement teams have a greater opportunity than ever before to "prove their worth." The ability in question aligns with definitions of procurement as the administration of an organisation's external resources under favourable conditions (Van Weele, 2018). The importance to adapt and evolve procurement strategies in accordance with external changes reaffirms procurement's vital significance within organisations. The ever-changing landscape of procurement necessitates that professionals not only keep tabs on the latest developments but also modify their strategies to make the most of industry-specific opportunities and overcome pressing matters.

5.1.2 Exploring the Potential of Blockchain

When it comes to highlighting the revolutionary potential of BCT across a range of different industries, the expert interviews strongly agree with the literature review presented earlier. Both the experts interviewed, and the academic literature emphasise the significance of BCT's immutability, which assures that transactions and activities are tamper-proof and trustworthy.

However, it is noteworthy to observe how the particular fields in which BCT might make a difference varies between the two sources. This is something that should be taken into consideration. In the literature, examples of use cases are cited, such as Bitcoin for payments (Sharples & Domingue, 2016) and private online ledgers (Iansiti & Lakhani, 2017). However, in the expert interviews, the focus is on the use of BCT to improve efficiency and responsibility in SCs. The interviewed experts highlight a variety of benefits, including improved contract clarity, expanded data sharing and overview, increased security, precise information granularity, efficient carbon emission tracking, streamlined purchasing procedures, and enhanced SC efficiency (Chapter 4). According to the aforementioned research (Seebacher & Schuritz, 2017), these new understandings lend support to the potential benefits that BCT may offer.

Decentralisation

Seebacher & Schüritz (2017) highlights that decentralisation emerges as a fundamental characteristic of BCT, contributing to the increased dependability of recorded transactions. Decentralisation serves as a crucial facilitator in mitigating the risks associated with a single point of failure commonly encountered in procurement processes. The decentralisation of BCT as discussed by Hull et al. (2016), serves to create a private, reliable, and versatile environment. This privacy is supported by the technology's peer-to-peer foundation and its use of public-key cryptography to secure communications between users. This notion finds support in the highlighted perspective of B3 who recognizes decentralisation as a vital characteristic that ensures equitable access for all participants and facilitates collective control over the ledger. From a practical standpoint, B2 highlights the common requirement of transferring numerous documents among different organisations. In this context, BCT offers a distinct advantage by enabling real-time data sharing as opposed to traditional data exchange methods. According to the scholarly work of Guo & Liang (2016) a decentralised system is and its foundation on data and code enables the introduction of automated measures, thereby reducing the possibility of individual errors since manual intervention is less necessary. BS1 emphasises this by underscoring the value of automated measures and its immutable nature, resulting in tamper-proof and trustworthy actions. B3 underscores the critical role of decentralisation in fostering equal rights among transaction participants and minimising monopolistic tendencies. They further argue that decentralisation contributes to the fairness, sustainability, and quality of processes within supply chain operations and procurement processes.

Immutability and Transparency

Based on our interviews, the immutability of data, a defining characteristic of BCT, emerges as a critical component ensuring tamper-proof integrity. The database's immutable nature prevents changes to committed transactions once they are added to a block and subsequently placed on the blockchain, further enhancing confidence as emphasised by Cucurull & Puiggalí (2016). This aligns with the viewpoint of BS1, who highlights the significance of establishing the integrity and credibility of transactions in the blockchain system. BS1 further emphasised this by asserting that data recorded in the blockchain is permanently stored and highly resistant to tampering. The overall consensus from the literature and expert perspectives is that

data immutability plays a pivotal role in enhancing data integrity, security, and trust within the blockchain system. These qualities, combined with transparency and traceability, contribute to the reliability and robustness of the processed data.

A significant challenge encountered is the limited availability and reliability of easily accessible information resources. BCT is recognized for its ability to provide transparency, an essential quality for addressing this challenge (Khan et al., 2021). Several of our respondents identify transparency as a significant driver for the adoption of BCT in procurement (BS1, P1, CE2, B3). However, concerns persist regarding the transparency aspect, particularly in the case of public blockchains where privacy remains a major issue to be resolved (B2).

5.1.3 Examining the Circular Economy

The study provides intriguing insight into the complexities and opportunities associated with procurement's role in the transition to a CE as well as general insights. It reveals the intricate perspectives of experts, who express a combination of excitement and scepticism, and this aligns strongly with the current literature's debate. As stated by CE2, the most exciting thing about the CE is the possibility of achieving environmentally responsible economic development. This comprehensive growth focus is in line with the General Systems Theory and Industrial Ecology that provide the theoretical underpinnings of the CE (Geissdoerfer et al., 2017). It also confirms the ability of the idea as discussed in the literature to reshape the global economy such that it is sustainable (Merli et al., 2018).

Experts' scepticism is not uncommon and is also reflected in the literature. As presented in the findings, P4 raises questions about the potential for tension between conventional company goals (profit and expansion) and the resource- and waste-saving ideals of the CE. This is a common challenge already predicted by Stahel & Reday (1976) when they stated that a pivot from selling things to selling their use was necessary for a successful loop economy. However, both P4's worry and Stahel & Reday's proposed solution, highlight the challenge of merging the mentalities and practices of the current economic system with those of a CE. Conflicts and competing interests inherent in the pursuit of revenue and profits often clash with resource preservation and sustainable practices. Some businesses prioritise short-

term financial gains over long-term sustainability, leading to reluctance in fully embracing circular principles. Furthermore, consumer behaviour and societal expectations shape market demands, which may not always align with the principles and requirements of a CE (Ghisellini et al., 2016). Achieving a CE requires multifaceted changes, including strategic shifts within businesses, supportive policy frameworks, and the cultivation of sustainable consumption patterns among consumers. The problems further highlighted by CE1 are more systemic in nature. They stem from, among other things, technological limitations, legal hurdles, and a general lack of public awareness. Transitioning to a CE is seen as a multi-actor procedure with far-reaching implications on social, environmental, and economic elements of development, hence these ideas are popular in sustainability transition research (de Jesus et al., 2018)

P3 also reminds us that the CE can reduce operating costs through resource efficiency. The research suggests balancing environmental and economical components of the CE. Prieto-Sandoval et al. (2018) noted that sustainable innovation, supported by legislative frameworks, demand improvements, and supply activities, is needed to reap these advantages. It is important to stress how the study findings shed light on the continuing conversations that have been documented in the literature. Experts were interviewed, and their varying opinions reflect the many barriers to implementation of the CE model identified in the literature.

5.2 The Intersection of Blockchain and Procurement

The intersection of BCT and procurement has emerged as a compelling area with significant potential for transforming SCM. In this section, we discuss the findings that shed light on the benefits of incorporating BCT into procurement processes. The complex nature of procurement, combined with the evolving market dynamics, calls for innovative solutions to improve efficiency.

5.2.1 Blockchain and Procurement

According to our findings, the emergent intersection of BCT and procurement presents a compelling potential for SCM, legal compliance, and data sharing. The findings provide a comprehensive examination of the potential benefits of incorporating BCT into procurement processes. The intricate nature of

procurement, aggravated by the rapid changes of a competitive market, necessitates the development of creative solutions to improve efficiency (Ghobakhloo, 2020). According to the experts, BCT can offer such an approach, particularly in the era of digital transformation and Procurement 4.0.

One of the main advantages of Blockchain is its decentralised, transparent, and tamper-resistant nature (Seebacher & Schüritz, 2017). When applied to the setting of complicated contracts, BCT has the potential to play a significant role in improving clarity and comprehension among all of the parties involved (P1). The technology enables all parties to have a distinct, shared awareness of the contract terms, thereby enhancing knowledge and decreasing the likelihood of disputes. This is consistent with Nicoletti's (2017) argument that shared databases enabled by blockchains can provide benefits to all parties by facilitating a seamless and trustworthy process. Expert B2's remarks on the possible application of blockchain in complex SCs reflect Härer's (2018) remark about SC efficiency. Härer (2018) argued that a decentralised plan for the procurement process, facilitated by BCT for example, can increase transparency and efficiency, including for buyer-supplier without established relationships. This demonstrates the changing landscape of purchasing and supply management, where innovative technologies such as blockchain can not only enhance operational efficiency but also foster new ways of collaboration and developing trust. This corresponds precisely with the adapting of procurement practices to unique contexts, including the construction industry. Due to the project-based approach to the assignment, short-term relationships are typical in the sector (Ruparathna & Hewage, 2015). Blockchain, however, can play a revolutionary role in such situations, as it has the potential to provide a safe and reliable system that improves transparency and efficiency in these brief but significant partnerships. Blockchain's features has the potential to facilitate smoother interactions, more widespread cooperation, and faster financial dealings (P1,B2). This is a perfect example of how the intersection of technology and strategic development in procurement may revolutionise highly specialised sectors with demanding needs.

Decentralisation can create a private, trustworthy, and adaptable setting to facilitate transactions and contracts (Hull et al., 2016). This benefit correlates with the empirical findings of the research, highlighting the potential of blockchain to

provide better data sharing and overview (P1, B3), reduce workload due to enhanced security (P3), and to improve the representation of information precision (B1). These enhancements contribute to simplified workflows, decreased inefficiency, and improved quality control, thereby, it can transform the dynamics of procurement procedures. Since businesses might spend up to eighty percent of their overall spending on goods and services they must purchase (Bals et al., 2019), ensuring that the purchasing process is efficient is a significant priority. This is in line with our empirical results on the potential for BCT to improve these characteristics. By adopting BC, organisations stand to realise a multitude of benefits. Cost savings and operational improvements are key advantages that can be achieved through streamlined processes, reduced transactional expenses, heightened transparency, and enhanced overall performance (Dubois et al., 2021;Gadde & Snehota, 2019; Patrucco & Kähkönen, 2021). These improvements can result from the decentralised and immutable nature of BC, which enables secure and efficient tracking, verification, and sharing of information throughout the SC.

Trust is reliant upon the immutability and transparency of blockchain. According to the research findings, transparency can lead to improved decision-making and increased stakeholder trust. As P1 pointed out, the concept of trust and transparency is especially significant in the context of monitoring carbon emissions, where blockchain could provide a verifiable, tamper-proof record of emissions at every stage of the SC. The experts' perspectives on blockchain's capacity for highly accurate granular data management (B1) and carbon emissions monitoring (P1) align with the literature's projections of emergent use cases for blockchain outside of finance (Zheng et al., 2017). Keeping emissions records in a blockchain is consistent with the transparency and precision of the technology, showing how it may shed light on the far-reaching effects of human actions on the environment and lend a hand to greener practices.

5.2.2 Leveraging Blockchain for Enhancing Circular Procurement

SCs have a substantial impact on the CE through various activities, including recycling programs such as reverse logistics, reuse, remanufacture, and reclamation (Xu et al., 2022). The application of BCT can potentially contribute to more CSCs, contingent upon decision-makers adopting necessary precautions and modifying operational procedures accordingly. Our research findings reveal several

advantages associated with the implementation of BC technology in procurement. These benefits encompass expanded market access that can stimulate the adoption of environmentally friendly practices (B3), enhanced transparency and accountability as a preventive measure against greenwashing (P5), improved delivery timing and conditions leading to more efficient capacity planning and cost-effective transportation, incentivising circular practices and enhanced management of material procurement (B2). By comparing our findings with existing literature, it can be inferred that the utilisation of established BC solutions within SC networks holds significant potential for inducing a CE and CP initiatives. However, the adoption of CP practices goes beyond mere reaction to external pressures. It presents organisations with a strategic opportunity to align their values and goals with procurement decisions, integrating sustainability into their core business practices.

The shifting landscape of procurement practices highlights the growing importance of sustainability considerations alongside cost reduction objectives. Incorporating sustainability-focused strategies not only helps organisations achieve their environmental goals but also drives innovation and enhances competitiveness (Xu et al., 2022). By actively seeking suppliers with sustainable practices and products, organisations can tap into new markets, attract environmentally conscious consumers, and gain a competitive edge (Neessen et al., 2021). CP, in particular, offers long-term cost savings through resource optimization, waste reduction, and operational efficiency improvements. To effectively implement CP, organisations may need to develop new capabilities (Bag et al., 2020). These include conducting comprehensive sustainability assessments of suppliers, establishing precise sustainability criteria, and fostering collaborative relationships with suppliers to drive sustainable innovation throughout the SC. Choosing a supplier is now a significant choice for procurement practitioners, as it will affect the quality of the final product in light of growing concerns about environmental preservation. Pagell et al. (2010) argued that a supplier performance evaluation system is required for determining the end product's appropriateness and underlined that Kraljic's (1983) work can be used in this instance. Strategic items (Figure 3) would be the most pertinent in the context of CP, as the products or services that have a high profit effect as well as a high supply risk, frequently as a result of their rarity. However, modifications will be required because the matrix is 40 years old. A modified

sustainable buying portfolio model is presented by Pagell et al. (2010), and they argue that it should serve as a tactical tool to assist academics and practitioners in adjusting to the new realities of today's business environment.

According to BS1, the motivation of SC actors to produce environmentally friendly products or minimise environmental damage is heightened when they are aware of being monitored and when their audience is environmentally conscious. This viewpoint aligns with de Jesus et al. (2018) perspective on social and cultural barriers such as effective public policies, consumer awareness of environmental issues, and demand for environmentally friendly products, which plays a crucial role in driving the transition towards a CE. Furthermore, da Awaysheh & Klassen (2010) underscores the fact that transparency drives suppliers to embrace socially responsible practices, which in turn affects purchasing decisions and creates conditions in which rivals are compelled to follow suit. As a result, ensuring transparency throughout the entire SC, from raw material procurement to product delivery, becomes crucial. This can be achieved by storing information at each stage to enhance traceability and encourage the adoption of sustainable practices by producers.

P1 raises concerns regarding carbon emissions in shipping operations. By leveraging BCT and transportation manifests, it is possible to identify the most environmentally friendly shipping routes, thereby reducing traffic, carbon emissions, and waste generation. Khan et al (2021) support this perspective by highlighting how Blockchain can enhance SC accountability and traceability, ultimately improving environmental outcomes. Through the transparency and traceability offered by Blockchain, procurement can achieve greater sustainability and contribute to a greener future.

B3 emphasised that BCT can enhance SC transparency by providing accurate data and statistics, facilitating well-informed decision-making concerning sustainability and ecological issues. Through the implementation of Blockchain in SCM, the environmental impact of each step can be monitored and, if necessary, improved. Similarly, P1 asserts that Blockchain enables precise and standardised measurement of ecological impacts, empowering SC stakeholders to optimise routes and minimise emissions. This promotes environmentally responsible decision-making

and proactive behaviour. This is in line with Shojaei et al. (2020) who describes how Blockchain facilitates the monitoring of products throughout their entire life cycle, enabling the accurate assessment of their environmental impacts. Likewise, Mengelkamp et al. (2018) observe that Blockchain's traceability and transparency can verify the true sustainability of "green" products. Increased transparency and precise measurement of carbon dioxide emissions mitigate data manipulation and can contribute to emission reduction.

B3 highlights the role of Blockchain in mitigating misinformation. In the absence of Blockchain, businesses can conceal information about potentially harmful environmental activities. However, the adoption of Blockchain enables access to comprehensive and accurate information for all involved parties, facilitating close monitoring of SC stages and preventing data concealment. This is underscored by Cucurull & Puiggalí. (2016), who emphasise the significance of the database's immutable nature, which prevents changes to committed transactions which further enhances confidence that prevents data concealment. This can make it easier to monitor waste disposal, preventing misinformation, and manufacturer fraud.

In the context of procurement and the CE, the integration of smart contracts with the blockchain system offers several potential benefits. The use of smart contracts enables secure and automated execution of procurement transactions within the SC. Stark (2016) asserts that smart contracts can streamline processes, eliminate the need for centralised control or coordination by external authorities, and assure tamper-resistance. This is in line with CE2 who underscores that the utilisation of smart contracts presents a significant opportunity to mitigate labour requirements and expedite the flow of goods within procurement processes. The implementation of smart contracts can contribute to enhanced workforce efficiency and reduced fuel consumption during the transportation of goods. By automating and streamlining various aspects of the procurement cycle, smart contracts optimise operational efficiency and contribute to the overall sustainability of SCM.

The transparency provided by the blockchain system, coupled with the automation and security of smart contracts, can significantly enhance the efficiency and integrity of procurement processes. This transparency can help in building trust among stakeholders, fostering collaboration, and facilitating the adoption of CE

practices. Moreover, the integration of smart contracts and BCT can enable the implementation of CP strategies. By leveraging the immutability of blockchain records, procurement processes can be designed to prioritise the sourcing of materials and products with a high level of recyclability, reusability, and sustainability. Smart contracts can be programmed to enforce specific criteria or sustainability standards during the procurement process, ensuring compliance with CE principles.

Our results highlight the potential for blockchain tokens to reward environmentally conscious actions and progress the CE, a concept with numerous implications and challenges (Kirchherr et al., 2017). This is in line with Kalmykova's (2018) description of CE strategies, specifically a bottom-up initiative in which enterprises develop their own initiatives. Blockchain tokens may offer a unique way to encourage and hasten this transformation in this scenario. In the instance of incentivising suppliers or consumers to deliver products after they are done with them, it can be an example of utilising the CE concepts of reusing and recycling. Extending product life cycles, increasing customer demand for used items, offering take-back incentives, and using trash or by-products in corporate operations are all examples illustrated by Ghisellini et al. (2016). However, it is important to note that these initiatives are not exclusive to BCT tokens but can be facilitated by the tokens' unique properties within their own system.

However, the successful implementation of BCT and smart contracts in procurement within the CE context requires careful consideration and adaptation. Considering the potential of blockchain to enhance efficiency, security, and transparency in procurement processes, it becomes crucial for CEOs and organisational leaders to familiarise themselves with its fundamental characteristics and explore its contextual implications. Embracing blockchain's disruptive potential requires proactively addressing existing knowledge gaps and uncertainties surrounding the technology. This may involve allocating resources to training programs, collaborating with consultants or experts, and fostering knowledge-sharing platforms for peer learning. By taking these proactive measures, organisations can position themselves as frontrunners in innovation, gaining a competitive advantage in the evolving procurement market. The complexity of SC networks, diverse stakeholder interests, and the need for interoperability pose

challenges that must be addressed. Collaboration among industry participants, policymakers, and researchers is essential to develop standards, frameworks, and best practices that can facilitate the seamless integration of these technologies into procurement processes and support the transition towards a CE.

5.3 Exploring the Challenges of Blockchain-Based Circular Procurement

The integration of BCT in procurement and the CE presents both opportunities and challenges. In this section, we discuss the financial, technological, and operational aspects as well as the regulatory, legal, and privacy considerations associated with blockchain adoption.

5.3.1 Financial, Technological & Operational

The immaturity of Blockchain is reflected in several aspects, including scalability limitations, privacy concerns, and economic aspects. The immaturity of BCT can be seen as a transitional phase, where the technology is still evolving and refining its capabilities. This immaturity presents challenges, as organisations face constraints in terms of transaction processing speed and network scalability. High-volume transaction environments demand robust and efficient systems that can handle a large number of transactions within short timeframes. Existing blockchain networks have struggled to meet these demands, thus limiting their applicability in certain contexts (Yeoh, 2017). Furthermore, the immaturity of BCT encourages collaboration and knowledge-sharing among stakeholders. Researchers and industry players are actively working together to improve the scalability and performance of blockchain networks. This collective effort fosters innovation and drives the development of new approaches and solutions.

The integration of BCT in the CE has the potential to address a variety of issues, including those related to cost reduction, and increased productivity (Khan et al., 2021). This focus highlights the importance of understanding the financial implications associated with adopting BC, including the initial investment required for infrastructure setup, data system integration, and employee training. When considering the integration of BC into existing SC systems, practitioners face the challenge of assessing whether the technology can deliver substantial benefits while aligning with the overarching business objectives. B1, in particular, emphasises the

significance of allocating adequate resources towards the implementation of BC technology in SCs, underlining the potential transformative impact it can have on operational efficiency and effectiveness. On the other hand, it is essential to stress that the evaluation of circular efforts has a wider scope than only the financial benefits. As Mazet and Dontenwill (2012) argue, an organisation's CP initiatives is determined by each of the three elements of sustainability: environmental, social, and economic performance.

It is essential for decision-makers to recognize the broader implications and long-term advantages of embracing BC technology in SCM. While there may be initial investments involved, viewing them as catalysts for unlocking the full potential of BC can provide organisations with a competitive edge in an increasingly dynamic and digitally driven business landscape. Moreover, the potential to revolutionise SC operations through BC should be considered in the context of achieving strategic goals such as enhanced traceability, improved trust among stakeholders, and the ability to adapt to evolving market demands.

5.3.2 Regulatory, Legal & Privacy

Several respondents highlighted the importance of considering legal obligations when adopting BCT. Legal obligations are closely linked to concerns about privacy in BCT (Yeoh, 2017). The transparency of blockchain, especially in public networks, poses challenges in meeting privacy requirements and safeguarding sensitive data. In order to address these concerns, enterprises may explore alternative blockchain configurations, such as private or permissioned blockchains, which offer enhanced control over data privacy by limiting access to authorised participants. Determining the appropriate balance between transparency and privacy considerations in the context of blockchain implementation within SCs necessitates an evaluation of specific operational requirements, regulatory compliance obligations, and associated risk factors.

B1 emphasises the regulatory concerns in public blockchains and the difficulty in controlling user actions and the visibility of all transactions. This lack of control raises concerns about potential unauthorised modifications, fraudulent behaviour, or malicious actions within the blockchain network. The concerns raised in B1 aligns with the findings of Yeoh (2017) , who emphasises the importance of a smart

regulatory approach that supports the innovative contributions of blockchains. Both highlight the need to strike a balance between regulation and technological advancements in order to address potential risks and foster the potential benefits of BCT. To address these challenges, organisations may consider utilising private or permissioned blockchains, which provide greater control over transaction visibility and participant permissions. By adopting alternative blockchain configurations, SC stakeholders can strike a balance between transparency and confidentiality, enabling effective monitoring, regulatory compliance, and protection of sensitive information.

5.4 Overview of Blockchain Technology´s Impact on Circular Procurement

On the basis of our empirical findings and the existing literature, we present in Figure 8 a new theoretical model that has evolved from our thorough review. This model illustrates the demonstrated connection between BCT and CP, as mediated by numerous enablers, challenges and opportunities, and is an extension of the theoretical framework described in the preceding sections. The figure illustrates a comprehensive framework that encompasses opportunities, enablers, and challenges. Within this framework, BCT assumes the role of an independent variable, while CP serves as the dependent variable. The interplay between blockchain and CP is visually represented by blue lines, highlighting the intricate connections and linkages between the two. Conversely, the red line signifies the challenges encountered in the implementation of blockchain-based CP practices. By visually representing these elements, the figure provides a holistic understanding of the complex dynamics involved in leveraging blockchain for CP initiatives.

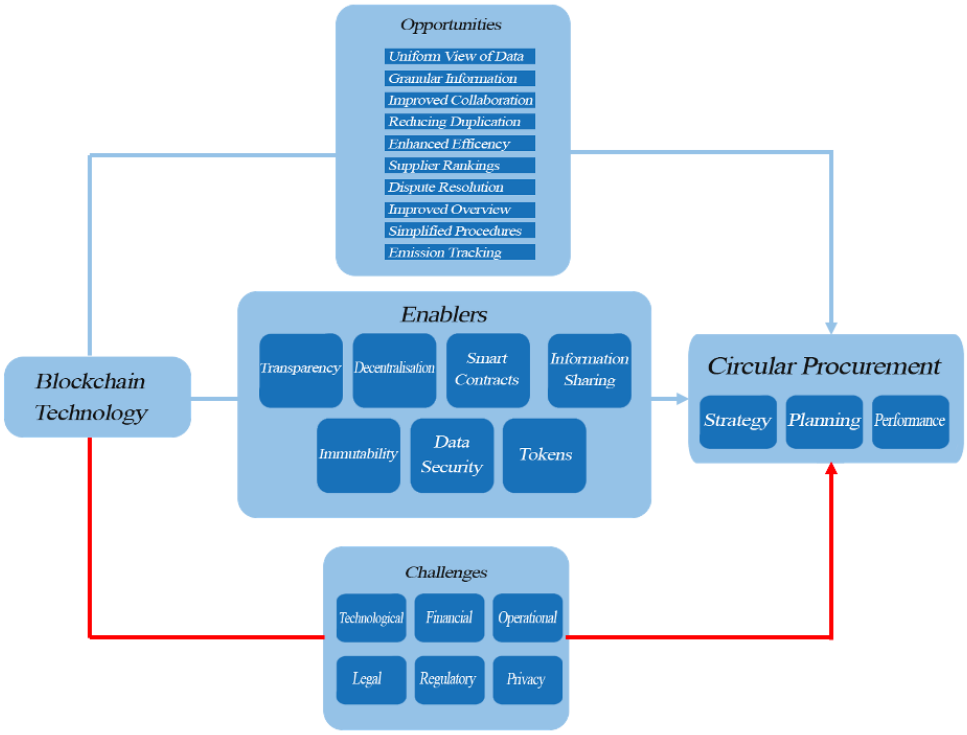

Figure 8: Background for Challenges, Enablers & Opportunities for Blockchain Technology to Enable Circular Procurement

Based on our research and in-depth analysis, our study investigates the potential of BCT to enable CP practices. We contend that BCT can play a pivotal role in facilitating the transition towards CP and through our research, we have identified several key mechanisms through which BCT can contribute to the realization of CP. Specifically, BCT offers the capability to enhance SC visibility, which is essential for integrating CE practices. By leveraging digital tokens and smart contracts, BCT can improve traceability and transparency, enabling more efficient tracking of materials, resources, and products throughout their lifecycle. Moreover, an example of our investigation of the enablers has revealed that blockchain-enabled smart contracts, incorporating incentive mechanisms, can provide a framework for promoting circular practices within procurement. However, it is crucial to acknowledge that certain challenges need to be addressed for successful adoption and implementation of BCT in CP. These include the establishment of clear economic incentives, supportive regulatory frameworks, and further empirical research on practical use cases. Our findings suggest that while BCT holds significant promise in enabling CP, further exploration and refinement of the technology are necessary to fully unlock its potential.

6.0 CONCLUSION

This chapter aims to provide a comprehensive summary and conclusion for our qualitative master's thesis, based on our research topic. Firstly, we will present the theoretical contribution of our findings. Subsequently, we will explore the practical implications. Finally, we will discuss the perceived limitations and suggest potential avenues for future research. The research question that guided our master's thesis is as follows: *How can blockchain technology enable circular procurement?* To further refine our investigation, we formulated a specific sub-question; *How can blockchain technology shape the future of procurement?* Considering the novelty of the phenomenon under study, we opted for a qualitative approach involving expert interviews. This method allowed us to gather valuable insights from twelve individuals representing five distinct consultancy companies, all of whom were somewhat involved with procurement, BCT, and/or CE, was selected. Their insights and expertise were crucial as their perspectives shed light on how BCT can enhance CP. Upon completion and analysis of the interviews, the collected data was carefully examined and compared with existing literature, forming the theoretical backdrop of our study. By integrating the information obtained from interviews with the theoretical foundations, we were able to develop a comprehensive understanding of the research issue.

6.1 Theoretical Contribution

Our research findings align with and support the limited existing literature on how BCT can enhance CP. However, our study goes beyond previous articles by providing a more comprehensive and extensive understanding of this relatively unexplored academic domain. To the best of our knowledge, our work is one the first to combine BCT, CE, and procurement, thereby addressing significant research gaps in the field. Our study confirms the findings of earlier research and does not contradict the limited literature available on BCT in procurement and its effect on the CE. However, our research goes further by offering a more detailed examination of this subject matter, presenting a more complete picture of the potential applications and implications of BCT in procurement.

Previous scholarly research and theoretical foundations emphasise the benefits of implementation of BCT in CE . However, our study has a particular emphasis, delving deeply into the domain of CP. The implementation of a decentralised plan for the purchase order process, facilitated by shared databases through blockchains, allows suppliers to participate using the data stored in the blockchain-secured process model, thereby offering benefits to organisations and suppliers in terms of enabling a dependable and seamless procurement processes (Nicoletti, 2017; Härer, 2018). This highlights the potential of blockchains to enhance transparency and efficiency in procurement processes.

Moreover, previous research has highlighted the significance of BCT as an immutable nature, which prevents changes to committed transactions once they are added to a block and subsequently placed on the blockchain, further enhances confidence ensuring the production of reliable transaction data for all participants within the network (Cucurull & Puiggalí, 2016). BCT can enable real-time transactions between different stakeholders that can be recorded and updated simultaneously (Iansiti & Lakhani, 2017). This can result in automated processes in procurement such as smart-contracts that could be programmed to incentivise CE practices in procurement by streamlining processes, eliminate the need for centralised control or coordination by external authorities, and assure tamper-resistance (Stark, 2016).

Furthermore, our empirical findings are aligned with previous literature which states that blockchain has emerged as a potential catalyst for the transition towards a CE (Adams et al., 2018; Khan et al., 2022). The integration of BCT in the CE has the potential to address a variety of issues, including those related to CP, recycling and remanufacturing, flexible production, resource conservation, carbon footprint reduction, cost reduction, and increased productivity (Böhmecke-Schwafert et al., 2022). Due to its open-source, peer-to-peer distributed ledger architecture and automation capabilities, blockchain has the potential to improve financial transactions and contribute to the restoration of balance and harmony between the economy, the environment, and society. Effectively, the development and varied application of BCT can help the CE agenda support the Green Economy agenda.

BCT plays a crucial role in aligning procurement with the principles of the CE, thereby promoting a CE (Ellen MacArthur Foundation, 2013). Through enabling

traceability and transparency, blockchain can significantly reduce the consumption of paper and other resources, facilitate the adoption of renewable energy sources, and effectively minimise waste within SCs. The immutable nature of blockchain transactions allows for the creation of cyclical processes in SCM, as records of resources, changes, and stakeholders are securely stored. Moreover, blockchain records serve as a valuable tool in monitoring and showcasing the environmental sustainability of manufactured goods (Upadhyay et al., 2021). Therefore, by fostering collaboration and knowledge exchange in the realm of BCT, we could potentially advance towards a CE.

In order to address our research questions, which focuses on the role of BCT in enhancing CP, we have summarised our key findings and contributions to the existing literature. Thus, we assert that by leveraging the inherent capabilities of BCT, it can be possible to closely examine every stage within the SC, commencing from procurement, extending through the entire process. The integration of BCT characteristics, such as transparency of information and other trust-building features, facilitates the monitoring of compliance with environmental standards within the context of a CE. This, in turn, incentivizes stakeholders to abstain from actions that contradict established CE-principles. In essence, the universal accessibility and accuracy of information pertaining to their activities prevents relevant actors from concealing issues that could potentially result in environmental harm during their operations, owing to the inherent features of blockchain. Consequently, the implementation of BCT can serve as a catalyst in mitigating inappropriate behaviours, including those involved in practices that contribute to heightened carbon dioxide emissions or the release of other environmental pollutants and waste. Building upon these findings, we propose the incorporation of smart contracts that integrate incentive systems compatible with BCT. These contracts can be utilised to incentivize companies to prioritise CE practices throughout the procurement process. Smart contracts, executed on the blockchain, automate, and enforce compliance with circular principles, ensuring that transactions occur only when specific requirements are met. By incentivizing the adoption of CE practices, smart contracts contribute to the establishment of CSCs, thereby advancing sustainable procurement.

6.2 Practical Implications

In the context of employing BCT to facilitate CP, our study provides valuable insights regarding practical considerations that stakeholders in the SC should acknowledge and incorporate. Based on our research findings and a comprehensive review of the literature, several obstacles need to be addressed. Our analysis reveals that the primary challenge hindering the application of BCT within procurement lies in its relative immaturity. The practical utilisation and implementation of this technology remain largely unexplored, however, in spite of the existing obstacles, numerous organisations are tempted by the prospect of leveraging BCT as a secure and reliable tool to enhance a CE, owing to its distinctive qualities elaborated upon in this study. However, for the practical implementation of BCT, effective communication to the target population is imperative in order to persuade their acceptance. Different industries demonstrate varying levels of maturity and willingness to adopt BCT. The construction industry, characterised by a notable resistance to change, is currently not fully prepared for the implementation of BCT due to its immaturity (Skjåvik & Kirsebom, 2021). Moreover, an adequate number of trained personnel is essential to accomplish the relevant tasks in this domain. Furthermore, governmental support through the enactment of requisite legislation is crucial to encourage the adoption of BCT and CE initiatives. It is important to note that meeting these requirements is crucial for the future progress of Blockchain within procurement. Without fulfilling them, the development of Blockchain would be significantly hindered.

Through our research, we have found an overall positive sentiment expressed by the interviewees regarding the impact of blockchain on the CE. The interviewees recognized and acknowledged the transformative potential of blockchain in the procurement process and expressed optimism about how blockchain's fundamental characteristics, including transparency, immutability, and decentralisation, can revolutionise current practices and drive more efficient and accountable CP initiatives. The positive responses from the interviews signify a growing consensus among key stakeholders that BCT has the capacity to play a crucial role in advancing CE practices. By leveraging blockchain, supply chain participants can gain enhanced visibility into the origin and history of materials, promoting transparency and trust throughout the procurement process. However, careful attention must be given to addressing the challenges that accompany its

implementation, ensuring that the benefits of blockchain can be effectively harnessed in the pursuit of a CE.

6.3 Research Limitations

The attainment of the ideal research is an unattainable objective. When conducting scientific research, three types of constraints must be carefully considered and documented: methodological limitations, theoretical limitations, and practical limitations.

The *methodological limitations* of our study were discussed in detail in Chapter 2.5, and this chapter serves to reiterate and underscore the most significant limitations. The relatively small sample size of only 12 interviews may be considered insufficient in capturing the full breadth of perspectives within the domains of blockchain, procurement, and CE. Furthermore, the scarcity of experts possessing comprehensive knowledge in all three fields restricted the ability to gather diverse viewpoints and insights. Consequently, there may be inherent limitations in the generalizability of the findings, given the limited representation of experts. To enhance the generalizability and transferability of our findings, a larger sample size with more knowledge within all three fields simultaneously would have been preferable. Nonetheless, despite the potential lack of complete generalizability, we believe that our findings offer valuable and initial insights into our research subject.

The *theoretical limitation* is the primary limitation of our study and arises from the lack of existing research pertaining to our research issue. We knew there would be certain limitations on the research topic and the pairing of the three phenomena we planned to investigate when we started working on this thesis. These limitations stem from the relative novelty of the implementation of BCT in procurement and especially its effect on the CE, as well as the immaturity of the scientific discourse surrounding the research topics. The combination of BCT, procurement and CE lacks substantial academic theory and is considered to be highly limited in research. To the best of our knowledge, this thesis represents one of the first attempts to integrate the three domains. Despite filling a literature gap, our research has several theoretical limitations related to the investigation of this novel topic. First, establishing a robust and comprehensive theoretical foundation for our research has been challenging due to the scarcity of relevant literature. As a result, not all of our

findings are supported or validated by existing literature. Second, given that we explored an uncharted area, the level of detail in our findings is not as extensive as it ideally should be. Consequently, the generalizability of our findings may be limited, although they can serve as a guiding framework.

Practical limitations arise in the application of BCT as a whole. Its efficient implementation requires specialised knowledge and expertise due to its complexity and evolving nature. Integrating blockchain into existing procurement systems and processes entails significant technical requirements and resource investments. Infrastructure development, software customization, and training initiatives may be necessary to facilitate successful integration. Furthermore, practical limitations exist in the implementation of blockchain for CP, particularly regarding integration and standardisation. Establishing compatibility and interoperability standards is essential to enable seamless data sharing and collaboration among multiple entities within the procurement ecosystem. Given the diverse range of stakeholders involved in procurement processes, ensuring compatibility between different blockchain platforms, legacy systems, and databases can be a challenging task. Legal and regulatory considerations introduce practical restrictions to blockchain-enabled CP. The decentralised and immutable nature of BCT may not align seamlessly with existing legal frameworks governing contract enforcement, data privacy, intellectual property, and procurement processes. Adapting current regulations or establishing new frameworks to accommodate blockchain-based procurement practices requires collaboration among stakeholders, policymakers, and legal experts. Lastly, the readiness and willingness of stakeholders to embrace BCT and adopt CP procedures present practical limitations. Resistance to change, lack of awareness, and unfamiliarity with the potential benefits and risks associated with blockchain may hinder its adoption in procurement processes. Building trust and promoting understanding among stakeholders, including buyers, sellers, and consumers, is crucial for the successful implementation of blockchain in CP.

6.4 Future Research

Regarding the study conducted for this thesis and the limitations discussed in the preceding section, we believe that our thesis topic could highlight intriguing topics for future research, as our study is one of the first to examine the intersection of BCT, procurement, and CE. Therefore, we would advise future studies to look into the studies on BCT's capacity to facilitate CE. It should be noted that the idea of using BCT as a platform for CE is still in its infancy, and there are very limited real-world application cases. However, our findings suggest that blockchain networks could potentially contribute to an enhanced CE and procurement process. Therefore, further research into the suitability and viability of BCT for enabling a CE could be a crucial step towards building sustainable and resilient organisations and mitigating the environmental impact of human activities.

In our research, we made a conscious effort to approach our subject of interest as holistically as possible. This is due to the fact that both the BCT and procurement are extensive subjects that can be studied from many different angles. To validate our findings and improve generalizability, we would recommend adopting a similar strategy to this study, but with a larger sample size and a distinct industry. It would also be very helpful to validate our conclusions with empirical data by conducting a single case study on an actual full-scale BC use case in procurement with the aim of enhancing CE initiatives. Additionally, we think it would be intriguing to carry out an ongoing research investigation to find out how long-term BCT usage will affect procurement performance. From a financial standpoint for example, the benefits or expenses associated with implementation cannot be quantified using our qualitative approach. Examining how BCT incentive systems may be incorporated into the SC using smart contracts and tokens is another interesting topic for future research, and what the effects of this is. Consequently, even though our research has laid a crucial foundation, the journey of investigating blockchain's complete potential in procurement is just commencing. We believe that our study serves as a launching pad for additional research into the long-term implications of BCT in procurement. This is a step into establishing a body of research-based knowledge for procurement managers, giving them the resources they need to leverage BCT for enhanced operational efficiency, transparency, and sustainability.

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8.0 APPENDIX

8.1 Appendix 1: Interview Guide Blockchain Technology

Tema	Mål	Spørsmål
Generelt	Identifiser intervjuobjektets perspektiv på hovedtemaene og dagens situasjon	Hvordan ser "Firmanavn"/du på blockchain? - Oppfølging: Hvordan jobber "Firmanavn" med dette nå? Hva tenker "Firmanavn"/du om fremtiden for blockchain? Hvordan kan BCT brukes for å muliggjøre transparens og sporbarhet i forsyningskjeder? Er det visse sektorer som har mer nytte av BCT? – Oppfølging: Kan disse sektorene karakteriseres til en viss grad? Kan du forklare forskjellen mellom offentlige og private blockchains og deres respektive styrker og svakheter? Hva synes "Firmanavn"/du om den sirkulære økonomien?
BCT, Procurement & CE	Undersøke mulig bruk av blockchain teknologi i sammenheng med anskaffelsesprosesser og implementering av en sirkulær økonomi.	Hvordan kan blockchain teknologi brukes i ulike bransjer, og hvordan kan det tilføre verdi? Hvordan påvirker blockchain teknologi innkjøpsprossesen? Hvordan støtter blockchain teknologi implementeringen av en sirkulær økonomi? Hvordan ser du at krysset mellom blockchain og sirkulær økonomi utvikler seg i fremtiden? Hvordan passer smarte kontrakter inn i bildet av blockchain og sirkulær atferd, og hvilken rolle spiller de? På hvilke områder i forsyningskjeden ville blockchain teknologi være mest gunstig for å fremme sirkulær økonomi?
Utfordringer & Muligheter	Utforsk mulige utfordringer og muligheter knyttet til implementering av blockchain teknologi for å fremme en sirkulær økonomi.	Hva er de viktigste fordelene med å iverksette blockchain teknologi i anskaffelser for å fremme en sirkulær økonomi? For å realisere en sirkulær økonomi med blockchain, hva tror du er de avgjørende forutsetningene for implementeringen? - Oppfølging: Er det en spesiell bransje som har en mer overbevisende grunn til å gjøre det? Er det noen bransjer som har det enklere tid med implementeringen? Hva er noen mulige utfordringer for å ta i bruk BCT, og hvordan kan de løses? I hvilke områder av forsyningskjeden ville blockchain vært mest fordelaktig for å lette den sirkulære økonomien? Kan du diskutere eventuelle utfordringer eller forutsetninger for å iverksette en sirkulær økonomi ved hjelp av blockchain teknologi?

8.2 Appendix 2: Interview Guide Procurement

Theme	Aim	Questions
General	Establish the interviewee's perspective on the main themes and today's situation.	What role does procurement play in today's business environment? What are the current trends in procurement/? - Follow-up: Are there any industry-specific trends? What are some of the challenges that exist in procurement now? - Follow-up: How do "Company name"/you see the future of procurement? How does "Company Name"/you see blockchain? - Follow-up: How does "Company name" work with this now? What do "Company Name"/you think about the future of blockchain? What do "Company name"/you think about the circular economy?
BCT, Procurement & CE	Investigating the potential uses of blockchain technology in the context of procurement processes and the implementation of a circular economy.	How can blockchain technology be used in various industries, and how can it add value? How does blockchain technology affect the procurement process? How does blockchain technology support the implementation of a circular economy? How do you see the intersection between blockchain and circular economy developing in the future? How do smart contracts fit into the picture of blockchain and circular behaviour and what role do they play? In which areas of the supply chain would blockchain technology be most beneficial in promoting the circular economy?
Challenges & Opportunities	Explore potential challenges and opportunities associated with implementing blockchain technology to promote a circular economy.	What are the main benefits of implementing blockchain technology in procurement to promote a circular economy? To realize a circular economy with blockchain, what do you think are the crucial requirements for its implementation? - Follow-up: Is there a particular industry that has a more compelling reason to do so? Are there any industries that have an easier time with the implementation? What are some potential challenges to adopting BCT, and how can they be addressed? In which areas of the supply chain would blockchain be most beneficial in facilitating the circular economy? Can you discuss any challenges or prerequisites for implementing a circular economy using blockchain technology?

8.3 Appendix 3: Interview Guide Procurement

Tema	Mål	Spørsmål
Generelt	Identifiser intervjuobjektets perspektiv på hovedtemaene og dagens situasjon	Hvilken rolle har innkjøp i dagens forretningsmiljø? Hva er de nåværende trendene innen anskaffelser/innkjøp? - Oppfølging: Finnes det noen bransjespesifikke trender? Hva er noen av utfordringene som eksisterer i innkjøp i øyeblikket? - Oppfølging: Hvordan ser "Firmanavn"/du for deg fremtiden for innkjøp? Hvordan ser "Firmanavn"/du på blockchain? - Oppfølging: Hvordan jobber "Firmanavn" med dette nå? Hva tenker "Firmanavn"/du om fremtiden for blockchain? Hva synes "Firmanavn"/du om den sirkulære økonomien?
BCT, Procurement & CE	Undersøke mulig bruk av blockchain teknologi i sammenheng med anskaffelsesprosesser og implementering av en sirkulær økonomi.	Hvordan kan BCT brukes i ulike bransjer, og hvordan kan det tilføre verdi? Hvordan påvirker blockchain teknologi innkjøpsprossesen? Hvordan støtter blockchain teknologi implementeringen av en sirkulær økonomi? Hvordan ser du at krysset mellom blockchain og sirkulær økonomi utvikler seg i fremtiden? Hvordan passer smarte kontrakter inn i bildet av blockchain og sirkulær atferd, og hvilken rolle spiller de? På hvilke områder i forsyningskjeden ville blockchain teknologi være mest gunstig for å fremme sirkulær økonomi?
Utfordringer & Muligheter	Utforsk mulige utfordringer og muligheter knyttet til implementering av blockchain teknologi for å fremme en sirkulær økonomi.	Hva er de viktigste fordelene med å iverksette blockchain teknologi i anskaffelser for å fremme en sirkulær økonomi? For å realisere en sirkulær økonomi med blockchain, hva tror du er de avgjørende forutsetningene for implementeringen? - Oppfølging: Er det en spesiell bransje som har en mer overbevisende grunn til å gjøre det? Er det noen bransjer som har det enklere tid med implementeringen? Hva er noen mulige utfordringer for å ta i bruk BCT, og hvordan kan de løses? I hvilke områder av forsyningskjeden ville blockchain vært mest fordelaktig for å lette den sirkulære økonomien? Kan du diskutere eventuelle utfordringer eller forutsetninger for å iverksette en sirkulær økonomi ved hjelp av blockchain teknologi?

8.4 Appendix 4: Interview Guide Circular Economy

Tema	Mål	Spørsmål
Generelt	Identifiser intervjuobjektets perspektiv på hovedtemaene og dagens situasjon	Hva synes "Firmanavn"/du om den sirkulære økonomien? Hvilke utfordringer og muligheter ser du i overgangen fra en lineær økonomi til en sirkulær økonomi? Hvilken rolle mener du bedrifter og organisasjoner kan spille i å fremme en sirkulær økonomi, og hvilke konkrete tiltak kan de ta? Hvilken rolle har innkjøp i den sirkulære økonomien? Hvordan ser "Firmanavn"/du på blockchain? - Oppfølging: Hvordan jobber "Firmanavn" med dette nå? Hva tenker "Firmanavn"/du om fremtiden for blockchain?
BCT, Procurement & CE	Undersøke mulig bruk av blockchain teknologi i sammenheng med anskaffelsesprosesser og implementering av en sirkulær økonomi.	Hvordan har digitalisering påvirket sirkulær økonomien i praksis? - Oppfølgning: Hvilken rolle kan digitalisering spille i fremtiden for sirkulære økonomiske praksiser? - Hvordan støtter blockchain teknologi implementeringen av en sirkulær økonomi? Hvordan ser du at krysset mellom blockchain og sirkulær økonomi utvikler seg i fremtiden? Hvordan passer smarte kontrakter inn i bildet av blockchain og sirkulær atferd, og hvilken rolle spiller de? På hvilke områder i forsyningskjeden ville blockchain teknologi være mest gunstig for å fremme sirkulær økonomi?
Utfordringer & Muligheter	Utforsk mulige utfordringer og muligheter knyttet til implementering av blockchain teknologi for å fremme en sirkulær økonomi.	Kan du gi eksempler på vellykkede sirkulære og bærekraftige initiativer når det gjelder implementert i forsyningskjeden? - Oppfølging: Hvordan har disse initiativene påvirket organisasjonens resultat? Hvordan sikrer du at leverandørene i forsyningskjeden er i samsvar med organisasjonens sirkulære og bærekraftige mål? Hva er noen av de viktigste utfordringene og barrierene for å ta i bruk blockchain og hvordan kan de overvinnes? Hvordan kan organisasjoner samarbeide med sine kunder for å fremme sekularitet og bærekraft gjennom hele forsyningskjeden? Hvilke tiltak kan organisasjoner ta for å måle og følge opp progresjonen mot en mer sirkulær og bærekraftig forsyningskjede?