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THE APPLICATION OF LIFE CYCLE THINKING IN IT BUSINESS CONSULTING

ABSTRACT

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The Application of Life Cycle Thinking in IT Business Consulting

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This research is an explorative study into how Life Cycle Thinking (LCT), can be applied within IT consulting. Environmental Sustainability is a pressing topic that has required business leaders to rethink the way they produce their products or services. Consulting organizations play a key role in influencing business leaders in changing their approach by providing advice that is usually profit-oriented. Consulting organizations can also play a key role in providing advice that is planet-oriented. The main research question is *"In what ways can an IT Consulting organization benefit from life cycle thinking?"*.

The research question was answered by collecting qualitative data in the form of four interviews and conducting background research on any relevant information regarding LCT and IT Consulting. The results were analysed using a deductive approach where theory from the literature was utilized to assess how life cycle thinking can be applied. The key findings include that Life Cycle Thinking can be defined as an active attempt to complete Life Cycle Assessments. The results indicate that even companies that have sustainability as a business model struggle with conducting LCAs especially for IT service-based offerings. Conducting LCAs is an iterative process that rarely gets done right the first time and requires a creative entrepreneurial mindset to complete accurately. The main challenge with applying LCT is that the LCA process can be complex and still may lack validity. Organizations that practise an open-door policy of innovation and work together with research partners or environmental industry expert are likely to adopt efficient LCT as part of their ways of working. In the long-run, IT organizations should put effort in incorporating more environmental specialists to increase the level of confidence in taking strong sustainable stances when conducting LCAs to help in implementing LCT within their organizations.

ACKNOWLEDGEMENTS

ABBREVIATIONS

IT	Information Technology
LCT	Life Cycle Thinking
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
LCSA	Life Cycle Sustainability Assessment
B2B	Business-to-Business
FEEI	Front-end Environmental Design
PSF	Professional Service Firms
SOI.	Sustainability-oriented innovation

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1 Introduction

This chapter will explore the background of the research topic, elaborate on the research motivation from the author's point-of-view, research gap and introduce the research questions.

1.1 Background

Sustainability is an ever-pressing topic for organizations and businesses across the globe. Holt (2020) describes in his article *"Sustainability in Business Is More an Opportunity Than a Threat"* that sustainable investing is at the forefront of business' during 2020, adding that business leaders recognise that failure to manage climate-related risks and other harmful activities will have permanent consequences to a company's reputation and poses a high risk in destroying shareholder value (Joseph Holt, 2020). The increased pressure to manage climate-related risks and damaging actions often lead organizations to acquire outside help to provide advice and possibly implement a strategy that will mitigate climate related risks cause by the organisation.

Circular economy is an approach to our current consumption model where consumption follows a circular flow instead of a linear flow of take, make, and dispose (Lewandowski, 2016). A circular flown refers to taking, making, then reusing or recycling materials. Each year the demand for and consumption of resources, materials, and products is growing. To fulfil the need for resources, materials, and products, while not compromising our ecological integrity there is a need for change in the way society consumes, and producers produce. The circular flow is beneficial for extending the world overshoot day and moving business and consumers from a linear consumption flow to a more climate conscious circular flow (Global Foodprint Network, 2022). According to the Global Foodprint Network (2022) the world overshoot day refers to the day when society's consumption of resources exceeds the earth's capacity to produce renewable natural resources and process greenhouse gas emissions.

The current business climate stresses innovation as a compulsion for businesses to stay competitive. A common phrase that is often preached at corporate events, "Innovate-or-Die",

is a symbolic term that actualizes the necessity of businesses to be innovative. The phrase is not repeated in vain, there are numerous examples of companies that have failed to innovate. Take for example blockbuster, a tangible film renting service forced out of the market by their more innovative competitor providing customers with hundreds of pieces of content in real-time for a one figure monthly subscription price (Cole, 2019). Over the past decade companies have raced to innovate, and many of these innovation efforts have lacked focus on sustainability. Companies most commonly innovate to increase brand awareness, maximize growth, increase sales and other business factors, setting aside sustainability as a secondary target (Ehrenfeld, 2008). Supporting only this type of innovations is ultimately doing more harm than good for this planet.

The consensus is that in the IT Consulting environment innovations are conducted based on business use cases which might consider aspects such as the business profit provided by an innovation, the potential increase in customer engagement and monetary gains when choosing a new innovative solution. Unfortunately, sustainability concerns often come after the innovation has been accepted by consumers. Senior Contributor Heather Farmbrough (2021) reports in Forbes magazine, that Capgemini interviewed over 1000 business leaders in companies that gross over 1b$ annually about their sustainable technology practices (STP) from which almost no one knew what STP was, she further elaborated that *"Although one-third said sustainable IT was on the board-level agenda, only 6% companies had a sustainable policy to limit the environmental impact of their activities (Farmbrough, 2021)."*

Sustainability is a growing concern, and there is an observable growing demand for companies to take a greater role in promoting sustainable behaviour. The ideal goal is to shift the current linear economy to a circular economy where the production of products and services are always designed with a sustainability-first approach (Lewandowski, 2016). Waste caused by overconsumption has been a significant driver for introducing sustainability to product manufacturing processes (Kneipp *et al.*, 2019). Design products using a "Sustainable design" is a common practice in the product manufacturing industry; however, it still lacks attention in the service provider industry (Consulting, IT services etc.).

An increasingly popular way of creating an environmentally sustainable design is applying a Life Cycle Approach when producing a product or service. According to UNEP *"Spreading the idea of life cycle thinking is an important part of UNEP's promotion of an integrated approach to sustainable consumption and production* (UNEP, 2004).*"* Applying

a Life Cycle Approach to buying and producing products does not only include the use of Life Cycle Assessments but a broader understanding of the impact of each stage of a products or service's life cycle. Consumers are continuously demanding to understand the environmental impact of the products or services they buy, which ultimately pressures producers and service providers to adopt a life cycle approach and provide as much transparency in their production process as possible (UNEP, 2004). Apart of adopting this life cycle approach is understanding how to implement Life Cycle Thinking within the organization.

This research will attempt to understand what Life Cycle Thinking is and how it can be applied in an IT Consulting.

1.2 Motivation

The author has a personal interest in understanding innovation practices that lead to sustainable innovations. Though this work is not commissioned by an organization, the company the author works in has an interest in understanding the applicability of Life Cycle Thinking (LCT) in IT consulting. This research will prove to be a valuable piece of work to assist the author in gaining a basic understanding of the concept of LCT and its' applicability in the IT consulting industry.

Sustainability is often considered a variable in a set of requirements during service solutioning. The goal is to find a suitable yet simple enough framework for solutioning that allows sustainability to become a default consideration rather than an aspect that may add business value from a product or service branding perspective.

1.3 Research objective

As mentioned in section 1.1 Background, the purpose of this research is to understand how LCT might be applied within the area of IT Consulting. Life Cycle Assessments (LCAs) have provided much needed clarity and aid in making sustainable business decisions in areas of waste management and manufacturing. The IT Consulting industry indirectly is part of

providing their business-to-business (B2B) customers within various industries, with much needed advice on how to retain competitive advantage with the use of IT tools. However, sustainability is a pressing topic that should be considered by default whenever any business advice is made. LCT can provide employees of an IT Consulting organization with the required confidence and tools to speak and include sustainability as part of every business decision making process.

1.3.1 Research gap

After conducting the literature review it is apparent that previous studies on Life Cycle Thinking within the area of business consulting or IT Consulting are few due to a lack in clarity on how LCAs should be conducted to properly estimate the level of actual sustainability of a product (Klöpffer, 2014; Hanegraaf *et al.*, 2020). Previous literature also relates organizational innovation practices and an entrepreneurial mindset as key drivers in implementing an LCT within the corporations. Further research of sustainable innovation practices within organizations that produce sustainable innovations, emphasize a focus on the human impact and formulating a strategic approach in understanding innovation governance within organizations (Becker and Gerhart, 1996; Chen and Huang, 2009; Nazarko, 2017; Varadarajan, 2017; Anzola-Román, Bayona-Sáez and García-Marco, 2018; Cheah, Ho and Li, 2018).

1.3.2 Research Questions and objective

Main Research Question: In what ways can an IT Consulting organization benefit from life cycle thinking?

> **Sub-question 1:** What are the main challenges and opportunities in incorporate life cycle thinking in IT Consulting?

> **Sub-question 2:** How can the right innovation practices play a role in making life cycle thinking a critical factor in consulting?

The answers to these research question can provide valuable insights to an organization looking to increase their sustainable innovation performance. This research will also provide a valuable case study to benchmark on the challenges of incorporating life cycle thinking in IT business problem-solving.

This study addresses the critical problem of understanding innovation practices that contribute to creating sustainable innovations. Furthermore, the study will attempt to rationalize the challenges and opportunities that arise from adopting life cycle thinking within an organization.

1.4 Methodology and Data

The research is divided between a literature review and empirical research. The purpose of the literature review is to understand previous research regarding Life Cycle Thinking within the context of IT Consulting. The literature was chosen based on its relevance to the topic of applying Life Cycle Thinking or Life Cycle Assessments in general business or IT consulting business. For this research the chosen data collection method was implemented through conducting interviews. The methodological descriptions are described in more detailed within the literature review chapter and the empirical research design sub-chapter.

1.5 Research Structure

The research structure of this thesis is broken down into expected input and output of each chapter that can be seen in table 1 below.

The first chapter of this research introduces the reader to the general topic and objectives of this research. As a result of this chapter the reader should understand the general importance of the topic and why the author is motivated to research this topic.

The second chapter of this research consists of the literature review. The literature review brings forth all the relevant theories and studies that assist the researcher in creating a

preliminary framework or hypothesis for what Life Cycle Thinking is and how it might be applied in an IT Consulting organization.

The third chapter of this research summarizes the theoretical framework formed of the basis of previous research. This chapter introduces a hypothesis of how life cycle thinking is applied according to the literature reviewed by this literature.

The fourth chapter of this research is the empirical research where a deductive approach is used though qualitative data collection to verify the preliminary framework created as a result of the literature review. The chapter is concluded with a thematic data analysis that reveals central themes discovered from the data.

Chapter five is a discussion chapter that pinpoints the theory into the data analysis results. The chapter also discusses the reliability and validity of the research results.

Finally, chapter six concludes the research with contributions, limitation and suggested further research approaches of applying LCT in IT consulting.

Input	Chapter	OutpuT
Relevant articles on the importance of sustainability in business	1. Introduction	Understanding of the general importance of this topic and the author's motivation
LCA, LCT, IT Business Consulting	2. Literature Review	A framework for life cycle thinking
A FRAMEWORK FOR LIFE CYCLE THINKING	3. Theoretical Framework	A hypothesis of how life cycle thinking can effectively contribute to sustainable-oriented innovations within an organization
Interview data	4. Empirical Research	Themes
Data analysis	5. Discussion	Deductive reasoning on how the framework for lice cycle thinking can be applied in IT Consulting
Final remarks	6. Conclusion	Contributions, limitation and suggested further research approaches of applying LCT in IT consulting

Table 1, Research input-chapter-output

2 Literature Review

This chapter will summarize the results of the literature review, as well as explore some of the main findings regarding previous literature on applying LCT, IT Consulting and sustainable innovation practices.

2.1 Methodological aspects and initial data search

The combination of keyword operators chosen for this literature review are as follow; "life cycle thinking" AND "business consulting"," "life cycle assessment" AND "business consulting"," life cycle thinking" AND "business management"," Life Cycle Thinking" Sustainability challenges", "sustainability", "sustainable innovation", "LCA", "LCT". The main combination of keywords for this literature review included ("life cycle assessment" AND "business management"), due to a lack of literature concerning LCT as a concept. These keywords and combinations helped identify the most relevant papers concerning what this research aims to study. At the beginning of this research, it was of most importance to understand the context of Life Cycle Thinking, Sustainability, and Business Decision making in relation to each other. The main keyword search found works that discussed LCT methodologies and other aspects of Sustainability that play into integrating LCT as part of IT Consulting. The search procedure for this literature review focuses on LUT Primo, Google Scholar Database, and Google search engine.

The keywords used for the literature search and terms are found directly on the title and chapters of this research. A range of databases such as ScienceDirect provided by Elsevier, EBSCO and ProQuest were searched as part of the literature search. The language of the literature search was limited to English. The scope of the research subject was limited to R&D technology/policy, research, engineering, economics, business, and organizational behaviour. The main search of literature was limited to a timeframe between 1981 to 2022, this is because the terms sustainability, innovation and life cycle thinking are ever evolving, making it most beneficial to study the newest literature first to understand a) how the term has evolved and b) what is the most common consensus within the expert communities on

the meaning of these terms. However, in case clarification or more information was required to understand a particular topic, earlier or relevant research on the topics outside of this search parameter were studied as a part of this literature review. The articles chosen for the literature review explore the themes of the subject and definition of the subjects in question. There are some limitations to consider when searching for literature on topics such as sustainable innovation because the term can often overlap with the term responsible innovation which is an umbrella term in which sustainable innovation falls under. The search for life cycle thinking literature also provided a few limitations regarding the meaning of the concept. Many papers would refer to life cycle thinking as life cycle assessment the tool. Another limitation is with the term Life Cycle Assessment, because many papers also refer to this method as life cycle analysis. These inter-related terms caused some confusion while reading through some of the literature.

Database	Main Search terms	Search results (no. of papers)
LUT Primo	Life cycle assessment AND business management	908
	Life cycle assessment AND business consulting	2
	Life cycle thinking AND business consulting	23
	Life cycle thinking AND business management	94
	Life Cycle Thinking	254,986
	Sustainable innovation	406,482
	Innovation Practices	160,718
	Sustainability	1,190,871
Total		2,014,084
Google Scholar	Life cycle thinking and consulting business	8
	Life cycle thinking AND business consulting	39
Grand Total		2,014,131

Table 2, Initial search results

The literature review search revealed that LCAs regarding business management is a widely studied subject, while LCT about business management is not. This might be due to the inter-relation between the terms LCT and LCA. Many of the publications found with the keyword "Life Cycle Thinking" fell under the product manufacturing industry, exposing a research gap for studies regarding professional business service providing industries. The search also exposed that previous studies on life cycle assessment and business organization studies are

mainly focused on infrastructure, construction, and manufacturing organizations. Sustainability, on the other hand, is a widely studied cross-industry and provided the most search results. The publications chosen for this study were evaluated based on the abstract. 30 publications were chosen, as well as relevant books and news articles related to the topic.

2.2 Sustainability

Recognition of the term sustainability gained major traction when the United Nations (1987) (UN) defined sustainability as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs* (WCOE, 1987; United Nations, 2021)". The definition provided by the UN takes a common human-centric approach that provides a general understanding of the importance of sustainability to society. Although, the definition is straightforward, the definition leaves room for uncertainty regarding the practicality of sustainability and how sustainability can be achieved in the business context (Sverdrup and Svensson, 2002). Costanza and Patten (1995) produced a probing commentary in 1995 on the problems faced with defining the term "sustainability". Costanza and Patten (1995) believe the problem with defining sustainability is much like the problem with defining fitness in biology "*that the determination of sustainability can only be made after the fact.*" (Costanza and Patten, 1995)*", suggesting that the term "sustainability" is only sustainable if it has truly achieved its goal and continues to clarify that *"What pass as definitions of sustainability are often predictions of actions take today that hopes will lead to sustainability* (Costanza and Patten, 1995).*" and suggest the following framework when defining sustainability "*(1) What system or subsystems or characteristics of systems persist? (2) For how long? (3) When do we assess whether the system or subsystem or characteristic has persisted?* (Costanza and Patten, 1995)*".

Sustainable development and LCT are not only directly related to each other, but directly contribute to one another(Mazzi, 2020; Jacobo-Hernandez, Jaimes-Valdez and Ochoa-Jiménez, 2021). LCT has a focus on micro components that enable sustainability to understand the impacts of a full life cycle of a product, while Sustainability tackles macro level issues regarding our planet, technology, and socio-cultural matters (Mazzi, 2020). The

underlying components of LCT and sustainability are logically inter-related. Previous studies show that the principles of LCT are built on the three principles of sustainability: Environment, Social, and Economic (Neugebauer, Forin and Finkbeiner, 2016; Hanegraaf *et al.*, 2020; Mazzi, 2020). Environmental sustainability is the avoidance of the over exhaustion of our natural resources as well as making sure the products produced today do not cause harm to our planet tomorrow. Social Sustainability is closely related to society prospering, while Economic Sustainability is ensuring all nations are equally monetarily prospering (United Nations, 2021).
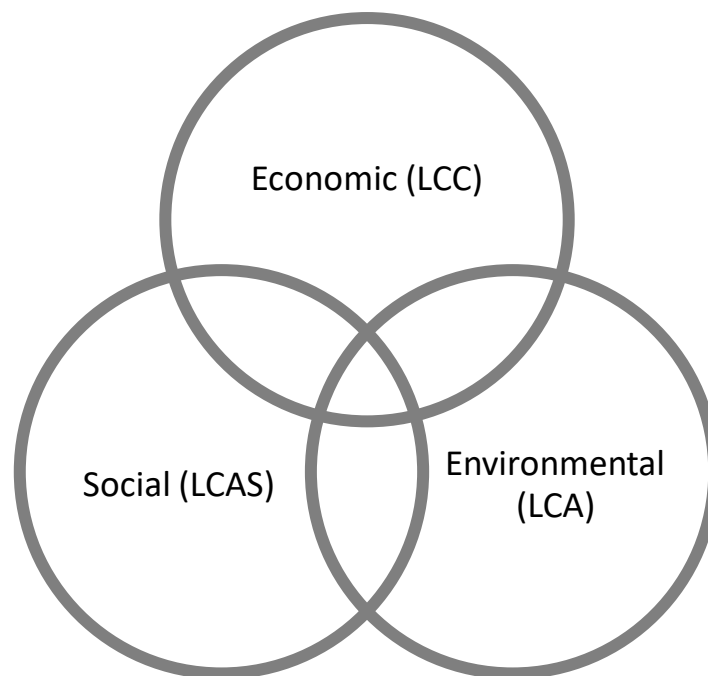
Figure 1, Relationship between LCT and Sustainability. Adapted from Mazza (2020)

2.3 Life Cycle Thinking (LCT)

According to UNEP's Life Cycle Initiative Progress Report in 2021 *"A Life Cycle Approach is the scientific underpinning of the circular economy to achieve the Sustainable Development Goals of the 2030 Agenda (UNEP, 2021, p. 3)."* The 2030 Agenda to achieve Sustainable Development Goals by the UN is a plan of action for people, planet, and prosperity, and by embracing the life cycle approach companies can make better informed decisions about impactful actions (UNEP, 2021, p. 3). The focus in achieving the UN sustainable development goals of the 2030 agenda is ensuring Life Cycle Thinking as a way

of operating and working within an organization. The UNs goals are geared towards businesses and consumers moving from thinking about the economy as liner to circular, where products are not built for disposal but reusage or refurbishment.

The most common definition for life cycle thinking is provided by the UN Environmental Program (2004) as *"A life cycle approach is a way of thinking which helps us recognize how our selections – such as buying electricity or a new t-shirt – are one part of a whole system of events.* (UNEP, 2004)*"*. The definition offered by the UN Environmental Program takes a very consumer focus on applying Life Cycle Thinking, much like the UN's general guide does. On the other hand, Jacob-Lopes et. al, (2021) define Life Cycle Thinking (LCT) as practicing a way of thinking that includes the economic, environmental, and social consequences of a product or process through its life (Jacob-Lopes et. al, 2021). The definition of LCT by Jacob-Lopes et. al, (2021) provides more relevancy in applying LCT within a business-oriented organization, while the UNEP definition is strongly related to the definition of life cycle thinking in the context of an individual consumer.

LCT is a way of working that by default, takes into consideration all circular life cycle stages of a process or product, that often comprise of production, transportation, commercialization, application, recovery, recycling, and raw materials recovery to minimise the environmental impact of a product or service (see figure 2) (Jacob-Lopes et. al, 2021). Life Cycle Thinking can also be seen as the application of Life Cycle Assessments (LCA). Pesonen (2001) argues that, though the results of LCAs can cause controversy due to the vague nature of the LCA methodology, just by conducting LCAs and taking initiative to understand the life cycle of a product, the LCA promotes a revolutionary way of thinking in business development –

LCT (Pesonen, 2001). The consensus is that to create a life cycle assessment one must practice life cycle thinking. This includes, yet is not limited to, Research, Evaluation and Mapping (Jacob-Lopes, Zepka and Deprá, 2021).

According to Jacob-Lopes et al., (2021), to conduct research is understanding pre-existing data regarding LCAs, by applying critical thinking in understanding cause and effect, in the product life cycles entirety. LCT requires a thorough understanding on how to research and synthesise data regarding the LCA.

Mapping is described as a key tool in exposing hidden production systems and comparing functional units to achieve an expected outcome. Proper mapping can help expand the knowledge and understanding of the final impact, which will consequently help in understanding different ways to see or build a product.

LCT is an evaluation approach that allows a holistic understanding of the full product life cycle. In LCT understanding the full life cycle prevents the displacements of impact loads and the creation of new problems, by focusing on the full life cycle rather than one life cycle stage or problem (Jacob-Lopes, Zepka and Deprá, 2021).
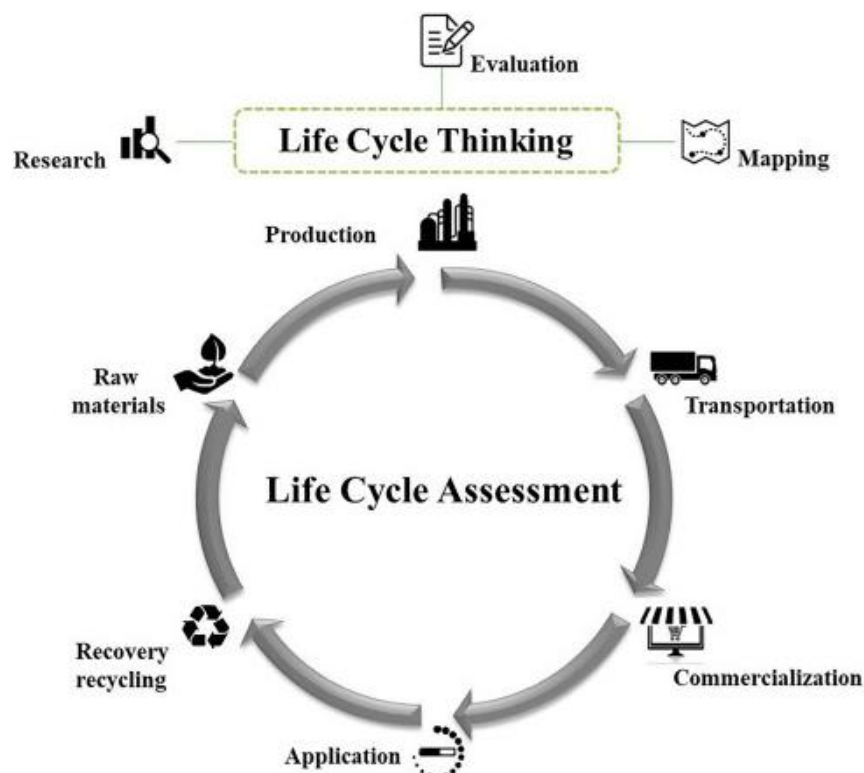

Figure 2, The role of LCT when conducting LCA (Jacob-Lopes et al., 2021).

Life Cycle Thinking highlights the importance of thinking beyond cleaner production and understanding the full life cycle of a product and its' sustainability (Mazzi, 2020). In this sense LCT can be considered as an overarching umbrella concept that maximizes the results and proficiency of the LCA. It may be correct to argue that without LCT, reliable LCAs do not exist. However, on the contrary to practise life cycle thinking is to attempt the understanding of the life cycle of a solution, by attempting to implement for example the LCA. Therefore, one might conclude that LCT is the attempt to thoroughly understand the life cycle of a solution.

2.3.1 Life Cycle Assessment

The literature review proves that LCAs is a widely studied and applied methodology for uncovering the environmental impact of a product or service. Previous studies reveal that Life Cycle Assessments (LCA), also known as life cycle analysis, are considered an integral impact assessment tool that enables a product or service provider in achieving goals that align with the principles of circular economy (Pickin, Yuen and Hennings, 2002; Junnila, 2009; Piekarski *et al.*, 2013; Sacco *et al.*, 2021). The definition of life cycle assessment can vary depending on the area where LCAs are applied. Previous literature shows studies on LCA mainly focus on environmental studies that tackle the manufacturing, energy, product development and technical industry.

In studies where LCA is applied to process or product development the definition is often in line with preventing the over exhaustion of earth's natural resources (Pickin, Yuen and Hennings, 2002; Petit-Boix *et al.*, 2017). Previous studies that focus on LCAs as managerial tools define LCA as tool for sustainable decision making. The definition of LCAs in business management can vary as well, Piekarski et al. (2013) argue in their paper on LCAs as an Entrepreneurial tool for Business Management and Green innovation that "*LCA are used as a tool for evaluating the environmental performance of products, processes and services to form a practice for sustainable business management* (Piekarski *et al.*, 2013)*."* They further argue that companies that adopt new tools like LCA with an entrepreneurial mindset, are more likely to solidify their competitiveness, leading to sustainable oriented innovations. Further emphasizing how LCA is a crucial tool for companies that desire excellent results from green innovations and facilitate green innovations (Piekarski et al., 2013). However,

Sacco et. al., (2021) describe in their paper on developing a new Circularity and Maturity Firm-Level Assessment tool (CM-FLAT), that LCA is an CE assessment method that lacks a common agreed scientific basis, that leads to the low applicability of the methods in industrial realities. The result of this leads to companies not addressing CE in their business processes (Sacco et. al., 2021). Alluding that the methods are there but lack clear guidance on successful outcome-oriented implementation.

Studies find that though LCAs are often celebrated and welcomed by organizations as an accurate mean of measuring the environmental impact of a product or service, there is some criticism of the method regarding its challenges and limitations. Curran (2014) summarizes in her chapter on *"Strengths and Limitations of Life Cycle Assessment"* that LCAs have concerning limitations due to vague instructions and a heavy focus on mainly the environmental impact. Though the methodology has a general framework and follows the international ISO standards, the implementation of the analysis is often left in the interpretation of the researcher(s) (Curran, 2014). This consequently may lead to the generation of contradicting environmental impact results regarding the same process or product (Klöpffer, 2014).

The actual emissions during a life cycle of a product or service can be difficult to interpret and may vary depending on how a product or service is utilized. Daae, J. and Boks. C (2015) found in their study *"Opportunities and challenges for addressing variations in the use phase with LCA and Design for Sustainable Behaviour"* that LCA studies on products that have a significantly high emission release during the use phase of the product have a high chance of returning mixed results depending on how the product is used (Daae, J. and Boks, C., 2015).

Another criticism of LCA is geared toward the limitations of the results. Though environmental sustainability is of high importance, it is also important to take into consideration the social and economic impact a solution may have on society. The LCA methodology is further criticized for a lack of economic or social focus, which often requires researchers to use other tools to measure social and economic factors (Klöpffer, 2014; Hanegraaf *et al.*, 2020).

2.3.2 Life Cycle Costing (LCC)

According to the European Commission (2022) Life Cycle Costing (LCC) is the process of considering all the costs that will occur during the lifetime of a product (European Commission, 2022). The LCC considers beyond the purchasing price all the aspects of the products cost within the life cycle. This cost can include but are not limited to any associated costs such as installation, delivery, or insurance. Operational costs, fuel and water use, maintenance, and costs associated with the disposal of the product or the residual value of the product (European Commission, 2022).

As briefly mentioned on the previous sub-chapter, previous studies on LCA criticize the methodology due to its' focus on mainly environmental issues. Neugebar et al. (2016) argues that most economic life cycle assessments are conducted by the means of LCC, which does not consider the various range of good and bad consequences, which consequently leads to limitations that prompts unpredictable ways of implementation (Neugebauer, Forin and Finkbeiner, 2016). Neugebar et al. (2016) introduce a modified life cycle assessment that attempts to tackle the limitations of the traditional LCA, called the Economic Life Cycle Assessment (EcLCA). The purpose of this updated methodology is to embody the economic stake within the Life Cycle Sustainability Assessment (LCSA) framework, following the requirements of ISO 14044 (Neugebauer, Forin and Finkbeiner, 2016).

2.3.3 Life Cycle Thinking in a Consulting context

To understand how LCT can be applied in IT Consulting, it is important to understand the nature of IT Consulting. IT Consulting falls within the category of Professional Service Firms (PSFs), these are organizations that provide professional services and operate knowledge intensively (Nanda and Narayandas, 2021; O'Higgins, Aramburu and Andreeva, 2022). Previous literature that attempts to understand the applicability of LCTs in PSF within IT consulting were not readily available, however, studies that attempt to understand the general applicability of LCT in general business consulting show that organizations struggle to understand and apply LCT within organisations due to a lack of knowledge in

implementing LCT or a limited interest in taking liability of the process (Piekarski *et al.*, 2013; Bocken *et al.*, 2014; Witczak *et al.*, 2014).

Nanda & Naryandas (2021) discuss and present in their article on *"What Professional Service Firms Must Do to Thrive"* written for the Harvard Business Review, the complexity within PSFs especially during an era of spontaneously new demands like providing LCAs and how PSFs can use two tools to manage their customer base and optimize their client position: practise spectrum or client portfolio matrix (Nanda and Narayandas, 2021). Moreover, it is suggested that IT Service practices fall under a professional service spectrum, see figure 3 below, that distinguishes the way the firms operate. Most practices fall under the entire spectrum; however, the most successful practices are clear about their position on the spectrum (Nanda and Narayandas, 2021)

The Professional Service Spectrum

	COMMODITY	PROCEDURE	GRAY HAIR	ROCKET SCIENCE
Client need	Solving routine, often simple problems	Implementing a complex project with several interrelated parts	Deciding on a major, ill-defined issue with which the client has little experience	Addressing a unique and difficult problem with major consequences for the client
Selling proposition	Low cost	Systematic and comprehensive approach	Track record of dealing with similar problems	Ability to solve complex challenges
Organizational capabilities	Efficient delivery processes	Methodologies	←Rigorous empirical analysis→	
			Learning from experience	State-of-the-art theory
		←— Knowledge management —→		
Professionals' skills	Focused execution against specific requirements	Following procedures rigorously and comprehensively	Converting specific knowledge to judgment that's applicable in other settings	Applying theoretical and empirical tools to devise innovative solutions

Profit drivers

MARGIN — LOW .... HIGH
RATE — LOW .... HIGH
UTILIZATION — HIGH .... LOW
LEVERAGE — HIGH .... LOW

Figure 3, The Professional Service Spectrum. (Nanda and Narayandas, 2021)

According to Nanda and Narayandas (2021) the PSF practices fall between a spectrum of four areas. 1) A commodity practise that uses economical, expedient and error-free service to aid their customers with routine problems. 2) A procedure practise might be a Technology Consulting practise like Accenture, that uses a systemic approach to solve complex problems that might not be considered cutting edge but require attention to a plethora of

considerations. 3) A Gray hair practise can be considered as a consulting firm like Bain and Company or McKinsey and Company. These types of practises often provide experienced strategy counsel based on experience in advising similar corporations through strategy exercises. 4) A rocket science practice is a consulting organization that deals with problems that require specialised expertise and creative problem-solving (Nanda and Narayandas, 2021).

Nanda and Narayandas (2021) find that although a practice's profile can extend across more than one the highest performing practises have a clear focus, making it easy for the clients to know what the services are the practice offers. Adding that, a diffused profiles increase the likelihood of the practice's brand being seen as a jack of all traders and a master of none.

In another study it is found that companies with solid overall knowledge management processes outperform the companies with weak knowledge management processes on innovation performance measures (Hussinki *et al.*, 2017), which is likely to place organizations under "Procedure" and "Grey Hair" practice in a stronger position. Bocken et al. (2014) researched the drivers and practices that facilitate small and medium sized enterprises (SMEs) in creating successful Front-end Eco-design (FEEI). FEEIs can be defined as the initial stages of the eco-innovation process (Bocken *et al.*, 2014), which can be interpreted as taking eco-design into consideration during the initial stages when designing the solution because during the first stages innovators still have room to adjust the final solution. Ulrich, K.T. & Eppinger, S.D. (2016) describe the product development process as quite linear, being a sequence that transforms inputs into outputs, seen on figure 4 below(Ulrich and Eppinger, 2016). IT Consulting organizations tend to work with modern IT Softwares that usually require agile development approaches that are often iterative an iterative approach that helps breakdown the work into small pieces and allows the release of the solution while still working on improvements(Dingsøyr *et al.,* 2012). In the FEEI approach the focus in purely on the drivers, motivation, and capabilities the organizations currently possess to enable FEEI in the initial stages of product or service design. Bocken et al, (2014) finds that creativity is viewed as the most significant skill, which is followed by engineering skills and environmental knowledge (Bocken *et al.*, 2014). The literature also reveals that the life-cycle Assessment (LCA) is a common method used by organizations to evaluate how a product will impact our environment (Bocken *et al.*, 2014) over the entire period of the

products life, thus taking maximum uses of the resources and minimizing liabilities (European Environment Agency (EEA), 2021). The life-cycle assessment is particularly useful in understanding product life cycle, conversely, might prove challenging in understanding service-based offering life cycles.

Figure 4, A simplified adaption of Ulrich, K.T. & Epping, S.D. (2016) Product Development Process

2.4 Sustainable Innovation Practices

Previous studies on sustainable innovation can drastically vary with the definition of the term. Rajan Varadarajan explores in his paper on "*Innovating for sustainability: a framework for sustainable innovations and a model of sustainable innovations orientation*" the definitions of sustainable innovation and how the definition has evolved over the years. Varadarajan (2017) divides the definition of sustainable innovation in three categories of types of sustainable innovation: Business model (Cost-reduction and revenue growth oriented), Product-service system (technical and non-technical innovations) and technological (a model for structuring and understanding the effects of innovations in terms of sustainability) (Varadarajan, 2017). The definitions of the term sustainable innovation can vary, and multiple definitions have been presented in the past. Costanza and Patten (1995) produced a probing commentary in 1995 on the problems faced with defining the term "sustainability". Costanza and Patten (1995) believe the problem with defining sustainability is much like the problem with defining fitness in biology "*that the determination of sustainability can only be made after the fact* (Costanza and Patten, 1995)*"*, suggesting that the term "sustainability" is only sustainable if it has truly achieved its goal and continues to clarify that *"What pass as definitions of sustainability are often predictions of actions take today that hopes will lead to sustainability.*(Costanza and Patten, 1995).*"* Adams et al. (2016) on the other hand introduces, a modern version of the term sustainable innovations;

the term sustainability-oriented innovations (SOI), referring to an organizations intention of creating value through social, economic, and environmental impact by implementing changes in their values, way of operating, and/or actions (Adams *et al.*, 2016). The definition of SOI offered by Adams et al. (2016) presents an interesting perspective to the conversation, *when does a sustainable innovation become sustainable* (Costanza and Patten, 1995). However, in the context of this study sustainable innovation can be seen as a model for understanding the expected sustainable outcomes of innovation, the way Varadarajan (2017) defined sustainable innovation.

Stig Ottosson (2016) introduces an innovation theory in which he believes that society often interprets the term innovation as something positive. This allows actors in the private, public, and idealistic (non-profit) sectors to produce hope in difficult times (Ottosson, 2016). However, in a publication on the darker side of sustainability Tura (2018) finds that implementing sustainable practices within organizations have a high probability of creating trade-offs which consequently lead to tension between stakeholders (Tura, 2018). Ottosson (2016) argues that the terms "Innovation" and "Sustainability" have become popular buzzwords without proper meaning (Ottosson, 2016). Much like, Innovation and Sustainability, the definition of Sustainable Innovation can vary depending on the context of the work, leaving the community unsure of the true definition of Sustainable Innovation. Even though sustainable innovation is not clearly defined, studies show that from a consumers point-of-view sustainability and innovation are key variables and a significant competitive advantage for organizations in the economy today (Bianca Miller Cole, 2019; Marín-García, Gil-Saura and Ruíz-Molina, 2020). It is also evident through the literature review that sustainable innovation often falls under the umbrella term for Responsible Innovation (Lubberink *et al.*, 2017).

Lubberink et al., (2017) study produces a high-level framework for creating responsible innovations within an organisation based on their systemic literature review on *"responsible, social and sustainable innovation practices"*. A model for "Responsible innovation in the business context" is discovered from the basis of an inductive and a deductive study (Lubberink *et al.*, 2017). Pradhan and Sandhu (2020) argue in their summary of review of various Responsible Innovations frameworks that previous frameworks on Responsible Innovations do not take into consideration the commercialization of innovations, calling it a

major oversight in previous frameworks that focus on mainly on scientific and technological advancements (Pradhan and Sandhu, 2020). IT Consulting organizations are profit driven organizations; therefore, the measure of their responsible innovativeness must be evaluated using a model that considers commercialization as part of the end-result. The model is a framework that can be used to increase the dimension of responsible innovation within an organization, see Table 3 below for an adapted description of Responsible innovation in the business context by Lubberink et al. (2017).

Anticipation	Anticipation is the process of foreshadowing the consequences of an 33 innovation and making decisions based on this understanding. (Lubberink et al., 2017). 1) Organizations take part in various actions that allows them to grow a better understanding of the innovation (Lubberink et al., 2017). Some examples by Lubberink et al. (2017) include market trends, technological developments, legislations and more. (Lubberink et al., 2017) 2) Organizations take part in actions that allow them to have a clear vision of the long run that goes together with their decision-making processes around innovation. (Lubberink et al., 2017)
Reflexivity	According to Lubberink et al. (2017) *"Reflexive innovators engage in several elements that need to be managed when engaging in innovation. They evaluate whether current and previous actions support the governance of the innovation process and help to achieve the desired outcomes of the innovation. The evaluation of the innovation needs to be in line with the type of innovation, what element is looked at, and the purpose of the innovation."* (Lubberink et al., 2017)
Inclusion	Making sure that stakeholders are engaged in the innovation process. The innovators are expected to decide who are the key stakeholders that require involvement, how, and which phases of the innovation process requires their involvement. (Lubberink et al., 2017)
Deliberation	Having dialogues with the stakeholders to consider their suggestions and inputs. Some examples of how this can be done listed by Lubberink et al. (2017) include crowdsourcing, focus group discussions, workshop settings, community visits, and deliberation with experts in the field. (Lubberink et al., 2017)

Responsiveness	Staying up to date on any changes in the general environment and economy that could require sometimes drastic changes to the innovation. (Lubberink et al., 2017)
Knowledge Management	Organizations sometimes lack key knowledge that must be considered when creating a particular innovation. This key knowledge may sometimes resonate with the stakeholder needs, which if goes unnoticed might lead to the failure of the innovation upon launch. This is also a reason why organization must take different actions to stay up to date and anticipate change. (Lubberink et al., 2017)

Table 3, An adaptation of the Model for increasing the dimension of Responsible innovation (Lubberink et al., 2017)

Further studies show that knowledge management can be of highest importance in organisations learning and adopting innovation habits that lead to sustainable innovations (Chen and Huang, 2009; Hussinki *et al.*, 2017; Abbas and Sağsan, 2019) found that knowledge management can exist as the main driver of a company's sustainable development activities. Previous research find that sustainable practices lead to the creation of positive impact within the organizations that adopt sustainable practices (Lubberink et al. (2017). Though studies often highlight the positive impact of sustainable practise, Nina Tura (2018) warns that on the contrary implementing sustainable practices may lead to four categories of tension between stakeholders: economic, structural, psychological, and behavioural tensions, see adapted summary in Table 4 below (Tura, 2018).

	Implementer	**Supplier**	**Customer**	**Network Partner**
Economic Tension	Cost allocations, higher investments	Stricter Compliance requirements	Increase in costs	
Structural tension	Higher focus on keeping up with requirements			Higher level of Network complexity
Psychological tension	Increased risks financial, political, or technological risk	reduced motivation to adhere to the implementer's codes of conduct		
Behavioural tension	increased disclosure requirements and internal resistance	an increased need to collect and share sustainability-related data and information		

Table 4, Tension from Sustainable Business Practices in Business Networks. Adapted from (Tura, 2018)

2.5 Summary of Literature Review

The literature on LCT and sustainable innovation practices shows that much has been researched on the drivers and motivations of organizations to adopt practices that support LCT and sustainable innovation practices (Rabetino *et al.*, 2015; Pesonen, 2001; Junnila, 2009; Klöpffer, 2014; Witczak *et al.*, 2014; Neugebauer, Forin and Finkbeiner, 2016;

Hanegraaf *et al.*, 2020; Jacobo-Hernandez, Jaimes-Valdez and Ochoa-Jiménez, 2021). These drivers are often opportunity-driven and build on past positive experiences (Bocken *et al.*, 2014). Nina Tura (2018) provides a new perspective on the negative impacts regarding tensions that form within organizations that implement sustainable innovation practices. Moreover, the literature supports a connection between having adequate sustainable innovation practices and producing sustainable-oriented innovations. However, the literature also proves that there is a lack of research around applying LCT in IT Consulting or in Business Consulting in general. The literature review shows that a large majority of the literature is empirical research, which provides valuable demonstrated results in using LCT tools, however the results are often limited to an industry or region. There is a clear emphasis on studies being conducted on industrial businesses, where production lines and waste management are the focus, and less on businesses in the field of law, consulting, or IT services. Based on the literature reviewed there is a lack of research on the application of LCT from a business case development point-of-view.

3 Theoretical Framework

Costanza and Patten (1998), use a systemic literature review approach in defining sustainability to evaluate, whether an already existing product or services can be considered sustainable. A product cannot be labelled sustainable until the product has proven itself sustainable, therefore when we assess sustainable innovations at the design stage, in practice, we cannot know if it will succeed in achieving its goal until the product or service is in actual use, this is why sustainable innovations will be referred to as sustainable-oriented innovations (Costanza and Patten, 1998; Adams, R. *et al.* (2016)).

It is also assumed that companies with more defined Front-end Environmental Designs (FEEI) have a higher likelihood of having more sustainable innovation performance (Bocken *et al.,* 2014). The FEEI approach can be used to benchmark improvements for the organizations way of working to adopt LCT.

Bocken et al, (2014) study finds that LCAs can be helpful in the early stages of designing for the environment. LCAs can be especially helpful when innovating sustainable solutions to understand where in the life cycle does the process produce the highest impact. Furthermore, Pesonen (2001) suggest a circular logical definition for LCT suggesting that the mere attempt to conduct LCAs in the organization is the practise of Life Cycle Thinking. This way we can create a hypothesis that suggests; by organizations that produce LCAs are practising LCT.

Many studies reviewed on innovation practices within organizations highlight that, the knowledge management process and internal creative capabilities are significant aspects for an organization to possess, to achieve sustainable innovation practices, which in turn will most likely lead to the production of sustainable-oriented innovations (Bocken et al., 2014; Lubberink et al., 2017; Abbas and Sağsan, 2019). Lubberink's (2017) framework to increase the dimension of responsible innovation shows relevance to this study in understanding where the organization stand in their current innovation activities and how can the right innovation practices play a role in applying Life Cycle Thinking in an IT consulting organization.
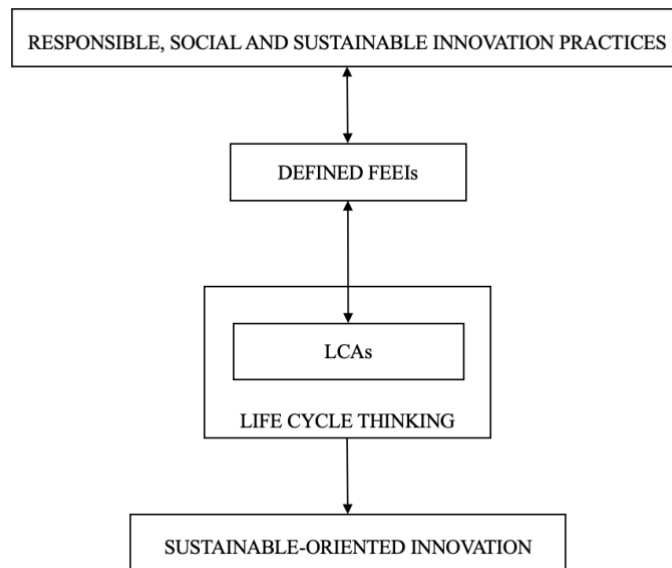
Figure 5, Theoretical Framework of the connection between responsible innovation practices, defined FEEIs and LCAs in creating SOIs

This work is empirical research that takes an exploratory approach in understanding the relationship between LCT and innovation practices inside a particular organization, and how LCT can be adopted within an organization. The theoretical framework above describes the hypothetical relationship between innovation practices that complement LCT, which in turn promotes the production of sustainable-oriented innovations. The data collected from the organizations will be done using a qualitative method. We can therefore assume that; an organization that produces or aims to produce sustainable-oriented innovations, will likely have responsible innovation practices set in place, which will include the use of LCAs and clearly defined FEEIs that enforces a sustainability-first approach that could be considered as Life Cycle Thinking. See Figure 5.

4 Empirical Research

This section describes the context of this case study and research methodology used to conduct this study, including the research design, sample, setting and analysis. The results from this study will be elaborated on this section.

4.1 Case Industry: IT Consulting

The professional consulting business is a highly complex, yet straightforward work that involves the process of understanding a business's processes, tasks, or any areas of challenges, and advising the business on how to perform these tasks to achieve goals defined by the business, such as higher profits, lower costs of production or higher overall efficiency (Kubr, 2002, p.). According to Gartner *"IT consulting services are advisory services that help clients assess different technology strategies and, in doing so, align their technology strategies with their business or process strategies* (Gartner, 2022)*". ("7 Reasons to Consult IT Professional Services Firms")* In a study investigating the source of IT consulting service value, Oesterle S. et al. (2020) defines IT consulting as *"expert services that are rendered to help companies survive, develop, and improve their performance, that is, to produce value* (Oesterle, Buchwald and Urbach, 2020)*"*. IT consulting services often includes helping business by providing operational or implementation strategies, architectural plans, or operational strategies to help clients achieve operational efficiency (Gartner, 2022). In the modern business environment where most organization are racing to acquire competitive advantage by harnessing the newest technology innovations, creates a high demand for knowledge around IT regarding operations, implementation, and strategy. This gap between IT knowledge and resources is often fulfilled by employing IT consulting service providers to contribute their resources.

IT Consulting often falls under the umbrella category of PSF (see section 2.2.3), which play a key role in the economy that is mainly competing over knowledge-based resources (O'Higgins, Andreeva and Aramburu Goya, 2020). Global PSFs are often divided by country units that operate under central group policies but have their own local leadership and team to communicate with their local clients(O'Higgins, Andreeva and Aramburu Goya, 2020).

Having localized services for each country is brings many advantages that help in understanding the market's needs, however distributed units across a global organization can cause several challenges as well. Previous studies find that the main challenge global PSFs face with having separate country units are related to knowledge transfer and retaining consistency in service(Kroll, Mäkiö and Assaad, 2016; O'Higgins, Andreeva and Aramburu Goya, 2020). O'Higging et al (2020) find in their literature review on *"international management challenges of professional service firms"* that a PSFs specialized knowledge of the professionals it the core of their services, in a global organization this accumulated knowledge needs to be stored and transferred to professionals globally. This will require organizations to build efficient knowledge management practices that will enable effective and consistent service across all global units (Kroll, Mäkiö and Assaad, 2016).

This research is conducted as part of a larger effort to integrate life cycle thinking within IT Consulting operations. As consulting organization IT consultants have an important role and responsibility in making sure clients within various industries are guided with IT solutions that contributes to sustainable development.

4.2 Research Design

This research will take an explorative approach to understand the current innovation climate within IT Consulting organizations and how Life Cycle Thinking might be applied across an IT Consulting organization. Explorative study is a research approach which takes advantage of open-ended questions to gain insight on a phenomenon and gain a full understanding of what is happening (Saunders et al., 2016). Due to the scope and amount of time available to conduct this research – this research takes a purely qualitative approach to data collection. The research is conducted as an explorative study. The qualitative method chosen for this research is semi-structured interviews due to the explorative nature of this research.

4.3 Qualitative method

As previously mentioned in section 3.3, the main data collection method used for this study is interviewing. The qualitative data analysis will take a deductive approach to understand

how much of the theory presented in the literature review applies to an IT Consulting organizations ways of working and how an organization can improve its way of working to adopt LCT in its way of work.

4.3.1 Sampling

Non-probability sampling was used as a method to identify without random selection of interviewees. The research sample consists of two large corporate IT service-providing companies, one medium-sized IT hardware, and service-providing company, and one LCA consultancy company. Two of the organizations interviewed work under a sustainable business model, so their mission is to provide their clients with sustainable-oriented solutions. The other two companies are consulting organizations that want to, but are not limited to, providing their clients with technologically sustainable-oriented innovations (See table 5). Six different IT consulting companies that fit the profile of an innovation leader in the IT industry were approached, as well as four different technology organizations that have sustainability as a central part of their business model. Four companies showed interest in going through with the interview. All companies wanted to stay anonymous, however, gave consent to use their title and role description as part of the research discovery. The company representatives for this interview will be referred to as A1, A2, A3, and A4.

4.3.2 Data Collection

A1: The first interview was organized with a Finnish medium-sized Sustainable IT solutions provider primarily operating and located in Finland. The interviewee was an executive that goes by the title Sustainability and Project Management Director. The interviewee agreed to be recorded for the interviewers personal transcribing purposes. Therefore, after the interview the recording was transcribed and analysed for any central themes.

A2: The second interview was conducted with a Large American Consulting Corporation that has a unit that operates in Finland. The interviewee was in middle management under the role of Presales Solution Architect. The interviewee agreed to be recorded for the

interviewers personal transcribing purposes. Therefore, after the interview the recording was transcribed and analysed for any central themes.

A3: The third interview was conducted with a small sized LCA consulting firm located in Finland, that specialises in helping organizations harness the power of LCAs, though providing academic students internships and training opportunities in organizations to conduct LCAs. The interviewee was the founder and marketing coordinator of the organization. The interviewee agreed to be recorded for the interviewers personal transcribing purposes. Therefore, after the interview the recording was transcribed and analysed for any central themes.

A4: The fourth and final interview was conducted with another Large American IT Consulting Corporation that has a unit which operates in Finland. The interviewee was in middle management under the role of presales manager. The interviewee agreed to be recorded for the interviewers personal transcribing purposes. Therefore, after the interview the recording was transcribed and analysed for any central themes.

All interviews were held and recorded using Microsoft Teams. The duration of the interviews were between 45 – 90 minutes depending on how much the interviewee had to say. The interviews were transcribed using Microsoft Word, which were anonymized and later transferred to a common Excel document. The transcriptions were cleaned from any company names or client references to allow the interviewees and their companies to remain anonymous for the purpose of this research. See appendix 1 for LinkedIn request sent to interview prospects with a category of sustainable innovation as business model sustainable innovation, see appendix 2 for LinkedIn request sent to interview prospects with a category of sustainable innovation as technological sustainable innovations, see appendix 3 for email calendar invite content sent out to all interviewees and see appendix 4 for interview template.

4.4 Qualitative Data Analysis

Thematic analysis was chosen as the method of qualitative data analysis for this research. Thematic analysis is a relatively popular approach to analysing qualitative data, that consists of identifying themes and patterns in the data sets provided for the research (Saunders, M. et al., 2015, p.579). As part of the thematic analysis the qualitative data, which in the case

of this research were the interview transcripts, was revisited multiple times including to identify any themes or patterns from the data sets. Special attention was paid to the understanding and measures taken to conduct LCAs within the organizations and drivers of sustainable-oriented innovation. The organizations were distinguished according to Varadarajan (2017) categories of sustainable innovation between companies that is a Sustainable Innovation through their Business Model and a company that aims to create Technological Sustainable Innovations.

Interviewee Profiles:

	Role	**Company**	**Category of Sustainable Innovation**
A1	Sustainability and Project Management Director	Sustainable IT Infrastructure Provider	Business Model Sustainable Innovation
A2	Presales Solution Architect that belongs to the technology unit	A large American Consulting Corporation	Technological Sustainable Innovations
A3	Founder and marketing coordinator	Finnish American LCA training and resource providing Startup	Business Model Sustainable Innovation
A4	Technology Consultant	A large American IT Consulting Company	Technological Sustainable Innovations

Table 5, Interviewee Profiles

4.4.1 Results – Thematic Analysis

Life Cycle of Solutions

Life Cycle of Solutions play a crucial role in understanding how LCT can be applied within the organization. Referring to section 2.3 one might conclude that LCT is the attempt to thoroughly understand the life cycle of a solution. There was a clear division of where this attempt was more apparent. Company representatives A1 and A3, brand themselves as ambassadors of sustainable and circular thinking, as sustainable-oriented solutions are embedded in their business models. Therefore, it came as no surprise that both organizations show thorough attempts to try and understand the environmental and financial life cycle of their own as well as their clients' solution.

> **A1:** *"So there's there are several things we try to look at the sustainability from different perspectives.* **We look at the services and solutions to life cycle thinking so we tried to conduct life cycle analysis.** *We're still in early stages of that work, but especially now with the new services where we're looking through that lens more thoroughly than of course, carbon footprint of different components of the service, where it's possible. For example, carbon footprints, and to see if the device is energy efficient and measure the use of electricity. Materials, their durability, their sustainability. So, for example, like whether a device is made of aluminium or plastic, and if it's recycled or primary product."*

> **A3: "Our training focuses providing knowledge about LCA in general, the idea is that that you, after the training, you should be able to pick up basically any tool….** *", "So that's of course* **built in our entire business model**, *so we have the curriculum that we are following, and it's built in a way so that basically anybody with an academic background can jump into the course. It doesn't matter if you are, you know marketeer, or if you are, uh. You know you have an environmental science background, or if you are a chemist. Anybody, uh, we have built this course. So that anybody can jump in and start learning."*

The sample of more traditional IT Consulting companies that have a clear sustainability goal showed attempts to understand the sustainability of a solution based on previous case studies and references. In these larger hierarchical organizations, they find it more difficult to explain a standardized life cycle of their solution, as well as, truly envisioning each step of the life cycle of a typical service they provide to their clients.

> **A2:** *"we refer to certain case studies of prior references and see what kind of the success criteria is. For those the success criteria of what that made you know what made the project successful and we try to reutilise the good aspects into our presales process. But sometimes some of the obviously some of the aspects are not that easily measurable, so then I would have to go in extra mile and talk to the for example, the project managers or service delivery managers because they have their own ways of actually measuring."*

> **A4:** *". So, we implement the project and then we move on to the ending of the project. But then again within the project there is its own owned life cycle as well. So yeah, then after the project ends, I'm unfortunately we are usually left sort of in the dark…. But yeah, there's a bit of a bit of a dark space there. So, we don't really understand how the project ends up in the end-of-life stage. I guess that's just the nature of a service providing company rather than a product providing company."*

Key Stakeholders

All the organizations show keen interest in working with research partners, and clients to increase their innovation anticipation as is expected from organizations that produce responsible innovation in accordance with A model for "Responsible innovation in the business context" by Lubberink et al., (2017). All the organizations show commitment to learning from partners and research facilities. The companies that did not have sustainable innovations as a business model mainly focused on understanding trends within innovations by following up on what their partners. Even though, A3 mentioned they collaborate with universities it is still unclear to what extent when it comes to LCAs or climate mitigation related topics.

A2: *"Right, so I think there is we consider different stakeholders if, for example, whether it's our clients and whether it's our products in our services...* **So, we check what are the partners developing? What is the market needs from the client side? Then we try to evolve our ways of implementing such products in in a more efficient way.** *I would say that would be the core way of innovating, but another point of innovation here that goes these days is for example how we deliver."*

A4: *"We collaborate with a* **lot of universities; we collaborate with other organizations and similar companies to keep up with**. *With uh anticipating what we need to innovate on and what are the things happening and this also includes staying on top of what our partners are doing..."*

The companies who have Sustainable Innovation as a Business Model showed clear focus on collaborating with universities and research centres with the government. It is clear that they recognise the value of academia and government legislations when conducting research on the area of sustainability and LCAs more specifically.

A1: *"We do a lot* **of collaboration with universities with other research centers with government. Organizations with software companies and other companies.** *So basically, collaboration then is just* **researching and following news and staying on top of things. Basically, being relevant and current.** *And then just read a lot of future studies or projections that we use even at company board level, we use those as tools for future planning..."*

A3: *"Sure, kind of keeping an eye out for what's happening in each of our markets in* **terms of legislation***. Then also we are getting quite a good indication of what's happening in companies and on the market through our customers. Just because many of them are kind of ahead of the rest of the market, like* **the companies that are jumping right now on and want to try out LCA and want to try out Earthster or want to try out our services. They are ahead of the game; they are the fore runners right now** *I would say. So, I think that gives us also. Quite a good indication of like. What's going on? In which direction? What? What kind of trends are we seeing? Uh, in terms of where there is a need"*

Inclusion

Inclusion in the context of this study reflects Lubberink et al. (2017) high-level framework for creating responsible innovations within an organisation based on their systemic literature review on *"responsible, social and sustainable innovation practices"*. All in all, most representatives from the organizations interviewed described their innovation culture as rather inclusive, with most saying that anyone within the organization is welcome. However, A1 expressed reluctance from their employees to do work that is not part of their work description nor their knowledge area leading to a highly homogeneous group of innovators within their leadership team.

> **A1:** *"To be really honest, we **have open doors** every time we sort of put our minds to anything we let the entire organization know. Whenever there's a workshop or brainstorming anyone from the organization is welcome. But it's like I said, **the excitement is not exactly overwhelming.** So yeah, it's an open-door policy, but it usually then ends up being the person that's in charge of that specific, like business unit or area…."*

> **A2:** *"So basically in my team we are all go to market leads for our topic…"*

> **A3:** *"So eight is our core team and then we have our teachers who are freelancing people, but they are kind of floating on the side, so **we are actually including our entire organization in innovating**."*

> **A4:** *"…**it's really up to wanting to be a part of the innovation process**, so on an operational level, looking at what we're doing in the organization, not with our clients, this is really up to people who are interested. So, **we do have different initiatives going on where we ask for volunteers who are interested in certain topics to hop in and try and ideate or innovate…**"*

Understanding Sustainability

Based on the interviews, as expected, the definition of sustainability was at a quite high-level for all representatives. However, the organizations that have sustainability and circular economy as an active part of their business model (A1, A3) clearly showed more initiative

to attempt life cycle analyses within their own and with their clients and partners. The definition of sustainability from these organizations aligned with

> **A3:** *"...we can be more sustainable than we are currently, or product can be better for the planet than the previous version has been, but I don't know if there truly something is that's truly sustainable. That's just my opinion. **I think you can incorporate sustainability, into the innovation, but I don't know if there is such a thing as in a sustainable innovation** ..."*

Though A2 and A4 do not actively attempts to conduct life cycle assessments, they do take into consideration sustainability by pulling in relevant resources from within their organization when needed.

Driving Sustainability

Driving sustainability can be hard in organizations that have a fixed pattern of work, A4 mentioned that a challenge with driving more sustainable thinking is closely related to defining what sustainability is. Many corporate employees are still quite insecure about their knowledge of sustainability, therefore leave it "to the few experts", if any, which might greatly limit the organizations capacity to gear their employees towards sustainable thinking.

> **A2**: *"in my team we have several go-to-market leads and I am for example or focusing on SFP on Azure. So, for me it's important to know; how can I incorporate the ESG goals onto it? **Usually what I do is I take help from cross functional teams like the ESG experts or sustainability experts in in my company.** So, like in our organisation we basically focus. Then we bring in. We pull in those experts, and we try to understand what kind of our homegrown products are."*

> **A4**: *"I think it's clear to people who are doing environmental studies, people who understand and environments and people who studied sustainability thoroughly, they probably understand how we can drive more sustainable innovations. But when you work in an organization where you have certain ways of doing things and things have been done to certain way for many years. **It's hard to suddenly start implementing the sustainable factor into it if it's**

not explained simply enough for the employees. So, there's definitely that, that element of translating to us what is sustainability and how do we translate it into our work, because I'm sure everybody would love to be more sustainable."

Categories of tension

Referring back to Tura's (2018) publication on *"Tensions from sustainable business practices in business networks"*. All interviewees indicated that there is some level of tension when introducing work around sustainability. Interviewee A1, showed evidence of reduced motivation to adhere to the implementer's codes of conduct (Tura, 2018), Tura (2018) described this sort of tension to take place when the practices have no direct benefits to the participants or if the value chain involved other partners who did not follow similar practices.

> **A1:** *"Maybe in some way it has to do with like education level so like immediately when you start throwing out words like innovation and system and management, people are already yawning a lot like maybe they don't have interest because they don't have a full understanding..."*

Interviewee A3 showed potential for structural tension due to focus in reaching customer targets. IT consulting corporations often deal with strict customer satisfaction targets that can with the addition of sustainable practices create structural tension within the organization.

> **A2:** *"...the ability to **reach customer satisfaction targets**. Those are usually defined by the PMO office. I don't partake into that as much, so from my personal goal as I mentioned before, it's more on the fact that if we reach a certain monetary value of deal sold and then ensuring that the customer gets something valuable out of it…"*

4.5 Reliability and Validity

Reliability is defined as the replication and consistency of a research (Saunders, M. et al., 2015, p.202). The reliability of this research can be considered as relatively low, due to a high risk of participant errors and biases formed from interviewing single individuals from organizations. A lot of the questions were answered using one employee's perspective of the whole organization's behaviour, which might not provide the study a fair understanding of how the organization operates regarding innovation and what type of initiatives and activities are being taken to ensure sustainable-oriented innovations are created. Furthermore, the study had a small sample of interviewee and focused on interviewing one person from the organization which creates the potential to lack validity due to possible ambiguity about causal effects.

5 Discussion

All in all, the results of the interviews correlate with the findings from the literature review. The model of increasing the dimension for responsible innovations by Lubberink et al. (2017) (1) anticipation, (2) reflexivity, (3) inclusion, (4) deliberation, (5) responsiveness and (6) knowledge management were clearly represented as central parts of each organization's initiatives. Though, inclusivity seemed to pose some individual challenges for the organizations, all organizations say they have an open-door policy for innovating and A1 more specifically expressed concerns with getting lower than management-level employees involved in the organizations innovation sessions. Bocken *et al.* (2014) stated that the drivers and motivation to adopt practices that support sustainable-oriented innovation are often opportunity-driven and built on past positive experiences. A1 mentions that the first characteristic of a typical innovator in their organization is **passionate** and then continues with someone who has a **high stake** in the company. It would be interesting to make further research on whether the passion is driven by the high stakes (making it opportunity-driven) or the passion is driven by passion for sustainability. For example, if an organization only involves top management that owns shares in the company, there is a high chance that they are motivated by the value of their shares rather than the actual sustainable impact of their organization. So, in terms of passion, sustainability, and high stakes, it is still unclear what is the true driver for sustainable-oriented innovation in an organization where the top management is the innovation team. Although all the interviewees talked about open door policies, they still characterize most of their innovators as management and directors. This approach directly contradicts Bocken et al, (2014), who found that creativity is viewed as the most important skill, which is followed by engineering skills and environmental knowledge, when creating sustainable-oriented innovations.

The results also agree with Sacco et. al., (2021) on how the LCA assessment method lacks a common agreed scientific basis, that leads to the low applicability of the methods in industrial realities. The result of this leads to companies not addressing CE in their business processes (Sacco et. al., 2021). Alluding that the methods are there but lack clear guidance on successful outcome-oriented implementation, which can be seen in organization A2 and A4 as probably barriers to implement LCAs within their work. Nanda and Narayandas (2021) argued in the paper on The Professional Service Spectrum" that *"a practice's position*

on the spectrum is determined not by the practice leader's presumptions but by the client's appraisal (Nanda and Narayandas, 2021)." Adding further that problems emerge when a leader does not recognize that their practice is not on the premium end of the service delivery spectrum (Nanda and Narayandas (2021). The interviewees from IT consulting organizations that have their category of innovation as Technological Sustainable Innovations (A2 and A3), indicated that their local leader's might not recognize that their practice on sustainability is on the lower end of the premium spectrum. A2 expressing that LCT *"it's not primarily my role as much"* and A4 adding that *"I am customer facing and I'm usually there to implement a certain service for our clients, which might not require life cycle thinking. So, this can be sometimes difficult on our part to really prove what life cycle thinking is in real life."* This shows evidence of a misalignment of practice, which can lead to consulting practices promising their employees and clients exciting work and the contribution to innovative sustainable solutions, while the consultants are actually measured on their billable hours to clients who expect the efficient delivery of routine solutions. The local leaders misunderstanding of their maturity to deliver sustainable-oriented work will create a misalignment within the employees and to clients in what the practice actually does (Nanda and Narayandas (2021).

As a recommendation based on these interviews, IT consulting organizations should put more effort into increasing their creative innovation profiles. As the interviews reviled, people play a very significant role in shaping the results of the innovation efforts. A2 and A4, are large enough organization to have separate creatives take part in conducting LCA's and getting involved in the FEEI process. A3 should consider adding more creative recourses with a background of environmental studies to further increase their sustainable-oriented innovation efforts.

Both interviewees A2 and A4 expressed concern and hesitance of people within the IT industry incorporating sustainability with IT business development, due to a lack of understanding of what sustainability is. This concern is concurred by interviewee A3, and Ottosson (2016) who claims that the terms "Sustainability and "Innovation" are overused buzzwords that require defining within the context of sustainable innovation. Organizations such as A1 and A3 understand the complexity and the uncertainty with conducting LCAs yet take a "fail fast" agile approach to tackling LCAs, to implement LCT. The lack of environmental specialists involved in both organizations A2 and A4 during the innovation

process might be a factor that affects the lack of motivation to develop sustainable understanding. Earlier it was mentioned that Bocken *et al.* (2014) suggest creativity is viewed as the most important skill, which is followed by engineering skills and environmental knowledge, when creating sustainable-oriented innovations. A3 agreed with engineering background and motivation being the strongest skills needed in LCAs, however failed to mention anything about creativity. IT organizations are likely to be filled with excellent engineering skills and a creativity, however, environmental knowledge might be at a very high-level inside an IT company. For the long-term both companies A2 and A4 should begin to invest in resources that have an in-depth understanding of the environmental implications and combining this information with IT software development. The new environmental resources should have a role in influencing the organization to make scientifically backed sustainable choices in IT development. Moreover, it is important to set-up the right type of knowledge management framework to enable sustainable-oriented innovations across the organization. This is of up-most importance in making sure the organization has a harmonized understanding of what sustainability is and encourage them to attempt the conduction of LCAs.

A Framework of Operating LCT in IT Consulting

Going back to Pesonen (2001) argument that, though the results of LCAs can cause controversy due to the vague nature of the LCA methodology, just by conducting LCAs and taking initiative to understand the life cycle of a product, the LCA promotes a revolutionary way of thinking in business development (Pesonen, 2001). This is evident in the organizations that have sustainable innovations as part of their business model.

Both companies interviewed that practised LCAs (A1 and A3) were relatively small and led with a rather entrepreneurial mindset. Pikarski et al (2013) mentioned that companies that adopt new tools like LCA with an entrepreneurial mindset, are more likely to solidify their competitiveness, leading to sustainable oriented innovations. This was proven with the interview results from the organizations that practised sustainable innovation as a business model. Further emphasizing how LCA is a crucial tool for companies that desire excellent results from green innovations and facilitate green innovations (Piekarski et al., 2013).
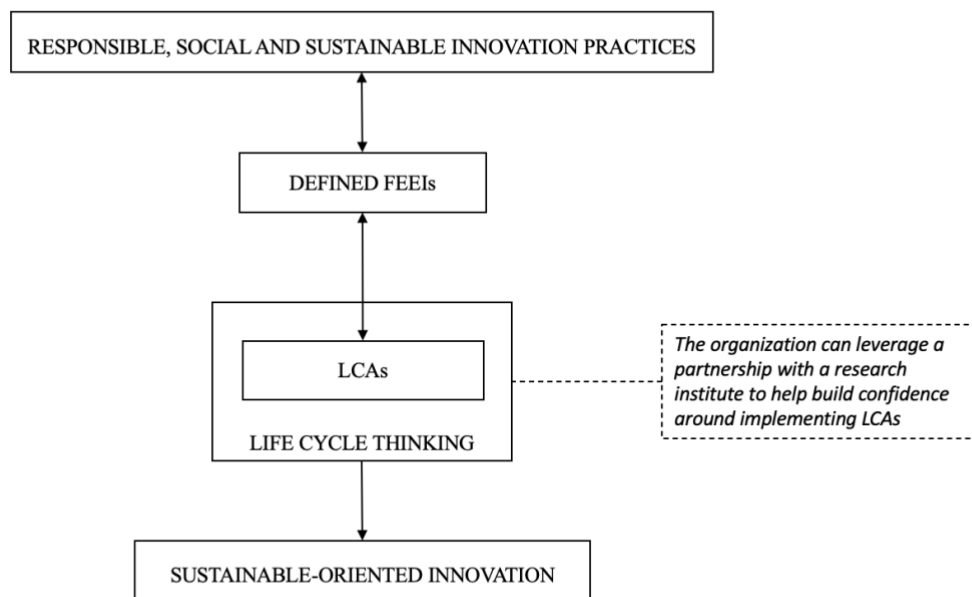
Figure 6, A modified framework of applying LCT

The results indicate that the framework suggested as a hypothesis from the literature review is applicable on a high-level. Organizations that do not have sustainability as part of their business model yet can apply the high-level framework above by outsourcing knowledge from research institutes of environmental resources to help build confidence in adopting LCT as a way of work for the consultants.

6 Conclusion

In conclusion, Life Cycle Thinking can be defined as an active attempt to complete Life Cycle Assessments. The study has shown that the only difference between organizations that practise life cycle thinking and organizations that don't, is the serious attempt in conducting LCAs. The interviews with sustainable-oriented organizations proved that LCT is derived from the attempt of LCAs. This often requires an agile approach where the conductor of the LCA is expected to fail fast and iterate until an acceptable LCA is created.

Now keeping this revelation in mind, the answer to the main research question *"In what ways can an IT Consulting organization benefit from life cycle thinking?"* – IT consulting organizations can benefit from LCT by becoming "a fore runner" in environmental sustainability giving them a clear competitive advantage in an increasingly climate conscious society. Companies and their end-users are more interested than ever to understand the environmental impact of the solutions that they acquire. Companies that invest in having proper education on LCAs or partner with research institutes are likely to be more successful in implementing LCT within their organization.

My second research question *"What are the main challenges and opportunities in incorporate life cycle thinking in consulting?"*. The main challenges in incorporating LCT in IT consulting come mainly in educating all the employees on life cycle thinking. As mentioned in the literature and proven in the results, most organizations that practise LCT do so with an entrepreneurial mindset. The challenge here is understanding how to reprogram corporate employees into thinking like entrepreneurs on a subject that still requires a lot of proactive research to keep up with the relevant information. The LCA process lacks validity and requires a lot of testing before finding the right formula. In IT consulting firms time is money, therefore it will require a significant investment and commitment to educate and keep all their employees up to date on the latest advancements in LCAs. LCAs play a critical role in LCT, therefore without conducting LCAs the organization cannot be conducting LCT.

Finally, the third research question *"How can the right innovation practices play a role in making life cycle thinking a critical factor in consulting?"*. Innovation practices that fall under inclusion and responsiveness play a major role in making ways of working such as LCT a critical factor in consulting. The study showed that organizations that practise open door policy in innovating and actively work together with research partners and environmental industry experts can exceed in implementing LCT as part of their organization.

Contribution, implication, limitations, and future studies

This study contributed to the basic understanding and defining of Life Cycle Thinking. The study also contributed to understanding what needs to be considered when applying Life Cycle Thinking within an IT consulting organization. The action points and framework provided provide a high-level understanding of what is Life Cycle Thinking and how it can be applied in an IT consulting organization.

As previously mentioned, this research has many limitations. The reliability of this research is low, due to the sample size and lack of variety in interviewees per organization. Furthermore, the research cannot be generalized since all the interviewees were in Finland. The research only considered four organizations which can contribute to the lack of validity in results.

Further studies on applying LCT could include real-life case studies where common use cases of LCA is assessed with friendly organizations conducting the LCAs. The approach could highlight some interesting facts regarding the level of maturity the organization has regarding LCT. Another interesting approach could be to further study how can organizations incentivise their employees to take more proactive initiatives to apply LCT as part of their way of working.

This research took advantage of only one qualitative data collection method. Based on these interviews it would be beneficial to evaluate sustainable-oriented innovation practices using more qualitative methods such as observation to sit in meetings and observe the actual

interaction between the teams working on LCAs to understand how they actually apply LCT in practice. In this case, it would be wise to focus on one company in a single case study.

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8 Appendix

Appendix 1 – LinkedIn Request Sent to Interview Prospects with a category of Sustainable Innovation as Business Model Sustainable Innovation

Hey XX!

I am writing a thesis on applying life cycle thinking in IT Business consulting as part of my M. Sc in LUT University. My thesis aims to understand how we might define "life cycle thinking" as a term used in IT consulting. I notice you work mainly with LCAs, which is seen as the foundation of applying life cycle thinking. As part of my master's Thesis, could I possibly bother you for a 30-45min semi-structured interview? The interview is anonymous. I will only have a description of your role and company, but I will not include your name or the name of your company.

Kind regards,

Candy Mbare

Appendix 2 - LinkedIn Request Sent to Interview Prospects with a category of Sustainable Innovation as Technological Sustainable Innovations

Hey XX!

I am writing a thesis on applying life cycle thinking in IT Business consulting as part of my M. Sc in LUT University. My thesis aims to understand how we might define "life cycle thinking" as a term used in IT consulting. I notice you work mainly in IT Consulting within a role that seems to focus on innovation. As part of my master's Thesis, could I possibly bother you for a 30-45min semi-structured interview? The interview is anonymous. I will only have a description of your role and company, but I will not include your name or the name of your company.

Kind regards,

Candy Mbare

Appendix 3 – Email Calendar Invite Content sent out to all interviewees

Hello!

My name is Candy Mbare. I am a final year LUT Master's student.

I am conducting interviews as part of my master's Thesis to gain valuable insight into the role of life cycle thinking in sustainable-oriented innovations in IT consulting. I am running this interview as a part of my research to identify how IT Consulting Companies could apply life cycle thinking within IT Business Consulting. I am gathering valuable experiences and understanding from organizations that practice initiatives that correlate with life cycle thinking.

This interview will display a general title of your responsibilities and a description of your employer. However, I will exclude your name from the study. If you have any questions or would like to receive my recommendation of action based on my background research on this topic and the outcome of this interview - You can contact me via email or LinkedIn.

For this study, Life Cycle Thinking is defined as "A systematic attempt to foresee the consequences of introducing a particular technology in all spheres it is likely to interact with, "and sustainable innovations are spoken of within the context of "A framework for structuring the sustainable effects of innovation."

Looking forward to chatting with you!

Kind regards,

Candy Mbare

Appendix 4 – Interview Template

Date: DD.MM.2022	*Time:*
Interviewer	Candy Mbare
Interviewee	Professional Title of Interviewee:

	Hello,
	My name is Candy Mbare. I am a final year LUT Master's student. I am conducting this interview as a part of my master's Thesis to gain valuable insight on the role of life cycle thinking in sustainable oriented innovations in IT consulting. I am conducting this interview as a part of my master's thesis to identify how life cycle thinking could be applied within IT Business Consulting. I am gathering valuable experiences and understanding from organizations that practice characteristics that connect with life cycle thinking. This interview will display a general title of your responsibilities and description of your employer; however, your name will be excluded from the study. If you have any questions or would like to receive my recommendation of actions based on my background research on this topic and the outcome of this interview - You can contact me via email or through LinkedIn.
	For this study Life Cycle Thinking is defined as "A systematic attempt to foresee the consequences of introducing a particular technology in all spheres it is likely to interact with ", and sustainable innovations are spoken of within the context of "A framework for structuring the sustainable effects of innovation". Are these terms clear to you? Do you have any questions before proceeding to the interview?
RECORDING AVAILABLE?	*The interviewee understood the purpose of this interview and had no further questions. Yes/No*
House Keeping	
	What does your organization do?

What is your role in the organization?

Life Cycle Thinking		Clarifying questions
	In what ways does your organization measure the level of sustainability of a new solution or already existing solutions? or the environmental impacts of your solutions?	
	Do you encourage your employees to practice life cycle thinking in anyway?	
	Can you give an example of a typical life cycle of a solution that your organization might provide?	

Innovation Practices		Clarifying questions
ANTICIPATION	*In what ways does your unit engage in any activities that help in anticipating your innovation context?*	
REFLEXIVITY	*How do you evaluate your previous innovation processes and outcomes?*	
INCLUSION	*In what ways do you determine who are involved in the innovation process?*	
DELIBERATION	*How do you engage in dialogue with different stakeholders?*	
RESPONSIVENESS	*How do you keep up with the trends and happenings around the innovation environment?*	
KNOWLEDGE MANAGEMENT	*How would you describe/evaluate the knowledge management process in your company?*	

Sustainability		Clarifying questions
DEFINITION	*How would you typically define a sustainable innovation?*	
ACTUALIZATION	*When is an innovation typically defined as sustainable?*	

Typical characteristics		Clarifying questions
LCAs	*Do you utilize Life-cycle assessments when introducing new technology? At what point would you typically use an LCA?*	
DRIVERS	*In your opinion what are the key components and/or drivers for creating sustainable innovations?*	
KEY CHARACTERISTICS	*How would you describe the innovators in your organization?*	