"The Nexus of Sustainability and Industry 5.0: Assessing Canadian Organizations' Readiness for the Next Technological Revolution."

Professor Dr. Nisa Chand

Ada del Carmen Sandoval Madrid [redacted]

University Canada West

MBAR 661 Consulting / Research Project

September 2023

Table of Contents

Abstract

The contemporary business landscape currently witnesses one of the most profound and revolutionary technological transformations -Industry 5.0. This revolution compels organizations with the need to navigate the intricate balance between the adoption of innovation and upholding the principles of sustainable economic growth. This investigation aims to uncover the strategies currently employed by Canadian organizations in anticipation of the challenges and opportunities presented by the synergy between sustainability and technological integration.

Industry 5.0 presents an emerging phase that envisions a novel confluence: The empowerment of human beings in their interactions with machines, and cutting-edge technologies. In an era of technological innovations, the incorporation of artificial intelligence, and machine learning, a paradigm shift towards the importance of human-centric values is a key driver of sustainability. The paper argues that this human-centric approach is vital to attain efficient, long-term, sustainable social, environmental, and economic practices.

This thesis presents a qualitative approach to research based on fourteen in-depth interviews conducted with senior managers and executives from various industrial sectors in Canada.

Results obtained from a qualitative approach show that Canadian organizations have adopted sustainable practices, mainly to comply with required normative and governmental policies formally. These practices have yet to fully permeate private enterprises due mainly to the high costs of incorporating sustainable practices in all areas and departments or to budgetary restrictions and priorities in other strategic areas. Public organizations, on the other hand, show more standardized and formal sustainable strategies implementation framework.

On the topic of the adoption of new technologies and the implementation of Industry 5.0-related practices, results show that the concept still needs to be fully understood. Organizations in both public and private sectors have adopted the latest trends in hardware, software, automatization of processes, and technology; however, several areas of opportunities are identified, regarding training and development programs, adoption of costly technologies, and fostering a change mindset across organizations.

Introduction

Organizations face new challenges to balance economic growth with sustainable practices in an era of rapid technological advancements, adaptive environments, and changing global settings as part of a world becoming more inclusive, respectful, and emphatic towards human-centric values (Prasanna et al., 2019; Gupta, 2022).

Canadian organizations are no exception in the face of unprecedented global environmental challenges. Like many enterprises around the world, they have recently accepted the relevance and importance of implementing sustainable practices and incorporating cutting-edge technologies in their organizational goals and regular operations to foster a more ethically responsible business landscape (Dodds & Holmes, 2011; Delannon et al., 2016; Matson et al., 2016).

As Industry 4.0 set the foundations for a more digitally connected and efficient manufacturing landscape in the last decades, Industry 5.0 presents the new phase of the industrial revolution by providing an opportunity for organizations to find a balance between the latest technologies and the opportunity to reach financial objectives through sustainable, more human-centered practices (Ben Youssef & Mejri, 2023). Industry 5.0 represents the convergence of technology and human-centered, sustainable practices within organizational settings (Aslam et al., 2020). After the COVID-19 pandemic, it became clear that business excellence and financial success for organizations could be reached in the upcoming decades only through business models characterized by long-term, sustainable, and resilient development models (Suciu et al., 2023).

To better comprehend the relationship between sustainable organizational practices and Industry 5.0, it is necessary to systematically examine relevant literature on the evolution of both concepts through history and, more particularly, the history of sustainable practices and the embrace of new technological trends within Canadian organizations. How are Canadian

organizations adapting to the convergence of sustainability and Industry 5.0, and how are their technological and sustainable strategies implemented? In order to answer these questions, this thesis outlines a qualitative academic research study aimed at exploring how Canadian organizations are navigating the encounter between sustainable practices and technological advancements to embrace Industry 5.0 to explore the status of sustainable organizational practices and how Canadian organizations are responding to the rapid technological advancements and a growing emphasis on human-centric values.

Through an extensive literature review and in-depth interviews with employees of diverse Canadian organizations located in the province of British Columbia from different industries and diversity of hierarchical levels, this research aims to explore some of the current strategies employed by Canadian organizations in preparation for the upcoming challenges and potential synergies between sustainability initiatives and technological integration.

It is crucial to clarify that, in a world in which seeing, assessing, and identifying pivotal events as linear, chronologically happening, one after another, to understand the notion of Industry 5.0 fully, it is required to adopt a new vision, to be open to a new perspective in order to fully understand the relevance of such a pivotal trend in which technology meets human-centric, sustainable practices within organizations. Although, in order to understand the foundations of where sustainability and Industry 5.0 meet, a chronological journey through a literature review must be addressed, readers should go beyond a sequential analysis of events and more through a discovery of how the synergy between technology and the evolution of human-centric efforts in an organization has created a new pivotal angle from which to analyze and understand the readiness of organizations for a new technological revolution in which technological advances cannot be measured without a symbiotic relation with humans and society.

Literature Review

The urgency for environmental concerns in organizations from the beginning of this twenty-first century has compelled organizations to reevaluate their operations' quality and adopt sustainable practices (Matson et al., 2016; Gupta, 2012). Industry 4.0 has brought to systems and operations a wide range of technological innovations such as artificial intelligence, blockchain, and the Internet of Things (IoT), opening new opportunities for organizations to optimize procedures, increase efficiency, and revolutionize business models (Gupta, 2012). Industry 4.0 has given rise to a more digitally connected manufacturing scene in several industries; Industry 5.0 envisions a more harmonious coexistence between humans and machines, emphasizing value creation, sustainability, and social problem-solving (Prasanna, 2019; Xu et al., 2021; Turner, 2022; Yitmen et al., 2023).

However, as opposed to all previous industrial revolutions, Industry 5.0 does not necessarily represent the "next step" as this trend has gained momentum in parallel with Industry 4.0. In order to understand the foundations of where sustainability and industry 5.0 meet, a chronological journey through a literature review must be addressed; however, we must go beyond a sequential analysis of events and more through a discovery of how the synergy between technology and the evolution of human-centric efforts in an organization has created a new pivotal angle from which to analyze and understand the readiness of organizations for a new technological revolution in which technological advances cannot be measured without a symbiotic relation with humans and society. As Xu et al. (2021) have recently expressed, "Industry 5.0 is not a technology-driven revolution, but a value-driven initiative that drives technological transformation with a particular purpose" (Xu, 2021, p. 533).

The Industrial Revolutions

The analysis and studies of the industrial revolutions have aimed to understand the economic impact of diverse technological advancements on societies and economies worldwide. All these revolutions have opened the window to new realities for civilization in education, manufacturing, innovations and economic development, productivity, and work efficiency. The relevance of these industrial paradigms can be defined in three major revolutions in the world based on the introduction of new products through diverse means of production, a disruption of the accepted status quo, and new requirements for workforce and infrastructure as these so-called revolutions generated the necessity for new rules of engagement in business, production, and manufacturing, changing the dynamics of the economy and social structures (Koc & Teker, 2019). What all industrial revolutions have in common is an apparent "transformation of the human, biological, labor, and social capacity within the main industrial formations" (Melnyk et al., 2019, p. 384).

Industry 1.0

The Industrial Revolution 1.0 was defined in England in 1760, reaching the new United States of America in the late 18th century by the standardization of mechanical production based on water and the steam engine, substituting the handicraft-based economy dominant until then. (Adel, 2022). The use of cast iron gave birth to textile industry technologies and a generalization of industrial production, replacing some processes completed through craftsmanship and manual labor (Popkova et al., 2018; Loy et al., 2021). Using machines for the first time brought a rise in productivity. It took manufacturing a step ahead, away from the dependency of manual elaboration of goods depending on manual skilled labor (Coleman, 1956). The main effect of this first industrial revolution was improving the standards of quality of life in the Western world, in

which the gross domestic product (GDP) per capita grew significantly due to the emergence of modern capitalistic economies (Loy et al., 2021).

Some of the social effects that Industry 1.0 brought to society mostly rely on the significant shift from artisanal crafty work at home to going to the factories. However, there were no safety regulations, and most workers had to work more than fourteen hours per day, six or seven days a week, to secure minimum wage; most workers would risk their lives without complaining to keep their jobs secure. Women and children were paid even less, increasing the factory owners' economic gains (Loy et al., 2021).

Industry 2.0

This era witnessed notable economic expansion, heightened business efficiency, and increased unemployment due to the automation of tasks previously performed by human labor in factories (Adel, 2022). These two characteristics completely changed the manufacturing process's paradigm and history. The assembly line significantly improved manufacturing efficiency by reducing production costs, producing goods faster, and creating higher-wage jobs. With the generation of mass production, division of labor took place as different workers would oversee different stages of producing goods. The development of innovations, technologies, and mechanisms related to the transportation of goods from factories, as well as the standardization of the telegraph to improve communication regardless of the distance, allowed for new ways to efficiently communicate and improve commercial trade (Koc & Teker, 2019; Loy et al., 2021). These first industrial revolutions generated a life-changing deal in society. The social effect for women of the Industrial Revolution 1.0 meant a new paradigm in modern societies. Women entered the workforce for the first time and competed with men for jobs, as women were commonly paid a third of a man's salary (Loy et al., 2021).

Industry 3.0

Several advancements in computer technology drove the Industrial Revolution 3.0, the emergence and normalization of personal computers, the emergence of semiconductors as drivers of new technological innovations, the transfer from analog to digital systems, and the birth of the internet (Melnyk et al., 2019). Commonly identified as having originated in 1969 with the invention of the first programmable logic controller (PLC), the third industrial revolution took manufacturing to automate production through electronics, introducing information technologies and helping organizations reach levels of productivity and efficiency never encountered before. The main characteristic of this revolution is defined by b mass production and the use of digital, integrated circuit chips (Adel, 2022). It was until the decade of the eighties and nineties that the use of information and communications technology (ICT) with the integration of telecommunication, the use of microelectronics in several industries, the use of renewable energy and resources, as well as the generalization of energy efficiency and renewable energy-based technologies entered the realm of business and organizations beyond manufacturing and production (Janicke & Jacob, 2013).

During this stage of industrial development, the relevance of human labor experienced a decline for the first time, as the speed of production due to the use of new technologies in organization generated a shift in the necessities of human labor in the process and manufacturing of products (Koc & Teker, 2019).

From the societal perspective, globalization and global governance became regular terms related to industrialization and manufacturing processes, as the automation of factories, the advancements in telecommunications, and the development of biotechnology crossed frontiers; the development of these three core technologies of this industrial revolution, microelectronics,

computers, and telecommunications, generated the environment for economic globalization of markets, production research, and development (Khan, 1987; Taalbi, 2019).

Industry 4.0

The term Industrial Revolution 4.0 was initially used in 2011 by the German government and later popularized in the 2015 World Economic Forum (Bai et al., 2020). Industry 4.0 became a technological revolution characterized by the deep integration of communication, information, and intelligence technologies into the production processes, which aims to improve efficiency and productivity in a high-tech plan to become more competitive in a new, globalized world (Xu et al.,2021).

This revolution is based on the concept of Cyber-Physical-Systems (CPS), in which a world where machines can talk to each other easily through the Internet of Things (IoT), and people can join through the Internet of People (IoP) is envisioned. This change allows organizations to put their labor systems into virtual environments and use artificial intelligence to analyze changing data and make intelligent choices. Integrating new technologies is believed to lead to several benefits for organizations by making business models more profitable and improving workplace conditions' efficiency and quality (Bai et al., 2020). Studies by scholars such as Goetz & Jankowska (2020) and Dos Santos (2021) have proved that the implementation of new technologies related to Industry 4.0 is linked to a sustainable increase of a company's levels of competitiveness regardless of the industry where these technological innovations are being implemented.

The Fourth Industrial Revolution is based on the utilization of high-tech production equipment to maximize the use of computerized processes in production and manufacturing, under the assumption that when reducing the number of human labor and interaction in

production, human mistakes diminish, making production more cost-efficient. Another goal of the fourth industrial revolution is creating more choices and flexibility in the production line to meet personalized customer requests. By accelerating the production process, the fourth industrial revolution intends to increase communication channels with the final consumer and reduce the waiting period for orders to proceed (Koc & Teker, 2019). "With the integration of technologies like artificial intelligence, automatization, and the Internet of Things (IoT), the industry has experienced unprecedented levels of efficiency and productivity" (Suciu et al., 2023, p. 2). Industry 4.0 focuses more on implementing new technologies, digitalization, and the use of AI to increase production rather than sustainability or a people-centered approach (Suciu et al., 2023).

This new phase of the industrial revolution comes with some direct consequences for human labor, as digitalization and technological innovations affect the labor market, as certain functions performed by employees in the past can now be realized by software, robotic processes, and technologically enhanced assembly lines. New jobs requiring unique and different specialization skills will require developing new types of specialization and training (Suciu et al., 2023).

Industry 4.0 has also shown organizations lack qualified human resources to efficiently deal with the implementation of current advanced technological solutions, as the innovation cycle is occurring at a faster pace than changes can be made to the labor markets to develop employees' skills, which imbalances the market and industry growth, reflected in high and long-term structural unemployment (Suciu et al., 2023).

The challenges presented by the fourth industrial revolution, however, have also become the platform for the birth of industrial revolution 5.0 by recognizing the potential risks implied in

the latent possibility of losing control over artificial intelligence and technological cyber-physical systems add the future challenge of societal degradation because of a diminished necessity for human labor as part of the production processes, and reduced need for human skills in a new era characterized by the Internet of Things (IoT) (Melnyk et al., 2019).

Identifying sustainability drivers in Industry 4.0 has become a growing research topic, focusing on sustainable and green manufacturing (Gupta, 2022). Authors like Stock et al. (2018), Jena et al. (2020), Farrell et al. (2020), and Ghobakhloo et al. (2021) have most recently centered their research on the effects of Industry 4.0 on finding cleaner and innovative technological production solutions, implication on social sustainability, optimization in the utilization of resources, waste reduction and waste management, as well as other social implications of this industrial revolution in employment generation and technological skills development.

Industry 5.0

The progress that information technology and digital transformation tools have shown in recent years has ignited the substantial shift in both the business and the industrial sectors known as Industry 4.0, which has emphasized mainly all technological aspects related to business, operations, and production, buy it has lacked a holistic vision which also involves sustainable social and environmental practices, as well as the human elements of the business (Mourtzis et al., 2022; Saniuk et al., 2022).

The European Commission officially used the term Firth Industrial Revolution (Industry 5.0) in two virtual workshops with several research and technology organizations' participants during discussions on the "Industry 5.0 - Towards a Sustainable, Human-centric and Resilient European Industry" report released on January 5th, 2021 (European Commission, 2021; Xu et al., 2021). The European Commission defines Industry 5.0 as a natural progression from 4.0,

focusing on research and innovation as the engine of a resilient, human-centered, environmentally friendly European industry (Yitmen et al., 2023).

According to Nahavandi (2019), "Industry 5.0 brings back the human workforce to the factory, where human and machine are paired to increase the process efficiency by utilizing the human brainpower and creativity through the integration of workflows with intelligent systems" (Nahavandi, 2019, p. 3).

Industry 5.0 is a future-looking concept that involves human-centered sustainable manufacturing systems in collaboration with robotic technologies and resilient manufacturing systems (Baradaran, 2019). Huang et al. (2022) state that "the industry 5.0 paradigm promotes systems' agility and resiliency by utilizing flexible and adaptable technologies. Furthermore, attempts to lead action on sustainability, respect planetary boundaries, and promote talents and diversity" (Huang, 2022, p. 425). When analyzing the evolution of the 5.0 paradigms, some key enablers can be identified: a vision of human-centricity, resilience, and sustainability, where the causal relationships between these factors meet the advancements in technology and innovation (Xu et al., 2021; Yitmen et al., 2023).

According to authors like Yitmen et al. (2023), the COVID-19 pandemic emphasized the necessity of shedding light on employee value and environmental and social factors in the technologies and innovations developed through Industry 4.0. The pandemic's impact led businesses to address the vulnerabilities of global supply chains and the necessity to build more resilient organizations with a sustainable vision and perspective centered around human well-being (Xu et al., 2021). "The adaptability of production methods and their effects on the environment are significant concerns in the industry 5.0 paradigm" (Yitmen et al., 2023, p. 1). This new paradigm is already enlightening the fact that as Industry 5.0 emphasizes the

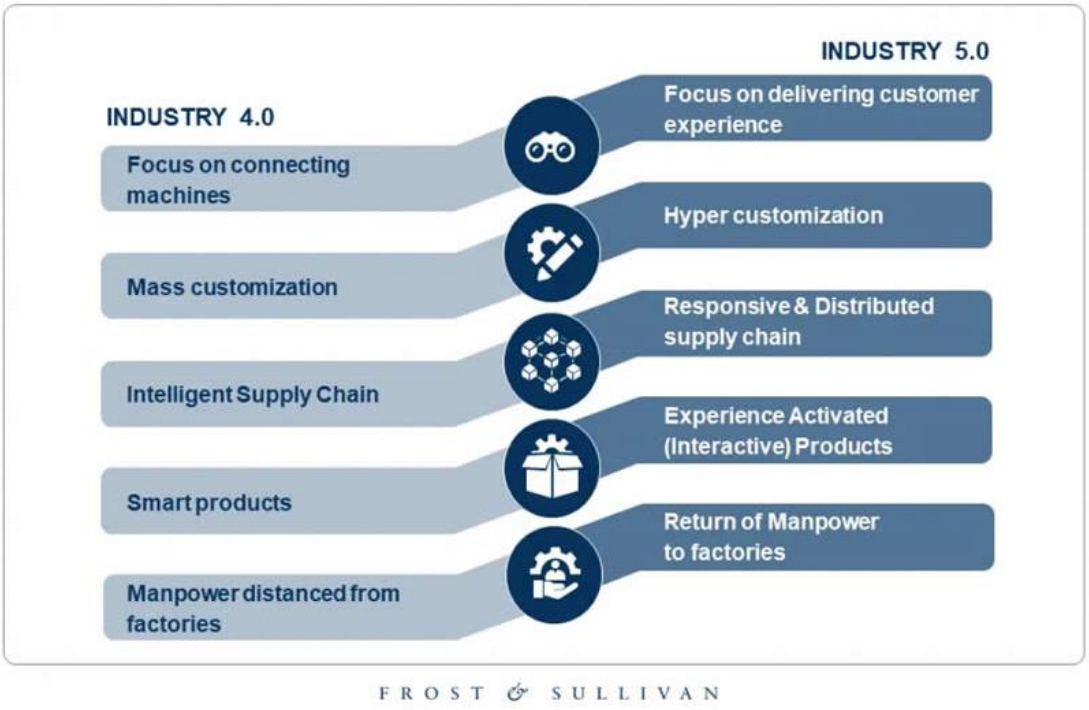
relationship between human and machine collaboration, human resources in organizations will be impacted as the transition to a more human value-centered vision will bring new opportunities but also challenges for both employers and employees (Siciu et al., 2023).

Siciu et al. (2023) define Industry 5.0 as a Human Industry based on combining human creativity and know-how with the 6 Rs of sustainability: Recognize, Reconsider, Realize, Reduce, Reuse, and Recycle. "In Industry 5.0, humans and robots collaborate and work together" (Siciu et al., 2023, p. 3), for which human labor must have specific core competencies and skills. For Industry 5.0 to be successful, several implications must be addressed and prevented. For example, proper training will aid the human workforce in quickly adapting to the new technologies while collaborating with automatized processes and artificial machine intelligence (Siciu et al., 2023).

Zutshi (2019) emphasizes specific characteristics and specifications when comparing Industry 4.0 and Industry 5.0, as seen in Figure 1. Industry 5.0 brings back the social, environmental, and sustainable dimensions into regular business operations and functions. The focus on the new industrial revolution changes from machines to enhancing customer experiences; for example, it brings back the value of human-centric functions into factories.

Figure 1

Highlights of Industry 5.0 compared to Industry 4.0



Note. Industry 5.0—Bringing Empowered Humans Back to the Shop Floor, by Zutshi, Aarop (2019). 30th International Exhibition for Industrial Automation, 5IR: The Emergence of an Experience-Driven Manufacturing Economy. Future is Digital, Smart, Flexible, and Intuitive, Frost and Sullivan.

Industry 5.0 represents the new phase of industrial development, marked by a resurgence of human labor within factory settings, decentralized production processes, and smart and adaptable supply chains. (Zutshi, 2019).

According to Figure 2, according to Demir et al. (2019), two main visions are emerging from the concept of Industry 5.0. One is related to the "human-robot co-working" atmosphere that organizations will foster and witness because of the collaboration of humans and technologies; the second vision is related to using resources for industrial purposes, in balance with ecological practices and economic gains for organizations.

Table 1.

Comparison of Industry 4.0 and Industry 5.0 in two visions

	Industry 4.0	**Industry 5.0 (Vision 1)**	**Industry 5.0 (Vision 2)**
Motto	Smart Manufacturing	Human-Robot Co-working	Bioeconomy
Motivation	Mass Production	Smart Society	Sustainability
Power Source	Electrical power Fossil-based fuels Renewable power sources	Electrical power Renewable power sources	Electrical power Renewable power sources
Involved Technologies	Internet of Things (IoT) Cloud Computing Big Data Robotics and Artificial Intelligence (AI)	Human-Robot Collaboration Renewable Resources	Sustainable Agricultural Production Bionics Renewable Resources
Involved Research Areas	Organizational Research Process Improvement and Innovation Business Administration	Smart Environments Organizational Research Process Improvement and Innovation Business Administration	Agriculture Biology Waste Prevention Process Improvement and Innovation Business Administration Economy

Note. Comparison of Industry 4.0 and Industry 5.0 Visions, by Demir, K. A., Döven, G., & Sezen, B. (2019). Industry 5.0 and Human-Robot Co-working. Procedia Computer Science, 158, 688–695.

Vision number 1 accentuates an outlook on human-technology collaboration. In contrast, Vision Number 2 focuses on sustainability as its primary focus of interest and motivation, including the smart use of renewable resources through a dual perspective (Demir et al., 2019).

For Industry 5.0, it is essential to recognize the importance of human creativity, capabilities, and decision-making while new technologies advance and bring new benefits to industries. The new industrial revolution centers its attention on facilitating the interconnection between three interconnected core values: human centricity, sustainability, and resilience to changes in organizations (Breque et al., 2021; Xu et al., 2021; Ben Youssef et al., 2023). The values emphasized by Industry 5.0 marks a shift from the technology-driven main characteristics

of Industry 4.0. It also reflects a broader understanding of societal and environmental factors and the role of industry and business in their effects (Xu et al., 2021).

Human Centricity

One of the pillars of Industry 5.0 is the focus on humans as they interact with technology. In this new revolution, the needs of humans become the central interest in the production process. From Industry 4.0, which had a more technology-driven approach, the fifth revolution brings the value back to the workers and human power instead of only on the financial cost. In this new paradigm, technology is intended to aid people and aim at employees' needs. Human centricity focuses on providing a secure and safe environment for the human capital. At the same time, it guarantees the protection of human rights, human dignity, and employees' mental health. While Industry 5.0 focuses on providing the workforce with opportunities for training and development programs to improve their skills, employees' career prospects improve, prioritizing the well-being of the personnel (Xu et al., 2021; Breque et al., 2021).

Organizational Resilience

Organizational resilience refers to an organization's ability to adapt, recover, and respond effectively to problematic situations, crises, unexpected disruptions, and arising challenges. Resilience refers, within most industries, to the capacity of the supply chain to mitigate the impacts of any disruptions and the capacity to reduce recovery times, ensuring operational continuity in facing those challenges. The future shows that corporations and industries must show organizational resilience to effectively navigate geopolitical shifts and natural disruptions like climate change. Adopting resilience strategies within any organization enhances its ability to

cope with disruptions, ensuring the uninterrupted effectiveness of its operations while responding to unexpected situations (Namdar et al., 2020).

Practices of Sustainability

Sustainability involves a holistic perspective that combines an equal interest and attention to social, environmental, and financial indicators. A business landscape emphasizing sustainability is expected to obtain more attention and improve its reputation, as sustainable, responsible entities are perceived as more ethical and just by customers and society. This new vision and importance paid to sustainability has evolved into integrating social sustainability into the business world, which has become of significant relevance and importance for manufacturing and production processes in all types of industries (Ajmal et al., 2018; Bengtsson et al., 2018).

Sustainability and Sustainable Practices

Sustainability has become essential for organizations as climate change, water scarcity, natural disasters, and poor labor conditions have started affecting business and industrial operations worldwide (Whelan & Fink, 2016).

The latest findings on climate change have brought to light in the last decade the importance of carbon emission reduction, transition to renewable energy, recycling, and intelligent and responsible disposal of waste. The rise of social inequalities, economic disparities, and the increment of unequal opportunities have made more inclusive development and circular economies preponderant (Koop & Van Leeuwen, 2017; Geissdoerfer, 2017).

As the world transitions into Industry 5.0, the significance of sustainability becomes more relevant when the advancements of new technologies like the Internet of Things (IoT), artificial

intelligence, and innovations allow a parallel evolution within sustainable practices in organizations (Shaikh et al., 2015).

Defining Sustainability

The term sustainability originates from the Brundtland Report of 1987, which addressed, for the first time, concerns regarding the aspiration of society to develop better levels of life and commodity while facing limitations imposed by nature (Kuhlman & Farrington, 2010). Sustainability determines the ability to preserve the equilibrium between the ecosystem and human activities so that both elements can foster societal well-being and healthy economic systems (Mensah, 2019).

There are four well-known pillars of sustainability. Environmental sustainability refers to the responsible use of natural resources, the reduction of contamination, and the reduction of climate change. Human sustainability refers to the attention paid to developing the human component in society and organizations by guaranteeing communities have covered their minimum necessities, such as education, justice, and healthcare. On the other hand, social sustainability refers to the development of fair and equal labor practices, the responsibility and engagement the organizations have with their community, and the respect for human rights. Finally, economic sustainability refers to creating long-term value and financial viability for business. Overall, sustainability is about managing resources wisely, while social, environmental, and economic aspects while keeping a balance with societal well-being and long-term economic stability (Duić et al., 2015; Jitmaneeroj, 2016).

For organizations, following sustainable practices is no longer an option, as it has become a source of competitive advantage, extending beyond environmental concerns and encompassing

social and economic dimensions; organizations that adopt sustainable practices position themselves as leaders, while consumers and investors have started to prioritize responsible and ethical practices in organizations when it comes to choosing where to invest, or where to buy their products or services (Huang et al., 2015; Galping et al., 2015; Haseeb et el., 2019).

Dyllick and Hockert define corporate sustainability as the ability to meet the needs of the direct and indirect stakeholders while protecting, sustaining, and enhancing the human and natural resources currently in the present and the future (Engert, 2016). As sustainability becomes, over time, more connected to organizational strategies, new terms and concepts arise. However, many companies still need a strategic approach to corporate sustainability integration (Engert, 2016). However, over time, not only do companies recognize that adopting sustainability strategies will benefit the planet and their brand reputation, but regulatory pressures around the globe are changing the dynamics of sustainable practices by pushing organizations to adopt more responsible actions (Caroll, 2015).

Sustainability and Industry 5.0

In the context of Industry 5.0, sustainability becomes eminent, as sustainable practices involve the responsible use of technologies while reducing environmental harm, improving societal equity and inclusivity, and fostering resilient, flexible, and socially responsible organizations (Zhanbayev et al., 2023). An "interesting benefit of Industry 5.0 is the provision of greener solutions compared to the existing industrial transformations, neither focusing on protecting the natural environment", as Maddikunta et al. (2021, p. 2) affirmed. The new technological revolution brings new technological advancements in both manufacturing and

production, while it will also require organizations to reevaluate how they responsibly respond through ethical, sustainable practices.

The emphasis Industry 5.0 puts on bringing back the value of human beings by empowering the workforce through proper, equitable, and inclusive training and development programs. At the same time, the fast evolution of technology exponentially speeds up its growth and can help organizations realize the potential to meet their sustainability goals in the upcoming years. Industry 5.0, in this sense, can provide, besides technological advancements and innovations for organizations, potential solutions, and strategies to address the sustainability challenges they face, as immediate innovative actions are needed to act on responsible, respectful practices that may provide immediate benefits to internal stakeholders, as well as the community and society organizations operate in (Maddikunta, 2021).

The principles of sustainability -environmental, social, and economic, align with the overall objectives of Industry 5.0, which are based on reducing ecological footprints through advanced technologies, the potential to create equitable workforce opportunities, and offering organizations long-term economic viability through efficiency gains and cost reductions in operations (Demir et al., 2019; Voulgaridis et al., 2022; Rajumesh, 2023).

Ghobakhloo et al. (2022) have recently presented sixteen functions in which Industry 5.0 can generate sustainable development value for organizations. These essential functions, like employee technical assistance, intelligent automatization, open, sustainable innovation, and supply chain adaptability, among many others, present a sample of the interconnected scenarios that will provide insight into how Industry 5.0 will play a crucial role in promoting sustainable practices within organizations in the upcoming years (Ghobakhloo et al., 2022).

Research Methodology

Using qualitative research methodologies is considered appropriate when exploring a novel study area to establish a precedent for developing theories about relevant issues. According to Cruz & Tantia (2017), qualitative research methods are used to describe experience processes, to "make meaning of experiences or phenomena by following data as they emerge" (Cruz & Tantia, 2017, p. 81).

In qualitative research, a method describes how data will be collected and analyzed (Cruz & Tantia, 2017). The most common qualitative methods utilized to obtain an in-depth and extensive understanding of the topic when addressing a novel study area are interviewing and observation (Jamshed, 2014). Semi-structured interviews facilitate a detailed understanding of research participants' perspectives, experiences, and perceptions (Galletta, 2013). This approach in qualitative research allows for data collection and interpretation to happen simultaneously, which means that the methods used to manage qualitative data must be adaptable (Kennedy & Thornberg, 2018).

The research objective has been to assess and discover the status of sustainability and technology initiatives adopted by organizations based on the opinions and perceptions of collaborators involved in decision-making processes within their organizations. Due to the novelty of research and studies on Industry 5.0, an abductive approach and abductive thematic analysis are performed in this research.

The Abductive Approach

According to Kovács & Spens (2005), several authors like Andreewsky and Bourcier (2000), Kirkeby (1990), and Taylor et al. (2002) define the abduction approach as "the systematized creativity or intuition in research to develop new knowledge," since creativity

becomes necessary to "break out of the limitations of deduction and induction which are delimited to establish relations between already known constructs" (Kovács & Spens, 2005, p.136). Differing from deductive approaches, in which a predetermined theory provides a specific framework to perform research, an abductive approach aims at understanding data to extend existing theories. Using the abductive approach, researchers can pay attention to unique aspects that may differ from the usual pattern when studying and analyzing a phenomenon. The researcher may then suggest new propositions and hypotheses based on the data analyzed (Timmermans & Tavory, 2012).

Abductive analysis encourages researchers to approach qualitative research with a solid theoretical foundation, incorporating existing theories in the research process and using them as a base and framework for developing new insights while offering flexibility and adaptable logic for discovering new phenomena (Timmermans & Tavory, 2012).

Data Collection

According to Busseto et al. (2020), qualitative interviews are "a conversation with a goal." (p.3). Semi-structured interviews are characterized by open-ended questions that can be used as a guide in which a broad area of interest is defined. (Busseto et al., 2020)

Semi-structured interviews require preparation and previous knowledge of the research topic, as the questions must be determined before the interview. Data collection through semi-structured interviews allows for the goal of qualitative research, to gain a rich understanding of a phenomenon, to be achieved (Kallio et al., 2016).

An interview guide was developed, divided into two sections: a set of questions regarding the sustainability strategies and approaches of the organizations being studied, and the second part focused on their approach to new technological advancements and innovations. (Appendix 3) This questionnaire was elaborated using the theoretical framework presented in the first section of this thesis to meet the requirements of a "rigorous development of a qualitative semi-structured interview guide," which has been proved and confirmed by authors like Kallio et al. (2016) to contribute "to the objectivity and trustworthiness of studies and makes the results more plausible." (Kallio et al., 2016, p. 10)

Selection of Participants

When designing qualitative sampling plans, researchers work with estimates. While methodological studies may require fewer than ten interviews, grounded theory studies an average of 20 to 30 interviews; when performing content analysis, 15 to 20 interviews are estimated to be sufficient to fully understand a phenomenon (Moser & Korstjens, 2018). The sampling plan for our study included 15 interviews. Twenty-five invitations were sent, from which 16 prospective participants agreed to collaborate. Due to time restrictions, only fourteen interviews took place.

The fourteen semi-structured interviews took place between August 24th and September 8th, 2023, via the MS TEAMS Online meeting platform. Each one of the interviews took an average of 30 to 40 minutes. Each interview was recorded in video, and the interaction between the interviewer and interviewees was adequately transcribed. Thirty questions were used as a guide; the first fifteen questions aimed at understanding the current role of sustainability in organizations, and the second half of the questions aimed at assessing the role of technology. (Appendix 3)

Once the final decision was provided by UCW's Board of Ethics on August 17th August, 202 (Appendix 1), twenty-five invitations were sent to prospective candidates to participate in our qualitative research (Appendix 2). The prospective candidates had been previously selected via their LinkedIn profiles under the following conditions:

- The research subjects' roles and hierarchical positions in their organizations. From Mid-level superior to Senior-level management and Directors.
- They had been working with their organization for at least one year.
- Their organizations had to be operating within Canada.
- Their organizations had to belong to one of the classifications of the North American Industry Classification System (NAICS) by the Canadian Government (2022).
- All participants must have been involved at least at a certain degree in decision–making processes within their organizations.

Only one of the prospective participants who agreed to collaborate in the study came as a referral. Advanced understanding or knowledge about their industry's latest technology and sustainability trends was optional.

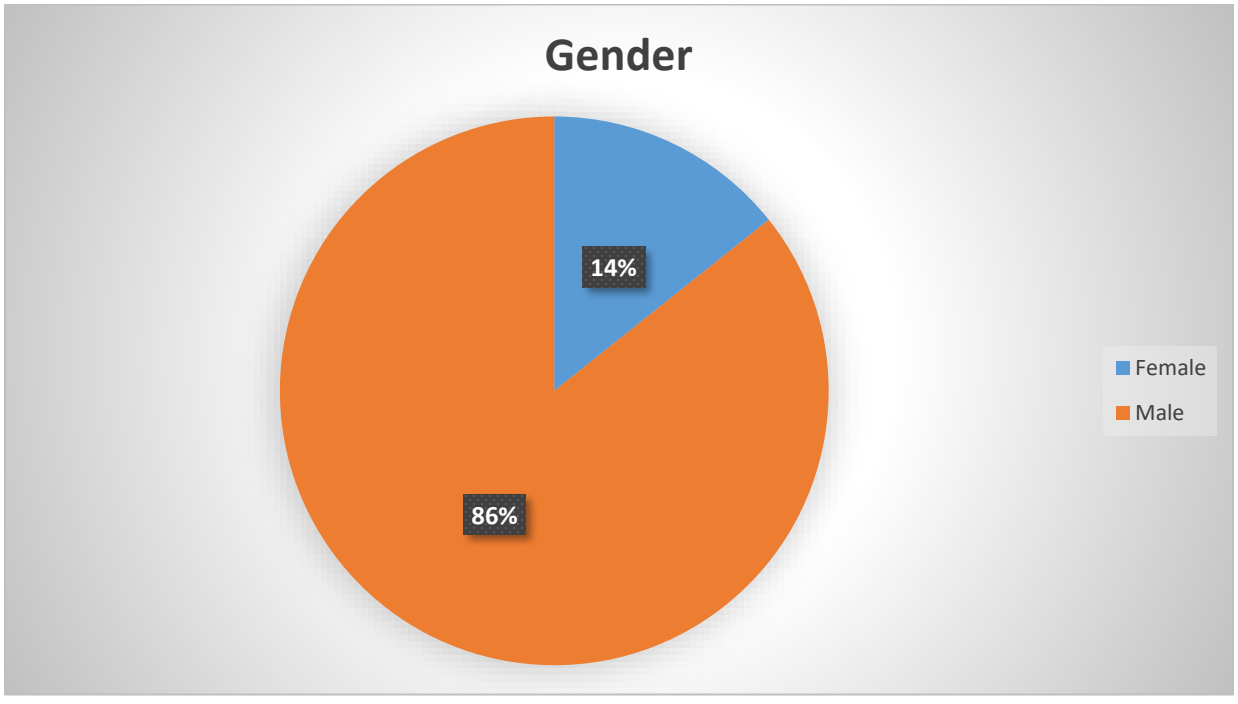
Sixteen participants responded affirmatively to the twenty-five invitations sent to the prospective candidates, confirming their willingness to collaborate in the research; two interviews are still pending.

Subjects were provided a copy of the consent form and a list of interview questions before the interview.

The following graphs present the general demographics of the fourteen participants.:

Figure 2

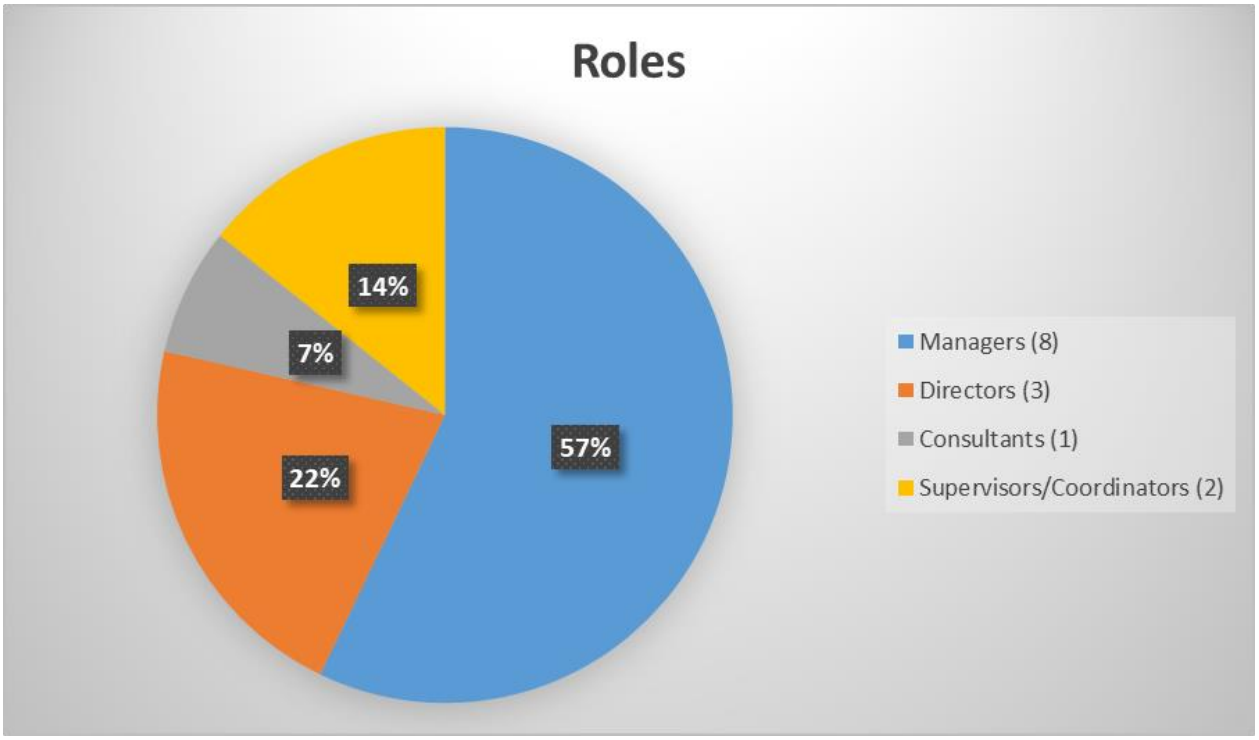
Gender of Participants



Note. Pie chart expressing the percentages of male and female participants.

Figure 3

Role of Participants



Note. Pie chart expressing the percentages of participants according to their organizational roles.

Based on the classification of types of industries (Ramantswana et al., 2019), the following chart presents the type of industries the organizations of the participants belong to.

Table 2

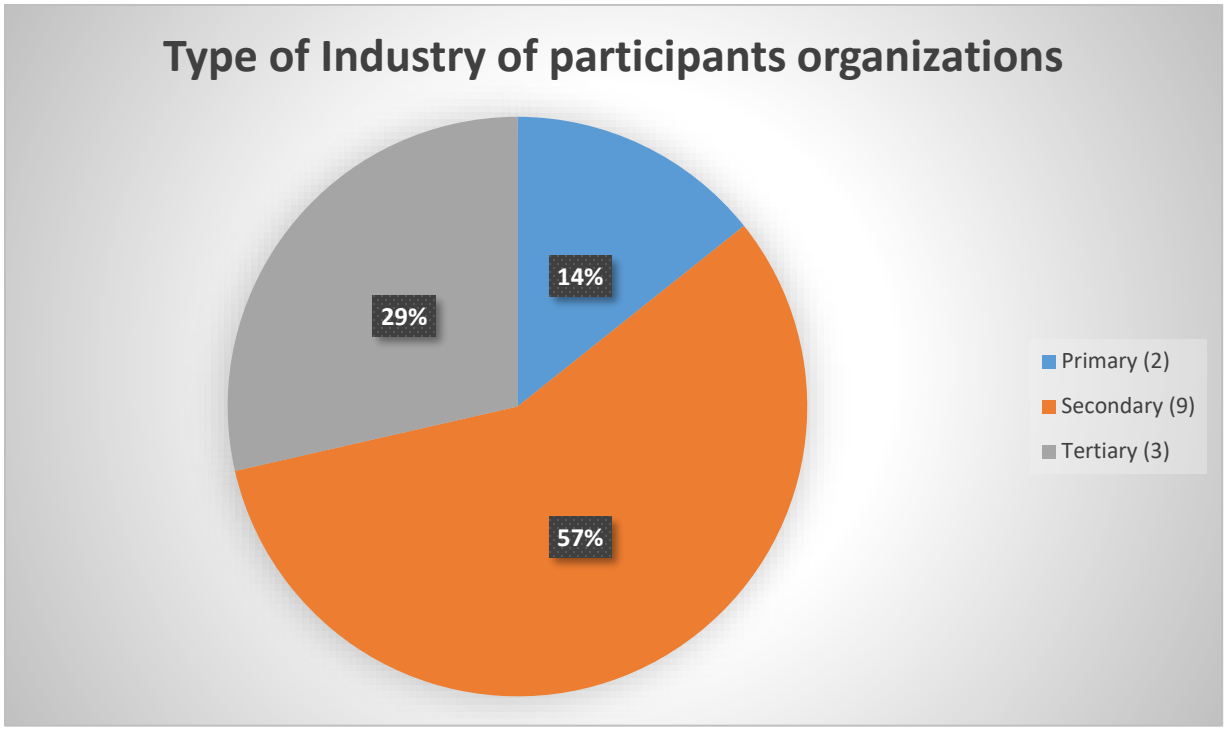
Type of Industry

Industries	Standard Industrial Classification
Primary	Agriculture, forestry, and fishing Mining and quarrying
Secondary	Manufacturing Electricity, gas, and water Construction
Tertiary	Wholesale and retail trade, catering, and accommodation Transport, storage, and communication Finance, insurance, real estate, and business services General government Community, social, and personal services

Note. Standard industrial classification. From "Headquarters site selection of public listed firms: a self-explicated conjoint model, by T. Ramantswana, K. Cheruiyot, & S. Azasu. University of Witwatersrand, South Africa, 2019, Pacific Rim Real Estate Society Conference(https://www.researchgate.net/publication/338101820_Headquarters_site_selection_of_public_listed_firms_A_self_self-explicated_conjoint_model). Copyright 2019, Pacific Rim Real Estate Society Conference Proceedings.

Figure 4

Role of Participants

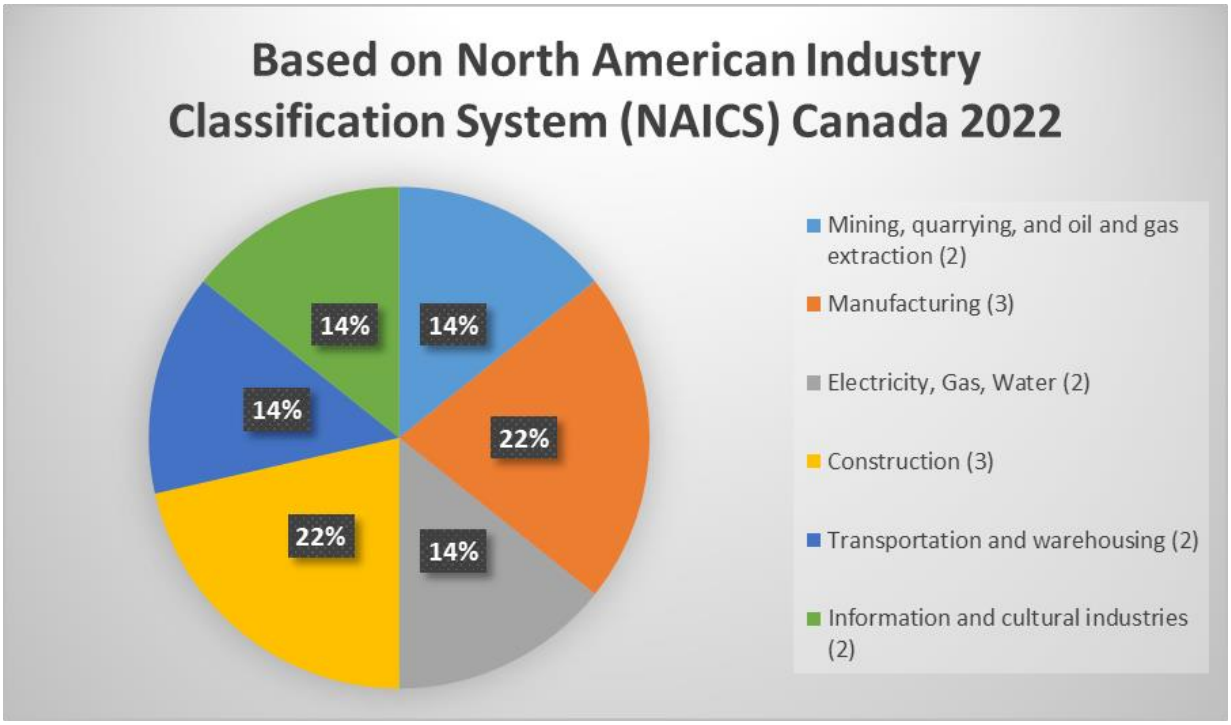


Note. Pie chart showing the percentages of participants according to their type of organization.

Of the fourteen organizations analyzed, four belong to the public sector, and ten belong to the private sector. It is essential to mention that, even though all organizations operate in British Columbia, two of the private enterprises being studied have been recently acquired, in the past year to be more exact, by multinationals from outside Canada.

Figure 5

Participants' Industries based on the NAICS



Note. Pie chart showing the percentages of participants according to the Type of Industries of the organizations where they work.

Data Analyses

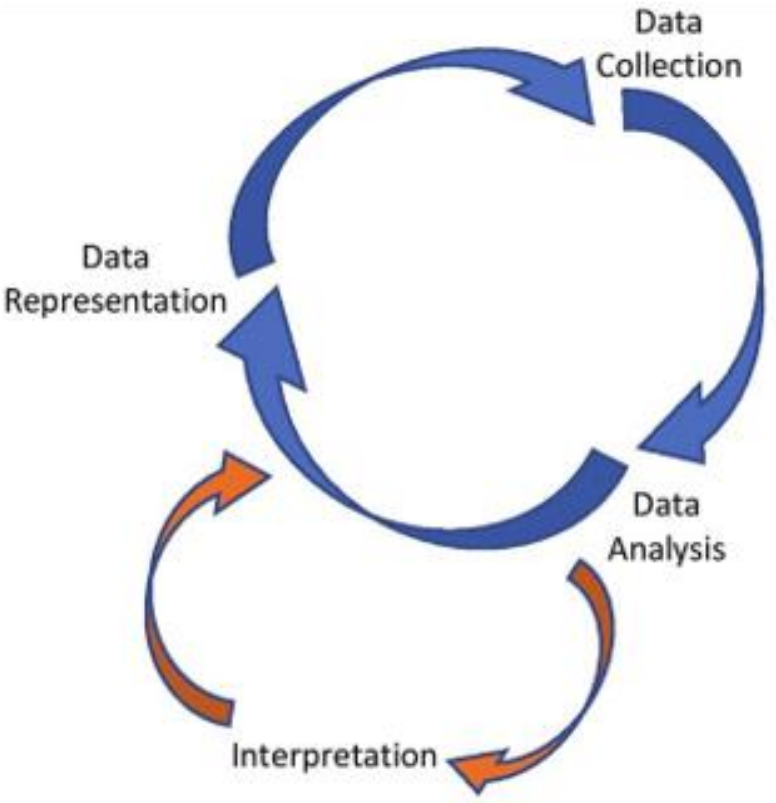
Qualitative Thematic analysis is a qualitative method of analysis to identify, analyze, and decode patterns or themes (Clark & Vealé, 2018). Thematic analysis involves observing and recording patterns while offering flexibility, allowing it to be used within most theoretical frameworks and distinguished from other qualitative analysis methodologies (Terry et al., 2017).

The strategies used to handle and analyze qualitative data are part of an iterative process in which the researcher explores, codes, reflects, and creates queries (Vaughn & Turner, 2016). NVIVO is a software that scholars and researchers have approved as reliable and effective for analyzing qualitative data, as "NVivo can work well with most research designs and analytical approaches." (Zamawe, 2015, p. 14). To effectively analyze the qualitative data obtained, NVIVO was used, allowing the qualitative data to be first organized and later coded.

The strategies used to handle and analyze qualitative data are part of an Iterative Process in which the researcher explores, codes, reflects, and creates queries (Vaughn & Turner, 2016).

Figure 6

Qualitative research cycle

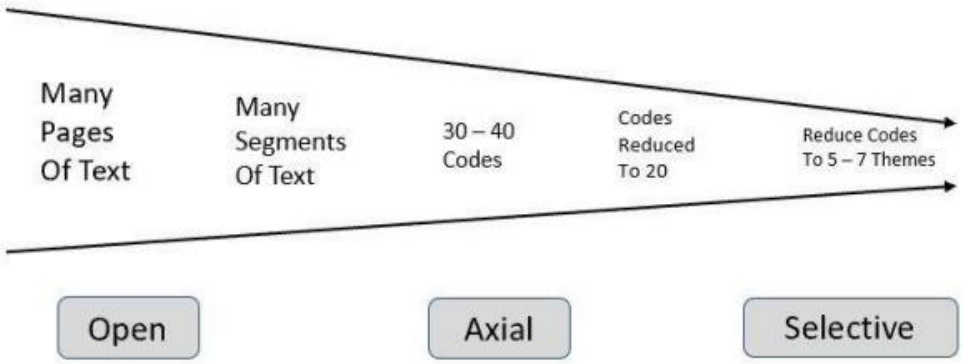


Note. Qualitative research iterative cycle, from Immersion-Crystallization: a valuable analytic tool for healthcare research, by J. Borkan, 2022 https://www.researchgate.net/profile/Jeffrey-Borkan/publication/357835967_Immersion-Crystallization_a_valuable_analytic_tool_for_healthcare_research/links/61e1c41f8d338833e36b7505/Immersion-Crystallization-a-valuable-analytic-tool-for-healthcare-research.pdf.

In the following figure, Williams and Mosser (2019) present an overview of the coding process in qualitative research, whose objective is to facilitate a rigorous and systematic analysis of data to find and present new information that may become the ground for a new theory (Williams & Mosser, 2019).

Figure 7

Overview of the Coding Process

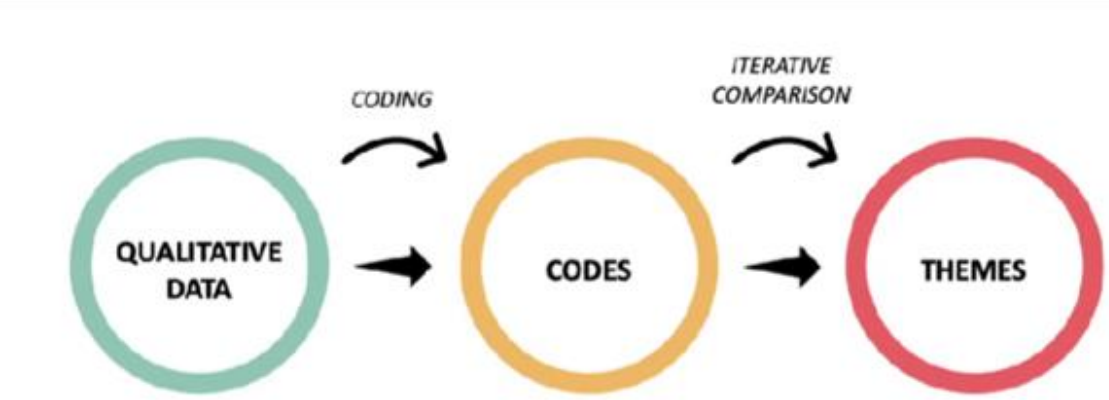


Note. Image showing an overview of the coding process in qualitative research. From "The art of coding and thematic exploration in qualitative research", by M, Williams & T. Mosser, 2019, *International Management Review*, *15*(1), 45-55. (https://www.proquest.com/scholarly-journals/art-coding-thematic-exploration-qualitative/docview/2210886420/se-2) Copyright © 2023 ProQuest LLC.

Qualitative thematic analysis was used in order to identify most common topics addressed by the interview subjects, and to identify patterns and relationships. Qualitative thematic analysis is a qualitative method of analysis to identify, analyze, and decode patterns or themes." (Clark & Vealé, 2018)

Figure 8

Overview of the Coding Process



Note. How to analyze qualitative data using thematic analysis, from Introduction to Thematic Analysis, by R. Menzies, 2021. Rachel Menzies https://www.youtube.com/watch?app=desktop&v=jgq62UZuCEU

Through qualitative thematic analysis, data has been coded and classified to be analyzed. Patterns related to sustainable practices and technological advancements were identified, providing valuable insights into the current state of Canadian organizations.

Using the features NVIVO provides to qualitative researchers, having coded the data collected from the semi-structured interviews, the following cloud tree and tree map were obtained as a result of the data analysis.

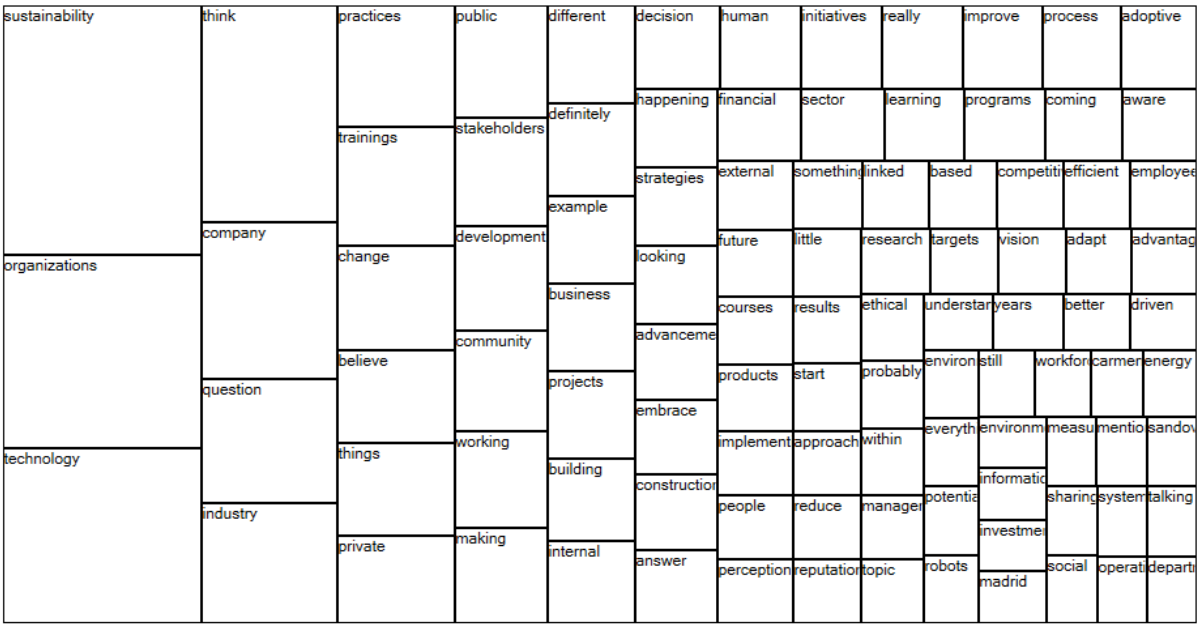
Figure 9

Word Cloud obtained from Data Analysis using NVIVO

Note. Word cloud showing the most frequently used words by participants.

Figure 10

Tree Map obtained from Data Analysis using NVIVO



Note. Tree Map showing the hierarchical relationships of the topics most used by research subject.

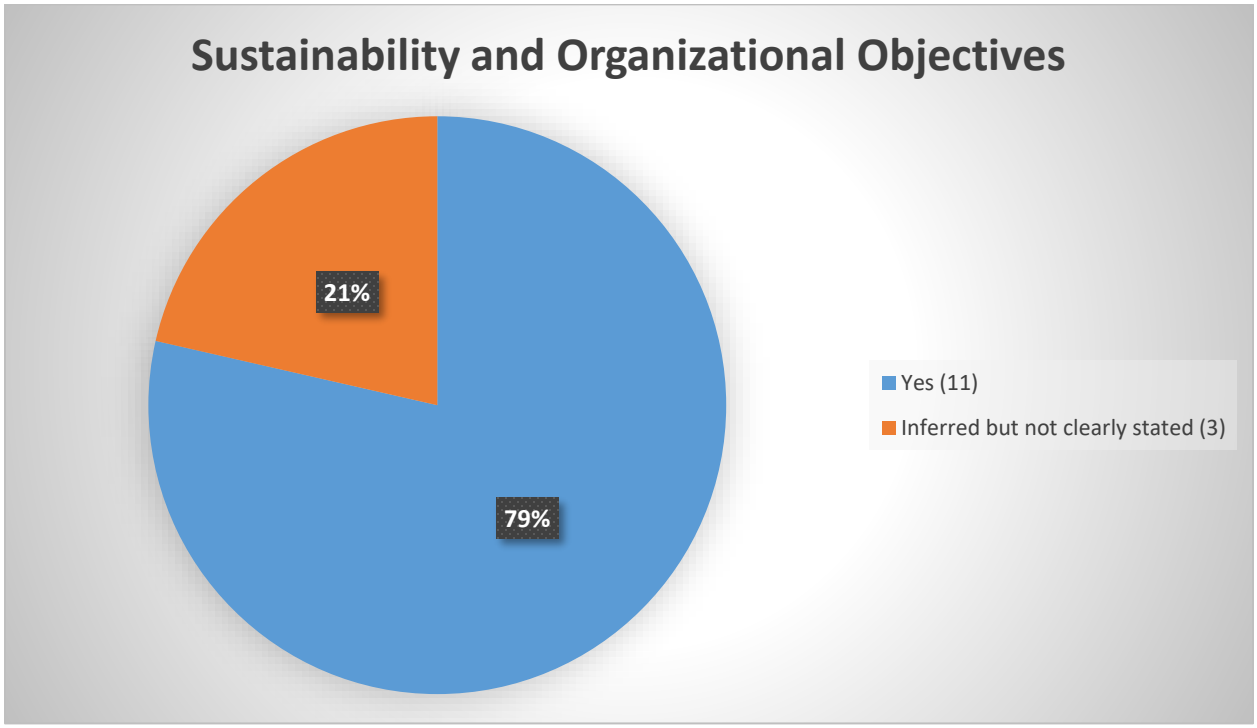
Data Findings and Discussion

The main themes identified throughout the fourteen interviews were coded and classified, having obtained seven main themes. The findings are presented as follows:

1) **Sustainability as part of Organizational Strategies**
    a. Linked to regulations.
    b. Related to customers' requirements.

Figure 11

Sustainability and Organizational Objectives



Note. Pie chart showing the percentage of participants responses regarding the relationship between Sustainability and the Organizational Objectives in their organizations.

79% of the participants affirmed that sustainability is part of their organizational objectives, placing more emphasis on the relevance and importance of this concept mostly in

public organizations or in organizations in which, albeit being private, they receive benefits, sponsorships, or financial support from public organizations. Two of the participants working with private organizations affirmed that the concept of sustainability could have been of little importance in the past; however, since being recently acquired by larger corporations, the concept of sustainability has become a big emphasis for the corporation. 21% of the organizations in which sustainability needs to be started as part of their strategic planning or organizational objectives are private corporations, considered big/medium companies. Four participants linked the role of sustainability with their organization's focus on the triple bottom line, which is the framework with three parts: social, environmental, and economic in organizations.

Another important finding was that at least half of the participants who affirmed sustainability was indeed a part of the organizational objectives of their organization also added that this necessity and focus on sustainable practices were linked to satisfying clients' and customers' requirements. Customers' requirements and necessities are changing, and to obtain contracts and be able to participate in bids, participants affirmed that their organizations had to incorporate more sustainable practices and initiatives to meet the customers' expectations.

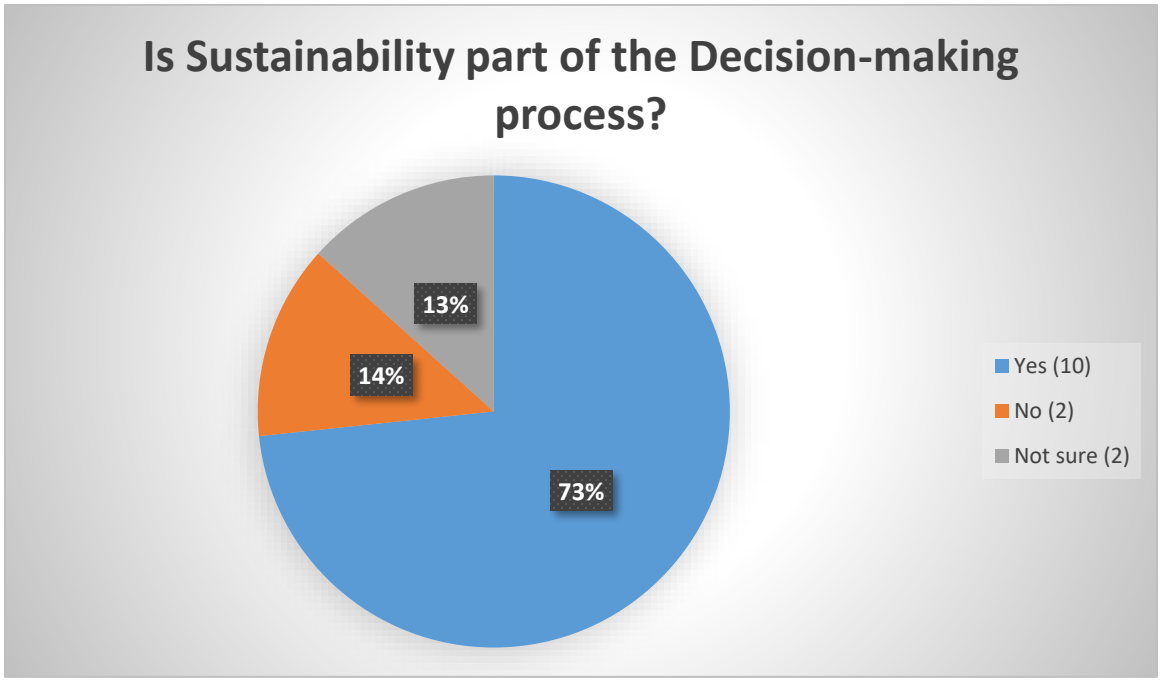
2) Sustainability part of Decision-making initiatives and practices

a. Depending on each area or department

b. Depending on the cost or budgetary limitations

Figure 12

Sustainability and Decision-making Process



Note. Pie chart showing the percentage of participants responses regarding the relationship between Sustainability and Decision-making processes in their organizations.

Most of the participants affirmed that sustainability is part of the decision-making process in most or several areas of their organization; however, four out of ten participants added that the incorporation of this practice was primarily due to the necessity to comply with the normative and regulations established by the government or regulatory organizations in their industry.

The participants also added that even though they could affirm that sustainability was part of the decision–making, this was also closely related to the nature of the area or areas in which they collaborate; for example, in construction companies, the decisions had to be made to comply with the normative and regulations, whereas, in other departments of the organization,

these decisions were up to the head manager or the executive in charge of the operations of each department.

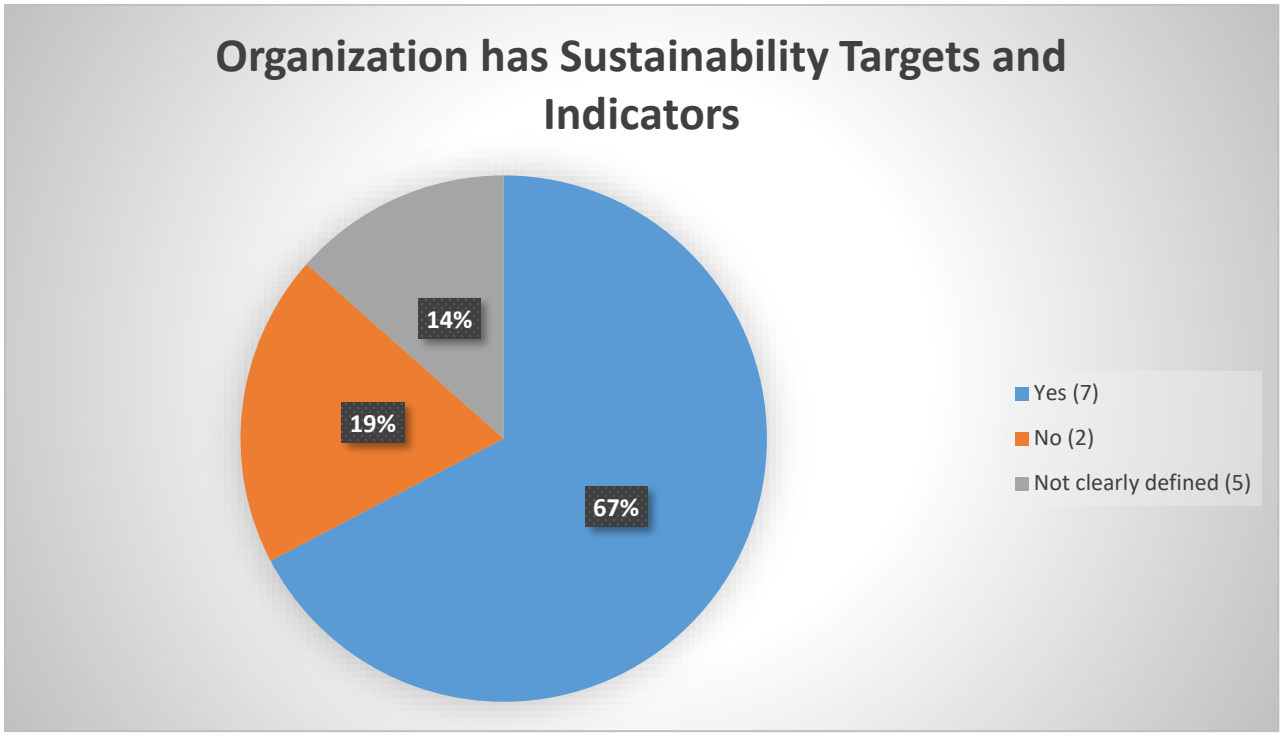
Another topic of interest in this matter was how adopting sustainable practices would be linked and connected to financial indicators and budgetary limitations, as some of the industries participants belong to are considered cost driven. Some of the participants who shared that the sustainability practices were just limited to what was required by regulations also expressed their awareness that committing to practice sustainable practices is of higher cost for their organizations; therefore, the decisions to switch or change to sustainable initiatives must be justified entirely via cost-benefit criteria.

3) Sustainability Measures and Targets

a. Public/private organizations

Figure 13

Sustainability Targets and Indicators



Note. Pie chart showing the percentage of participants responses regarding the relationship Sustainability targets and indicators in their organizations.

Half of the participants expressed that their organization had clear indicators and targets to be met regarding sustainability. These indicators were mainly established to comply with the regulations in both some of the private and all the public organizations. The need for clear sustainability targets was also linked to the necessity to comply with normative regulations, mainly in the public sector. In contrast, the private sector seemed less structured in defining such targets.

Participants who expressed that their organizations did not have formal measures or targets established as a corporation could affirm, they could identify specific areas and departments within their organizations in which the managers and directors would establish their internal sustainable parameters and constantly communicate those to their staff.

The communication of sustainability targets and indicators with internal and external stakeholders also depended on the transparency required by public organizations, in which all targets, measures, and indicators were shared quarterly and annually.

Private corporations showed more secrecy regarding sustainability measures and targets being met, sometimes even within their internal stakeholders.

4) Sustainability and Technology Training and Development Programs

All participants affirmed that their organizations provide training programs and make several courses available to all employees to develop sustainability and technology. Most interviews affirmed that their organizations achieve this goal through partnerships and agreements with universities and open-access education organizations like Coursera or LinkedIn.

Several courses are always available; however, five of the fourteen participants, mostly from private corporations, affirmed that most employees do not have the time to take any of the courses or commit to their career development through the programs offered by their corporations due to excess workload and priorities to other work-related commitments. Even though private corporations have well-structured and established training and development programs to promote better sustainable practices and incorporate new technological innovations, except for the manufacturing industries, participants expressed the need for more free time employees must be trained in their corporations' development programs and courses. As these

training programs are optional and not part of the staff's working hours of a formal career plan, only a few staff members are formally trained in sustainability and new technological tools that may not be directly connected to their everyday functions. The private sector is more lenient in this matter, as described by research subjects.

In public organizations, or those receiving public sponsorship or funding, training programs about sustainable practices were more formal and, in some cases, included as part of their working hours and career plans; therefore, the participants affirmed that most employees receive mandatory ongoing training as part of the organizational targets and objectives.

Most interviewees affirmed that their corporations fostered a collaborative culture of ongoing learning and innovation with their collaborators as part of their organizational strategies.

5) Integration and Embracement of New Technologies

All participants were able to confirm that their organizations had a positive and open attitude toward the embracement of new technologies. However, the extent to which these new technologies have been adopted depends on the type of industry and the area or department in which some participants work.

For example, those working in the manufacturing industry shared examples about automating processes in the production line and using software that could make results more efficient. However, participants from private organizations shared the limitations in budget their companies faced when attempting to acquire either software or hardware that was still considered of high cost to their corporations. Some participants expressed that several co-workers still need to feel more confident embracing the new technologies, even though the organization is pushing to adopt new technologies. They expressed that there are still silos within

the corporations in which some collaborators who have been working with the company for a long time do not easily adopt new software, for example, and prefer to keep registering their data, for example, elaborating their reports manually.

Depending on their industry, participants were able to predict that some of the upcoming advancements would help enhance the way organizations run projects, artificial intelligence will aid in making advanced data analytics more accurate and efficient, and it would make the operations of manufacturing industries more efficient. Several interviews, however, also shared that due to the characteristics of their industries, construction, for example, they could not see how the new advancements of technology could aid in specific procedures that are very physically detailed and in which human labor is still required to perform most activities.

The telecommunication and information technology industries were the ones where more technological advancements could be perceived in the future and in which the adoption of technological advancements is the foundation for their operations.

Four private sector participants showed reluctance to the feasibility of their organizations adopting the new technological advancements due to high costs and their corporations having other mid and long-term priorities. Participants from the private sector believe their organizations may more easily adopt sustainable and technological practices if the benefits of adopting new technologies could be shown financially to their top management, clearly stating the future financial gains and ROI of adopting such practices.

Research subjects of three public organizations confirmed that old software and hardware are still being used, as most technological innovations take a long time to approve. Bureaucracy and lengthy, tedious procedures to upgrade technology make public organizations, in real life

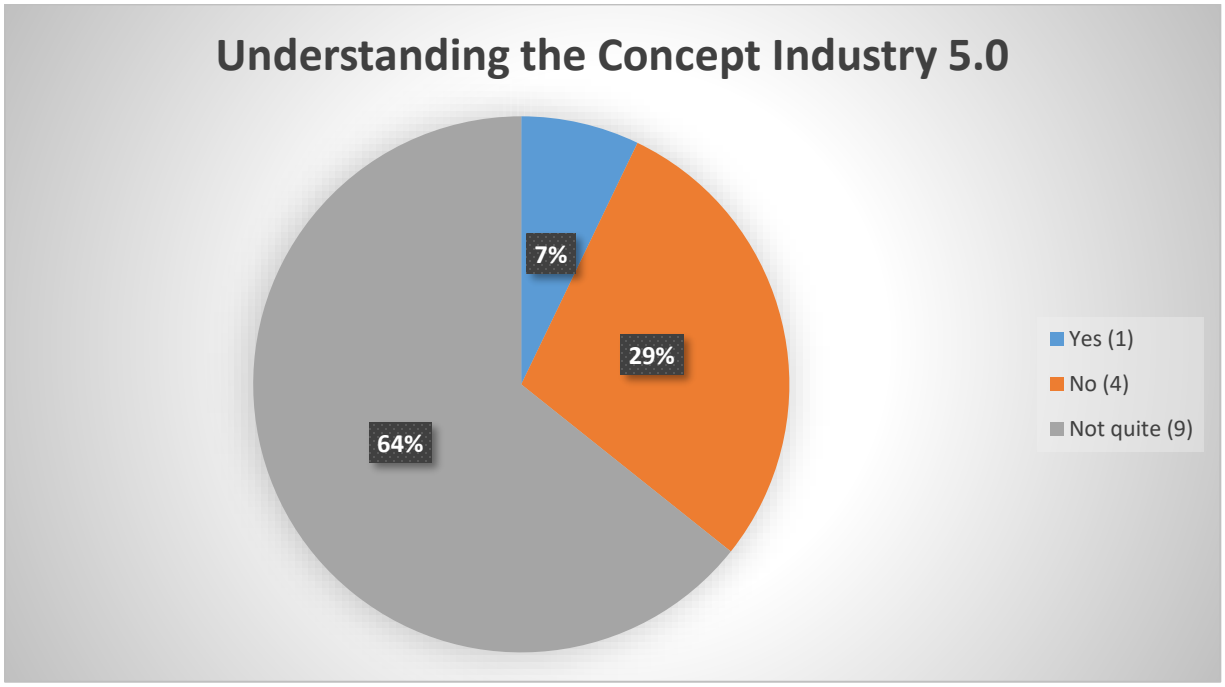
and everyday practices, still solve most problems with an Excel table instead of using software some private organizations already use to improve their results.

6) Perception of Concept Industry 5.0

Most participants knew of the latest technological innovations related to their industries, such as robotizing specific processes or incorporating AI tools in some practices. However, all the participants expressed a need to fully understand what Industry 5.0 was about, and how it could be incorporated into the operations of their organizations.

Figure 14

Sustainability Targets and Indicators



Note. Pie chart indicating the percentages of research subjects understanding the concept Industry 5.0

However, when it came to understanding the relevance and importance of the workforce developing new abilities and skills to effectively engage in collaboration with automatization, robotization, and artificial intelligence in the future, most participants agreed that organizations would have to create the necessary conditions to assure the workforce learns how to collaborate effectively with the new technology.

Most participants mentioned that all industries will have to provide the necessary training and development programs to develop employees' skills and abilities to meet the demands of emerging sustainable and technological novelties.

Five out of the fourteen participants expressed that they are starting to see and realize the necessity of planning the balance between human and machine collaboration; however, the research subjects did not identify this trend as related to the concept of Industry 5.0.

7) **The Role of Sustainability and Environmental Considerations in Shaping Organizational Future Strategies and Technological Choices**

All participants affirmed that they believed sustainability would continue to guide and shape many of the decisions made as part of their organizational objectives and philosophy, permeating from all areas and functions, from strategic planning to everyday operations.

All the participants believed there are several opportunities for their organizations to start paying more attention to these relevant topics. From formally incorporating sustainable targets into their organizational objectives and corporate strategies to starting to plan for the incorporation of new technological innovations into all areas of their operations, participants affirmed that organizations in Canada have a new window of opportunities opened by the incorporation of new technologies to promote more responsible and sustainable practices.

Most participants in the private sector expressed their interest in this type of research, emphasizing that they could understand the relevance of bringing the topics of sustainability and new technologies for discussion into their organizations. Research subjects from public organizations also affirmed that they could foresee several areas of improvement, mainly those to do with the implications related to how incorporating new technologies could affect the human factor, to which corporations will have to guarantee their safety and well-being.

8) Need of Change Mindset to Adapt to Trends in Sustainability and Technology

A topic that was not originally part of the initial questionnaire but that constantly kept appearing in most of the interviews was that of a change mindset in their organizations. Besides the words 'sustainability,' 'organization,' and 'technology,' the words that most appeared were 'think,' 'training,' 'industry,' 'question,' 'practices,' 'stakeholders,' and 'change.'

Eleven out of the fourteen participants added that they believed organizations had to show resilience, flexibility, and adaptation to face the new advancements and technology and to incorporate all new practices being developed to be socially, ecologically, and financially sustainable.

The tree map obtained as a result of the data analysis, the word ‘change’ among the main 10 words used by the participants. As a second group of other words that brought light into what were the interest and concerns of the participants were ‘development’, ‘community’, ‘different’.

In a third group, the words ‘decision’, ‘strategies’, advancement’, ‘embrace’, ‘financial’, ‘future’, ‘implementation’, ‘initiatives’, ‘approach’, ‘reputation’, and ‘results.

The categories in which these outcomes were organized resulted in:

1. Category 1. Decision-Making and Strategic Planning
2. Category 2. Sustainability and Organizational Focus
3. Category 3. Training and Industry Practices
4. Category 4. Development and Community

Some of the quotes shared by participants regarding the topic of Change Mindset, were:

- "We should live with that mindset of being ready for change."
- "The deployment (of new initiatives) always is, you know, like a bit of a difficulty because it requires change management and if you have a strong change agent that that could be done easily."
- "The fear of unknown when we're thinking about such a rapid advancement in technology and AI and what the future may hold."

Limitations

Limitations of this study are based on the relatively small sample of interviews, which may only partially represent the diverse range of perspectives and practices across all Canadian organizations in British Columbia. There have been qualitative studies based on 10 to 20 in-depth interviews since qualitative studies have been found to reach saturation at small sample sizes (Bekele & Ago, 2022; Hennink & Kaiser, 2022).

As the participants interviewed hold mid-senior management positions, the busy agendas of research subjects were also a significant limitation. It took several days, several days, in some cases weeks, for most of the interviews to be arranged. In some cases, interviews had to be rescheduled, and several no-shows due to last-minute work commitments took place throughout the few weeks planned for data collection. In the end, two of the participants who had initially agreed to collaborate had to reschedule at the last minute, and their interviews did not meet the deadline for this paper.

Another limitation is the rapidly evolving nature of technological and sustainable practices. New academic papers and research on sustainability and Industry 5.0 are constantly being published and presented at conferences worldwide (Akundi et al., 2022). New technological innovations and sustainable initiatives are also being developed rapidly to meet competitive industries' demands and regulations and norms changes (Alvarez-Aros & Bernal-Torres, 2021). The findings of this study, adding relevant insight to the body of knowledge on the topic, will need timely reflections and revisions due to the fast pace of new technologies being developed and launched.

The author had to change the initial research topic mid-way as it was very ambitious, for which data collection in only three months presented considerable challenges. The time

limitation resulting from this change of topic placed additional pressure to present the results and analysis of this research.

It is important to add, this is research in process, as several research subjects have not been able to accommodate their busy schedules to hold the semi-structured interviews according to the previously stablished formal protocol of this qualitative study.

Ethical Considerations

The ethics of research, including informed consent, confidentiality, and respect for the participants' privacy, will be strictly upheld throughout our research. The information obtained will be used for academic purposes. The participants' identities and organizations will remain private per the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2). Some of the participants showed concern about their names and the names of their organizations not being disclosed and were provided the consent form and assurance of complete anonymity.

Opportunities for Future Research

Several areas and topics can be identified as opportunities for future potential research.

*Impact of Sustainability and Industry 5.0 initiatives on Organizational Performance. Conducting research or organizational performance in organizations where sustainability initiatives and industry 5.0 practices are being implemented could bring light to assessing the impact on productivity, profitability, or other KPIs.

*Cost–benefit analysis of Sustainable practices supported by Industry 5.0 practices. While researching the implications of applying sustainable practices to organizational processes, organizations can obtain objective results to justify the financial investments of sustainable initiatives while benefiting from the technological advancements at hand.

*Assessing the effectiveness of HR Strategy and Training and Development Programs as sustainable Industry 5.0 practices permeate industries. By assessing the effectiveness and impact of sustainability and technology training and development programs, new adjustments, adaptations, and improvements can be made, proposed, or justified to help the workforce within organizations develop new abilities and skills.

*Organizational Culture and Change Management. Assessing the role of organizational culture in several industries and corporations to identify the strategies in which they facilitate or hinder the adoption of sustainable practices and new technologies and how they foster a change mindset within the organization.

*Cross – industry Comparative research. Identifying commonalities and differences in the integration of sustainable practices and technological innovations in different industries, beyond regulatory compliances, in or der to share best practices and find transferable strategies.

Conclusion

Industry 5.0 promises to surpass its predecessor, Industry 4.0, aligning more effectively with sustainability goals and highlighting the importance of human well-being and environmental health. The future of Industry 5.0 is still being written as scholars continue to research the connection between the advancement of technology and the intrinsic relationship with the workforce, emphasizing a higher value in human interaction.

This qualitative research aimed to reveal initial relevant insights and add to the emerging knowledge on the conjunction of Sustainability and Industry 5.0. The implications of this research are relevant for academics, industry experts, and policymakers since these results can shed light on the challenges Canadian organizations will face in pursuing sustainable practices and technology integration in the upcoming years. The findings also reveal threats and opportunities Canadian organizations have in incorporating new technological innovations to respond to the growing necessity of sustainable policies and practices in all industries.

In response to the research question: How are Canadian organizations adapting to the convergence of Sustainability and Industry 5.0, and how are their technological and sustainable strategies implemented? We can affirm that Canadian organizations are somehow prepared to face the convergence of Sustainability and Industry 5.0; however, there are many opportunities for improvement, like public organizations adapting more rapidly to technological innovations or private organizations including training and development programs as part of the role description and obligations for employees to truly benefit from these programs aimed at helping collaborators better adapt to the changes in every industry.

The data presented can guide business executives and strategy planners in balancing profit-driven growth and environmental, sustainable, and ethically responsible practices in a more effective, focused manner. The findings also contribute to the evolving development of Industry 5.0 and Sustainability in public and private enterprises in the dawn of novel and disruptive technological advancements.

Understanding these concepts will be crucial for developing corresponding theories and business applications, as the concepts of Sustainability and Industry 5.0 will shape the trajectory of industry and society as organizations head toward the future. Fostering a continuous culture of innovation, flexibility, and adaptability will be essential for organizations to meet customers' demands and look for environmentally and socially responsible organizations to associate with. A changed mindset will also be necessary to adapt to governmental authorities' new regulations and requirements regarding sustainable, responsible practices.

Organizations must monitor and measure the effectiveness and impact of their sustainable initiatives and practices, understanding how these actions affect their financial results, the perception, reputation, and competitive advantage of their enterprises. Only those parameters and actions that can be measured can be later improved.

More research, field studies, and analysis are needed in all relevant industries to assess the effectiveness of current strategies in all areas and departments of organizations. Strengths and weaknesses must be identified to make the necessary adjustments and apply the necessary policies to guarantee profitability and efficiency.

Canadian organizations navigate an ocean of opportunities and new challenges set by the principles of Sustainability and human-centric values. The future scenario, characterized by the joint of Sustainability and new Technological innovations, brings a plethora of opportunities for Project Management, Human Resources, Operations Management, Financial Strategic Planning, CEOs, and Chief Executive Officers to undertake a multifaced approach to face the challenges industrial revolution 5.0 implies effectively.

In this fast-paced, evolving landscape, only those organizations that rapidly adapt to new industry trends and dynamics and learn how to embrace change effectively will ultimately thrive and continue to achieve their ultimate goals.

References

Adel, A. (2022). Future of industry 5.0 in society: Human-centric solutions, challenges, and prospective research areas. Journal of Cloud Computing, 11(1), 1-15.

Akundi, A., Euresti, D., Luna, S., Ankobiah, W., Lopes, A., & Edinbarough, I. (2022). State of Industry 5.0—Analysis and identification of current research trends. Applied System Innovation, 5(1), 27.

Alvarez-Aros, E. L., & Bernal-Torres, C. A. (2021). Technological competitiveness and emerging technologies in industry 4.0 and industry 5.0. Anais da Academia Brasileira de Ciências, 93.

Aslam, F., Aimin, W., Li, M., & Ur Rehman, K. (2020). Innovation in the era of IoT and industry 5.0: Absolute innovation management (AIM) framework. Information, 11(2), 124.

Bai, C., Dallasega, P., Orzes, G., & Sarkis, J. (2020). Industry 4.0 technologies assessment: A sustainability perspective. International Journal of Production Economics, 107776. doi:10.1016/j.ijpe.2020.107776

Baradaran, B. (2019). How Design thinking can be leveraged and supported by artificial intelligence. Politecnico Di Milano. Dipartemento Di Ingegneria Gestionale Management Engineering.

Bekele, W. B., & Ago, F. Y. (2022). Sample size for interview in qualitative research in social sciences: A guide to novice researchers. Research in Educational Policy and Management, 4(1), 42-50.

Ben Youssef, A., & Mejri, I. (2023). Linking Digital Technologies to Sustainability through Industry 5.0: A Bibliometric Analysis. Sustainability, 15(9), 7465.

Bengtsson, M., Alfredsson, E., Cohen, M., Lorek, S., & Schroeder, P. (2018). Transforming systems of consumption and production for achieving the sustainable development goals: Moving beyond efficiency. Sustainability science, 13, 1533-1547.

Borkan, J. M. (2022). Immersion–Crystallization: a valuable analytic tool for healthcare research. Family Practice, 39(4), 785-789.

Breque, M., De Nul, L., & Petridis, A. (2021). Industry 5.0: towards a sustainable, human-centric and resilient European industry. Luxembourg, LU: European Commission, Directorate-General for Research and Innovation.

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. Neurological Research and practice, 2, 1-10.

Carroll, A. B. (2015). Corporate social responsibility. Organizational dynamics, 44(2), 87-96.

Clark, K. R., & Vealé, B. L. (2018). Strategies to enhance data collection and analysis in qualitative research. Radiologic technology, 89(5), 482CT-485CT.

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. The counseling psychologist, 35(2), 236-264.

Coleman, D. C. (1956). Industrial Growth and Industrial Revolutions. Economica, 23(89), 1. doi:10.2307/2551266

Cruz, R. F., & Tantia, J. F. (2017). Reading and understanding qualitative research. American Journal of Dance Therapy, 39, 79-92.

Delannon, N., Raufflet, E., & Baba, S. (2016). Corporate community engagement strategies and organizational arrangements: A multiple case study in Canada. Journal of Cleaner Production, 129, 714-723.

Demir, K. A., Döven, G., & Sezen, B. (2019). Industry 5.0 and Human-Robot Co-working. Procedia Computer Science, 158, 688–695. doi:10.1016/j.procs.2019.09.104

Dodds, R., & Holmes, M. R. (2011). Sustainability in Canadian B&Bs: comparing the east versus west. International Journal of Tourism Research, 13(5), 482-495.

Dos-Santos, S. M. (2021). Relationship between innovativeness and competitiveness in networked organizations: A perspective from the electric and electronic industry in Brazil. Creativity and Innovation Management, 30(2), 248-267.

Duić, N., Urbaniec, K., & Huisingh, D. (2015). Components and structures of the pillars of sustainability. Journal of Cleaner Production, 88, 1-12.

Engert, S., Rauter, R., & Baumgartner, R. J. (2016). Exploring the integration of corporate sustainability into strategic management: A literature review. Journal of cleaner production, 112, 2833-2850.

European Commission, Directorate-General for Research, and Innovation, Breque, M., De Nul, L., Petridis, A. (2021). Industry 5.0: towards a sustainable, human-centric, and resilient European industry, Publications Office of the European Union. https://data.europa.eu/doi/10.2777/308407

Farrell, L., Newman, T., & Corbel, C. (2021). Literacy and the workplace revolution: a social view of literate work practices in Industry 4.0. Discourse: Studies in the cultural politics of education, 42(6), 898-912.

Fraga-Lamas, P., Lopes, S. I., & Fernández-Caramés, T. M. (2021). Green IoT and edge AI as key technological enablers for a sustainable digital transition towards a smart circular economy: An industry 5.0 use case. Sensors, 21(17), 5745.

Galletta, A. (2013). Mastering the semi-structured interview and beyond: From research design to analysis and publication (Vol. 18). NYU press.

Galpin, T., Whitttington, J. L., & Bell, G. (2015). Is your sustainability strategy sustainable? Creating a culture of sustainability. Corporate Governance, 15(1), 1-17.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy–A new sustainability paradigm? Journal of cleaner production, 143, 757-768.

Ghobakhloo, M., Fathi, M., Iranmanesh, M., Maroufkhani, P., & Morales, M. E. (2021). Industry 4.0 ten years on: A bibliometric and systematic review of concepts, sustainability value drivers, and success determinants. Journal of Cleaner Production, 302, 127052.

Ghobakhloo, M., Iranmanesh, M., Mubarak, M. F., Mubarik, M., Rejeb, A., & Nilashi, M. (2022). Identifying industry 5.0 contributions to sustainable development: A strategy roadmap for delivering sustainability values. Sustainable Production and Consumption, 33, 716-737.

Gupta, A. (2022). Sustainability in Industry 4.0. Ushus Journal of Business Management, 21(3).

Haseeb, M., Hussain, H. I., Kot, S., Androniceanu, A., & Jermsittiparsert, K. (2019). Role of social and technological challenges in achieving a sustainable competitive advantage and sustainable business performance. Sustainability, 11(14), 3811.

Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. Social science & medicine, 292, 114523.

Huang, K. F., Dyerson, R., Wu, L. Y., & Harindranath, G. (2015). From temporary competitive advantage to sustainable competitive advantage. British Journal of Management, 26(4), 617-636.

Huang, S., Wang, B., Li, X., Zheng, P., Mourtzis, D., & Wang, L. (2022). Industry 5.0 and Society 5.0—Comparison, complementation, and co-evolution. Journal of manufacturing systems, 64, 424-428.

Jamshed, S. (2014). Qualitative research method-interviewing and observation. Journal of basic and clinical pharmacy, 5(4), 87.

Janicke, M., & Jacob, K. (2013). A third industrial revolution. Long-term governance for social-ecological change, 47-71.

Jena, M. C., Mishra, S. K., & Moharana, H. S. (2020). Application of Industry 4.0 to enhance sustainable manufacturing. Environmental Progress & Sustainable Energy, 39(1), 13360.

Jitmaneeroj, B. (2016). Reform priorities for corporate sustainability. Management Decision, 54(6), 1497–1521. doi:10.1108/md-11-2015-0505

Ivanov, D. (2023). The Industry 5.0 framework: Viability-based integration of the resilience, sustainability, and human-centricity perspectives. International Journal of Production Research, 61(5), 1683-1695.

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. Journal of advanced nursing, 72(12), 2954-2965.

Kennedy, B. L., & Thornberg, R. (2018). Deduction, induction, and abduction. The SAGE handbook of qualitative data collection, 49-64.

Khan, R. N., (1987) The third industrial revolution. An economic overview. Impact of science on society. UNESCO Taylor & Francis.

Koc, T. C., & Teker, S. (2019). Industrial revolutions and its effects on quality of life. PressAcademia Procedia, 9(1), 304-311.

Koop, S. H., & van Leeuwen, C. J. (2017). The challenges of water, waste and climate change in cities. Environment, development and sustainability, 19(2), 385-418.

Kovács, G., & Spens, K. M. (2005). Abductive reasoning in logistics research. International Journal of Physical Distribution & Logistics Management, 35(2), 132–144. doi:10.1108/09600030510590318

Kuhlman, T., & Farrington, J. (2010). What is sustainability? Sustainability, 2(11), 3436-3448.

Loy, A. C. M., Chin, B. L. F., & Sankaran, R. (2021). 1.1 Industrial Revolution 1.0. The Prospect of Industry 5.0 in Biomanufacturing, 1.

Maddikunta, P. K. R., Pham, Q.-V., B, P., Deepa, N., Dev, K., Gadekallu, T. R., … Liyanage, M. (2021). Industry 5.0: A survey on enabling technologies and potential applications. Journal of Industrial Information Integration, 100257. doi:10.1016/j.jii.2021.100257

Matson, P., Clark, W. C., & Andersson, K. (2016). Pursuing sustainability: a guide to the science and practice. Princeton University Press.

Melnyk, L. H., Kubatko, O. V., Dehtyarova, I. B., Dehtiarova, I. B., Matsenko, O. M., & Rozhko, O. D. (2019). The effect of industrial revolutions on the transformation of social and economic systems.

Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. Cogent social sciences, 5(1), 1653531.

Menzies, R. (March 16, 2021). Introduction to Thematic Analysis. Rachel Menzies [YouTube Video]. https://www.youtube.com/watch?app=desktop&v=jgq62UZuCEU

Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. European journal of general practice, 24(1), 9-18.

Mourtzis, D., Angelopoulos, J., & Panopoulos, N. (2023). The Future of the Human–Machine Interface (HMI) in Society 5.0. Future Internet, 15(5), 162.

Namdar, J., S. A. Torabi, N. Sahebjamnia, and N. N. Pradhan. (2021). Business Continuity-Inspired Resilient Supply Chain Network Design. International Journal of Production Research 59 (5): 1331–1367.

Nahavandi, S. (2019). Industry 5.0—A human-centric solution. Sustainability, 11(16), 4371.

Popkova, E. G., Ragulina, Y. V., & Bogoviz, A. V. (2018). Fundamental Differences of Transition to Industry 4.0 from Previous Industrial Revolutions. Studies in Systems, Decision and Control, 21–29. doi:10.1007/978-3-319-94310-7_3

Prasanna, R. P. I. R., Jayasundara, J. M. S. B., Naradda Gamage, S. K., Ekanayake, E. M. S., Rajapakshe, P. S. K., & Abeyrathne, G. A. K. N. J. (2019). Sustainability of SMEs in the competition: A systemic review on technological challenges and SME performance. Journal of Open Innovation: Technology, Market, and Complexity, 5(4), 100.

Rajumesh, S. (2023). Promoting sustainable and human-centric industry 5.0: a thematic analysis of emerging research topics and opportunities. Journal of Business and Socio-economic Development.

Saniuk, S., Grabowska, S., & Straka, M. (2022). Identification of social and economic expectations: Contextual reasons for the transformation process of Industry 4.0 into the Industry 5.0 concept. Sustainability, 14(3), 1391.

Shaikh, F. K., Zeadally, S., & Exposito, E. (2015). Enabling technologies for green internet of things. IEEE Systems Journal, 11(2), 983-994.

Statistics Canada (2022). North American Industry Classification System (NAICS) Canada 2022 Version 1.0. Government of Canada. https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=1369825

Stock, T., Obenaus, M., Kunz, S., & Kohl, H. (2018). Industry 4.0 as Enabler for a Sustainable Development. A Qualitative Assessment of its Ecological and Social Potential. University of Berlin, Germany.

Suciu, M. C., Plesea, D. A., Petre, A., Simion, A., Mituca, M. O., Dumitrescu, D., ... & Nasulea, D. F. (2023). Core Competence—As a Key Factor for a Sustainable, Innovative and Resilient Development Model Based on Industry 5.0. Sustainability, 15(9), 7472.

Taalbi, J. (2019). Origins and pathways of innovation in the third industrial revolution. Industrial and corporate change, 28(5), 1125-1148.

Terry, G., Hayfield, N., Clarke, V., & Braun, V. (2017). Thematic analysis. The SAGE handbook of qualitative research in psychology, 2, 17-37.

Timmermans, S., & Tavory, I. (2012). Theory Construction in Qualitative Research. Sociological Theory, 30(3), 167–186. doi:10.1177/0735275112457914

Turner, C., Oyekan, J., Garn, W., Duggan, C., & Abdou, K. (2022). Industry 5.0 and the circular economy: Utilizing LCA with intelligent products. Sustainability, 14(22), 14847.

Vaughn, P., & Turner, C. (2016). Decoding via coding: Analyzing qualitative text data through thematic coding and survey methodologies. Journal of Library Administration, 56(1), 41-51.

Voulgaridis, K., Lagkas, T., & Sarigiannidis, P. (2022, May). Towards industry 5.0 and digital circular economy: Current research and application trends. In 2022 18th International Conference on Distributed Computing in Sensor Systems (DCOSS) (pp. 153-158). IEEE.

Whelan, T., & Fink, C. (2016). The comprehensive business case for sustainability. Harvard Business Review, 21(2016).

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. International Management Review, 15(1), 45-55.

Yitmen, I., Almusaed, A., & Alizadehsalehi, S. (2023). Investigating the Causal Relationships among Enablers of the Construction 5.0 Paradigm: Integration of Operator 5.0 and Society 5.0 with Human-Centricity, Sustainability, and Resilience. Sustainability, 15(11), 9105.

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception, and perception. Journal of Manufacturing Systems, 61, 530-535.

Zhanbayev, R. A., Irfan, M., Shutaleva, A. V., Maksimov, D. G., Abdykadyrkyzy, R., & Filiz, Ş. (2023). Demoethical Model of Sustainable Development of Society: A Roadmap towards Digital Transformation. Sustainability, 15(16), 12478.

Zutshi, A. (2019). Industry 5.0—Bringing Empowered Humans Back to the Shop Floor.

Appendixes

Appendix 1

Letter of Approval by UCW Research Ethics Board Committee

REB
Application Decision
Policy 5020; Procedure 5020
Research Ethics Board
Application Decision
Policy 5020; Procedure 5020

Date: 2023-08-17

To: Dr. Nisa Chand

From: UCW, Research Ethics Board

Project Title: The Nexus of Sustainability and Industry 5.0: Assessing Canadian Organizations' Readiness for the Next Technological Revolution

Dear Dr. Nisa Chand

The UCW REB has considered your application for Primary Research submission for the above project. Please refer to UCW Policy 5020.

The REB has conducted a 'Review' of our submission as per policy, procedure, and TCPS2 standards.

The decision by the REB is for you to **proceed with the research**.

This letter has been electronically signed in accordance with all applicable regulations, and the Academic Department records retain a copy.

Sincerely,

UCW Research Ethics Board

Appendix 2

Invitation to Participate in Academic Research

Invitation to Participate in Academic Research Letter

August 17th, 2023
XXXXXXXXXXXX

Research: "The Nexus of Sustainability and Industry 5.0: Assessing Canadian Organizations' Readiness for the Next Technological Revolution.", by Ada Sandoval Madrid, MBA Candidate.

Dear *XXXXXXXXXX,*

I am writing to let you know about an opportunity to participate in a research study with the objective to explore how Canadian organizations are navigating the encounter between sustainable practices and technological advancements, on the journey toward Industry 5.0

This study is being conducted by Ada del Carmen Sandoval Madrid, MBA Candidate at University Canada West. This study will be relevant for academics, industry experts, as well as for policymakers since the results will provide light into the challenges faced by Canadian organizations in the pursuit of sustainable practices and technology integration.

We kindly ask for your collaboration with our study as you are being contacted via the description of your Linkedin professional profile, stating your working relationship with a Canadian organization related to one of the following industries: Manufacturing, Information Technology, Retail, Education, Professional Services, Energy/Utilities, or Construction

I will happily share the questionnaire including the questions that would be asked during our one-on-one online interview, as well as the UCW Research Ethics Board authorization, and letter of consent and confidentiality for your consideration. An agreement to be contacted or a request for more information does not oblige you to participate in any study.

If you would like to participate and collaborate in our study, please call or email MBA Candidate Ada del Carmen Sandoval Madrid at (604) 318 5359 or adissandovalm2020@gmail.com / adadelcarmen.sandovalmadrid@myucwest.ca

Thank you again for considering your valuable participation in this research opportunity.

Researcher: Ada del Carmen Sandoval Madrid

Appendix 3

Questionnaire approved by UCW Research Ethics Board Committee for Semi-structured Interviews.

SECTION I. SUSTAINABILITY

1. Is **Sustainability** part of the Organizational Objectives, Mission, or Vision of your organization?
2. How has **sustainability** been integrated into the decision-making processes of your organization?
3. To what extent does your organization embrace **sustainability practices and initiatives** to reduce environmental impact and promote social responsibility?
4. How effectively has your organization communicated its **sustainability goals and initiatives** to internal stakeholders, such as employees and management?
5. How effectively has your organization communicated its **sustainability goals and initiatives** to external stakeholders, including customers, partners, and the community?
6. Can you tell me about some of the **sustainability** targets and indicators your organization has established to measure its performance?
7. In what ways has your organization implemented clear strategies and targets towards energy efficiency, waste management, and carbon footprint reduction?
8. How has your organization incorporated **sustainable practices** throughout its supply chain, including sourcing, manufacturing, distribution, and waste management?
9. To what extent has your organization utilized advanced technologies (such as artificial intelligence, automation, or IoT) to **optimize sustainability outcomes** in its operations?
10. How has your organization engaged with external stakeholders like local communities, NGOs, and government agencies to address **sustainability challenges** and collaborate on innovative solutions?
11. Can you share how your organization has invested in research and development activities to drive **sustainable innovation** within its industry?
12. How has your organization provided **sustainability training and awareness programs** for employees to foster a culture of sustainability?
13. In what ways has the integration of **sustainability practices** positively influenced your organization's competitive advantage?
14. How has the integration of **sustainability practices** positively influenced your organization's reputation?
15. Could you elaborate on how the integration of **sustainability practices** has positively influenced your organization's financial results?

SECTION II. TECHNOLOGY

1. How does your organization approach technological advancements and digital transformation in the context of your industry's evolution?
2. How would you rate your organization's progress in embracing new technologies and practices to stay competitive and meet evolving industry demands?
3. Can you describe the level of collaboration and integration between human employees and technology within your organization's operations?
4. How does your organization foster a culture of continuous learning and skill development to meet the demands of emerging technologies?
5. How is your organization preparing your workforce to adapt to the changing business landscape and potential technological disruptions?
6. To what extent does your organization invest in employee training and development programs to enhance digital skills and adaptability in the workplace?
7. What steps have you taken to address the potential impact of automation and artificial intelligence on your workforce, and how do you plan to balance human-machine collaboration?
8. How well does your organization integrate data analytics and insights into decision-making processes to drive business growth and optimization?
9. How well does your organization leverage digital platforms and technologies to enhance internal stakeholders' experiences and engagement? (Employees, management)
10. How well does your organization leverage digital platforms and technologies to enhance external customer experiences and engagement? (Customers, partners, community)
11. How do you evaluate and assess the success of technology implementation and digital initiatives within your organization?
12. How do you address potential ethical and societal implications arising from the adoption of new technologies within your organization?
13. Can you discuss any strategic partnerships or collaborations your organization has pursued to leverage external expertise in cutting-edge technologies?
14. With all new technological advancements (AI, Robotics, Automatization, etc.) how do you see the future of your industry, and what potential shifts or advancements do you anticipate in the coming years?
15. How do you perceive the role of sustainability and environmental considerations in shaping your organization's future strategies and technological choices?