SCHOOL OF
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A Multi-Level Analysis of Sustainable ICT Transitions

What strategies are managers at Ericsson using to influence the socio-technical transition towards more sustainable 5G?

by

Claudio Pauwels

Nicole Skoglund

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Supervisor: Tanya Kolyaka
Examiner: Bo Göransson

Abstract

5G has the potential to enable transformational reductions in carbon emissions across industries. As the technology can assist with decarbonisation efforts, it is essential to understand how one can accelerate the diffusion of sustainable innovations like 5G. This thesis examines what strategies managers at Ericsson are using to influence the socio-technical transition toward more sustainable 5G. A case study containing semi-structured interviews was conducted on managers working with innovation and sustainability at Ericsson to understand their strategies to influence socio-technical transitions towards more sustainable systems.

The case study's findings reveal four main strategies that managers utilise to stir the innovation process: (1) exploration and exploitation activities, (2) collaboration with various stakeholder groups, (3) knowledge sharing activities, and (4) embed sustainability into daily practices, inspiring further sustainability thought leadership. Findings reveal that the strategic decisions that managers make are paramount to the innovation process. However, various barriers to the innovation process cannot be undermined (e.g. path dependency, immature markets, lack of knowledge within certain industrial settings, and institutional barriers).

Keywords: sustainability, socio-technical transitions, 5G, IoT, MLP

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5G: the 5th generation mobile network, enabling the connection between machines, objects, and devices.

Internet of Things (IoT): the network of physical objects - "things" - that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet.

Landscape: The exogenous environment beyond the direct influence of niche and regime actors (e.g. demographic shifts, the rise of consumer culture, climate change).

Niche: Exist on the micro-level and act as "incubation rooms" where radical novelties emerge.

Regime: Shared cognitive routines in an engineering community and explained patterned development along technological trajectories (e.g. culture, actor configurations, infrastructure, financial and juridical arrangements).

Sustainability: Meeting our own needs without compromising the ability of future generations to meet their own needs.

List of Abbreviations

4G - Fourth Generation of Wireless Technology
5G - Fifth Generation of Wireless Technology
COP26 - 26th Conference of the Parties (UN Climate Change Conference)
GHG - Greenhouse gas
ICT - Information Communications Technologies
IoT - Internet of Things
IPCC - Intergovernmental Panel on Climate Change
SDGs - Sustainable Development Goals

1 Introduction

According to MIT and Ericsson's research, the ICT industry has the potential to enable a reduction of global carbon emissions by up to 15 per cent by 2030 (MIT Technology Review Insights, 2021). The capabilities of 5G (5th Generation of Wireless Technology) have the potential to enable transformational reductions in carbon emissions across industries (MIT Technology Review Insights, 2021). As the technology can help increase the interconnectedness of supply chains, transportation and energy networks and share data to increase efficiency and productivity, it can accelerate decarbonisation efforts (MIT Technology Review Insights, 2021). Nonetheless, the idea that innovation is about the commercialisation of ideas suggests that it is relatively simple (Smith, 2015). This is far from reality, as the adoption of innovations takes immense amounts of effort and time (Smith, 2015). With this in mind, it is crucial to understand how one can accelerate the diffusion of innovations that promise more sustainability.

The UN Climate Change Conference (COP26) marked an important date. It's a day when stakeholders from governing bodies as well as the public and private sectors come together to collaborate and outline strategies for meeting climate goals (UK COP26, 2021). Sweden confirmed its long-term strategy for reducing greenhouse gases which entails being net-zero by 2045 and net negative after 2045. On top of that, private sector mobilisation was higher than ever, where 5200+ businesses and 450 financial institutions committed to science-based net-zero targets (UK COP26, 2021). COP26 made it clear that the private sector must develop robust and transparent plans to deal with sustainability (BCG, 2021). Ericsson, a Swedish ICT company, illuminates that digital communications have a role in combating climate change and that delays in 5G roll-out could hamper efforts to halve emissions by 2030 as well as reach net-zero in 2050 (Ericsson, 2021a). Approximately 15% of the world's population has access to 5G and this is forecasted to rise to 75% by 2027 (Ericsson, 2021a). At this momentum, the company claims that there is a risk of missing the chance to fully make use of 5G's potential to combat climate change (Ericsson, 2021a). Considering this, one needs to gain more insights into how to accelerate the adoption of sustainable innovations such as 5G.

At the same time, according to the Intergovernmental Panel on Climate Change (IPCC)'s most recent report, it remains possible to keep temperatures from rising by more than 1.5°C over preindustrial levels - and thereby stabilise the climate. Reaching this 1.5°C target would require rapid reductions in greenhouse gas (GHG) emissions, but these reductions are not yet happening at the necessary pace or scale (IPCC, 2021). This highlights that corporate leaders play a vital role in setting the pace of the sustainability transition, where acceleration is needed (BCG, 2021). Business cannot be a bystander in a system that gives it life in the first place (Polman, 2014). This is supported by Raworth (2017)'s doughnut economics, which reveals that social and planetary boundaries must not be overshot, a new corporate mindset needs to be sparked -

one where business models can generate results for greater society and humanity (Polman, 2014). At the same time, Timmer et al. (2018) emphasise the importance of science, technology, and innovation for achieving the United Nation's Sustainable Development Goals (SDGs), stating that "*the devolution of information processing and communication to electronic systems is the most important driver to have a transformative impact on the near-term global future of our societies*" (Timmer et al., 2018, p. 41). Within Europe, 1.75 per cent of carbon emissions originate from using ICT equipment. However, according to the European Commission and Sweden's government, the ICT industry has the potential to reduce emissions in all sectors of society whilst also increasing cost savings (Government Offices of Sweden, 2010). This illuminates that corporate leaders and managers within the ICT field have the responsibility to understand how diffusion of sustainable innovations can occur whilst also understanding unintended consequences of actions (as well as inactions).

With this being said, this thesis aims to look at what managers are doing to diffuse 5G, a sustainable innovation, into Sweden's socio-technical system. Socio-technical systems are defined as the interaction between society's complex infrastructures and human behaviour (Geels, 2002). By scoping into what strategies managers at Ericsson are pursuing to diffuse 5G into Sweden's socio-technical system, we provide clarity on systemic challenges and opportunities that exist in the ICT industry's innovation landscape. Through a holistic perspective, this thesis uses the multi-level perspective to understand innovation transition from three analytical levels: the niche, socio-technical regimes and socio-technical landscape. Niches are on the micro-level and where innovation happens, acting as "incubation rooms" from normal market forces and allowing for research and learning through experience (Geels, 2002). Regimes are on the meso level and consist of rule-based processes, technologies, skills, corporate cultures and artefacts embedded in institutions and infrastructures (Geels, 2002). Regime shifts occur due to a cascade of changes throughout time. Lastly, the landscape exists on the macro-level and forms the external structure or context for interaction between actors (Geels, 2002). Landscapes are slow to change and consist of factors such as economic growth, political coalition, environmental problems, cultural norms, war and more.

As our world becomes increasingly complex and the pace of change continues to increase, it is beneficial to view the managerial perspectives in conjunction with the complex environment, which is made up of technological, social and institutional actors. The research seeks to inspire business leaders within the ICT industry to take responsibility for their sustainability journey. Thus, this thesis sheds light on what strategies managers at Ericsson are utilising to diffuse 5G innovation into the socio-technical regime whilst being mindful of the complex environment they interact with. By being aware of which strategies help stir the innovation process, managers are better equipped to manage the innovation process to their advantage. The strategies can help managers make more informed business decisions when making sustainable ICT innovations more widely available.

1.1 Aim and Objectives

The overarching aim of this study is to understand what managers at Ericsson do to enforce more sustainable innovations into socio-technical systems. Socio-technical systems describe the co-evolution of technology and society, where the interrelationship between humans and technology affects social structures and the design of systems that involve communities of people (Geels, 2004). This study more specifically aims to shed light on what managers are doing to diffuse 5G into Sweden's socio-technical system, illuminating how 5G innovation is utilised to enforce more sustainable technological transitions. Therefore, the following research question has been formulated:

Research question: What strategies are managers at Ericsson using to influence the socio-technical transition towards a more sustainable 5G?

Ultimately, there are three sub-aims which support the overarching research question.

- To understand the role of managers in the transformation towards more sustainable systems.
- To pinpoint the factors that hinder the diffusion process of sustainable 5G innovation.
- To discuss the managerial ability to mobilise relevant stakeholders using the multi-level perspective (MLP) as the study's theoretical lens.

Considering this question, the aim of the thesis is threefold. Firstly, this study seeks to understand what managers can do to diffuse more sustainable innovations, like 5G, into socio-technical systems. By exemplifying the role of managers in diffusing sustainable innovations within the ICT sector, we gain clarity on what actions need to be taken to mobilise sustainability transitions on a systems level. Secondly, this study seeks to recognise factors that hinder sustainable innovations, such as 5G, from diffusing into socio-technical systems. By shedding light on the pain points, we come to a greater understanding of what may need further attention and what managers may need more significant support on. Thirdly, the research has a motive to gain a practical point of view on the role of managers in the multi-level perspective framework through a case study. The case study will shed light on how managers can be a force creating an impetus for change, mobilizing themselves and other relevant stakeholders in the landscape, socio-technical regime, and niche innovation area. These will be discussed in detail in Section 2.2.2.

1.2 Research Purpose

On an overarching level, the purpose of this thesis is threefold. Firstly, it seeks to inspire business leaders to take responsibility for their ICT companies' sustainability journey, focusing on driving change where they can reach. It seeks to contribute to the scholarly research within innovation studies, sustainability studies and management studies. Secondly, the study seeks to exemplify how the multi-level perspective can be used as a theoretical tool to understand socio-technical systems and the shift from one socio-technical system to another (in this case, the change from 4G, the fourth generation of wireless technology, to 5G, the fifth generation of wireless technology). The environment in which these socio-technological systems exist is highly complex. Multi-level perspective as a theoretical framework helps us understand the system by breaking it down into sub-parts, all whilst not undermining the underlying complexity of the system itself. Thirdly, with this research, we seek to unravel the complexities of socio-technical transitions and the systemic nature of innovation, as emphasised by the works of previous scholars across a wide range of disciplines, e.g. sustainability transitions (Smith, Voß, Grin, 2010), sectoral systems on innovation (Geels, 2006; Geels, 2004; Breschi & Malerba, 1997; Malerba 2002), technological systems (Carlsson & Stankiewicz, 1991; Carlsson, 1997), large technical systems (Hughes, 1983; Hughes, 1987; Mayntz and Hughes, 1988; La Porte, 1991; Summerton, 1994; Coutard, 1999). Building on extant research, this study seeks to unravel what strategies managers within Sweden's ICT industry can take to enforce socio-technical transitions towards more sustainable systems.

1.3 Outline of the Thesis

This thesis is structured into five chapters.

Chapter 1 introduces the research topic, research questions, research aims, research objectives as well as the research purpose.

Chapter 2 consists of a literature review and the theoretical framework. The literature review introduces previous scholarly work in innovation studies, sustainability of the ICT industry, 5G and 5G's socio-technical system. The theoretical framework outlines the primary model utilised to analyse managers' strategies to diffuse 5G into Sweden's socio-technical system: the MLP.

Chapter 3 highlights the methodological approach, which includes the research design and methods for data analysis. On top of this, it considers the study's limitations and a critical reflection on the generalisability, validity, and reliability of the research.

Chapter 4 consists of a presentation of the data collected, research findings, and a discussion surrounding the findings, all whilst considering the previous literature and theoretical framework.

Chapter 5 illuminates the main findings of the research, contributions of the study and answers the research questions of the thesis. Finally, we conclude the paper by discussing the practical implications of the research and present future research suggestions.

2 Literature/Theoretical Review

The following section contains two parts, a literature review and the theoretical framework. The literature review consists of previous scholarly work, which will situate our research with existing knowledge within the fields of innovation and sustainability management, more specifically, innovation theories, sustainability of the ICT industry, 5G and sustainability of 5G, as well as 5G's socio-technical system in Sweden. The theoretical framework introduces the main model utilised to analyse what strategies managers are utilising to diffuse 5G into Sweden's socio-technical system, namely, the multi-level perspective as well as its sub-parts: the niche, the socio-technical regime and the landscape.

2.1 Previous Research

The previous research below builds the foundation for this thesis. This research relies on prior research to emphasise the importance of the current study, for instance, in challenging the standing argument or addressing research gaps within the field of innovation and sustainability studies.

2.1.1 Innovation Literature

Innovation is one of the major sources of economic growth and helps transformation of the world occur, all while creating value and enabling change towards a socially valuable direction (Bessant & Tidd, 2014). New technologies are developed with the thought that such innovations will be beneficial for society, but in the long run, recognising the limitations of such innovations becomes apparent (Dodgson et al., 2008; Smith, 2015, p. 396). Joseph Schumpeter (1911) laid the grounds for innovation literature, shedding light on the notion of "creative destruction", which is when innovation leads to the rise of new industries and the destruction of old established ones (Smith, 2015, p. 76; Schumpeter, 1911). Creative destruction is:

"[the] process of industrial mutation ... that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of creative destruction is the essential fact of capitalism" (Schumpeter, 1954, p. 83).

The application of creative destruction within the context of this thesis can be observed in the eventual destruction of 4G, making way for the creation of 5G. At the same time, evolutionary economics articulates that innovation growth occurs through technological trajectories, defined

by systems of localised technological knowledge, distributed knowledge, innovation networks and competence (Antonelli, 2009, p. 613). Path dependency is apparent with such interconnected systems (Antonelli, 2009, p. 613).

Dahmén (1988) illuminates that transformation pressure enforces innovation, as there is a strongly felt necessity to adjust and adapt. Such transformation pressure can be seen in the form of opportunities, such as opportunities to increase production or advance in developing new technologies, but can also stem from negative transformation pressure, which is characterised by situations such as declining profits or the felt need to respond due to the natural setting (e.g. climate change, unmet needs from consumers) (Dahmén, 1988). Similarly, Rennings (2000) illuminates that greener innovations are driven by a combination of technology push factors and market pull factors. Technology can push innovation forward through the development of scientific understanding (Nemet, 2008), for instance, through research and development (R&D) processes of mobile connectivity at Ericsson. At the same time, market pull factors may stem from consumer demand and expectations which lead to the investment in greener technological innovation (Smith, 2015).

Mokyr (1990) illustrates that innovation does not always obey previous laws and does not necessarily always respond to incentives. Instead they may defy most attempts to relate to exogenous economic variables (Mokyr, 1990). Innovation is complex and path-dependent, characterized by interdependence and the interaction of diverse agents (Antonelli, 2009, p. 611). Therefore, it is beneficial to consider what factors may or may not hinder the diffusion of 5G through the lens of managers at Ericsson.

Carrillo-Hermosilla et al. (2009) reveal that barriers to innovation come in three forms: economic barriers, technological barriers, and institutional barriers. Economic barriers relate to the failure to make green innovations economically advantageous enough (Carillo-Hermosilla et al., 2009). Sunk costs can also exemplify this, the initial investment costs connected to the withholding of innovation such as product support, training and maintenance equipment (Smith, 2015, p. 412). Technological barriers illuminate technological lock-in effects relating to the resilience of pre-existing dominant technical systems. Köhler, Whitmarsh, Michie & Oughton (2008) exemplify how the lock-in effect exists in the automobile industry, where the internal combustion engine has become technologically locked into the technological regime, giving the engine more power and making it more difficult to adopt radical green innovations such as the electric car. Lastly, institutional barriers consist of "norms, routines and structures that guide and influence human behaviour", most notably seen in lobbying for technology or policies that influence lock-in (Smith, 2015, p. 413). Such institutional barriers are seen as an embedded social and technological fabric of society which ultimately hinders the diffusion of innovations. With these barriers in mind, this thesis will also help understand if 4G impedes the development of 5G from an economic (i.e. sunk costs), technological (i.e. lock-in effect) and institutional perspective (i.e. policy).

The innovation literature acknowledges that three phases make up the innovation process: exploration, exploitation, and diffusion. Firstly, exploration is the most creative and exploratory phase where innovation occurs from openness, intuition, and the ability to improvise. It

demands “thinking outside of the box” and breaking away from conventional thought (Galbraith, 1958). This is best exemplified by Henry Ford’s legacy, “If I’d asked people what they wanted, they would have said faster horses” (Vlaskovitz, 2011).

Secondly, exploitation occurs from taking advantage of already known things (Levinthal & March, 1993). It is not as creative as exploration and instead is deemed as more pragmatic, such as aligning the innovation with the requirements of the market and consumer. Smith (2015) illustrates that in the exploitation phase, difficult decisions about how the new product or service will be made and delivered will need to be agreed upon to generate some profit. Chen & Katila (2008) also emphasise the need for creating a strong balance between exploration and exploitation, as too much emphasis on exploration hampers innovations from reaching the market whilst too little focus on exploitation leads to high expenditure (e.g. R&D) and companies’ not generating enough revenue.

Lastly, diffusion concerns the “rate at which an innovation, once launched onto the market, is taken up and adopted by consumers” (Smith, 2015, p. 36). It considers whether the innovation comes into use by individuals. Rogers (2003) reveals that diffusion tends to follow an S-curve, where diffusion enters a trajectory at a slow phase, then enters a period of acceleration that eventually levels off as saturation occurs, finally followed by maturity (Rogers, 2003; Geroski, 2000). Scholars note that the importance of social networks should not be undermined, as they influence the innovation’s likeliness of adoption and factors such as peer pressure and trends. Another factor which affects the rate of diffusion is the characteristics of the innovation itself, such as the innovation’s compatibility, complexity, relative advantage (i.e. perceived improvement that an innovation offers over existing products) and observability (i.e. extent to which potential users of an innovation can see clear benefits arising from using the innovation) (Smith, 2015).

2.1.2 Sustainability of the ICT Industry

The World Economic Forum (2021) constitutes that the global electronic waste (e-waste) discarded in 2021 amounted to 57.4 million tonnes, outweighing the Great Wall of China, the world's heaviest human construction. Aside from the ICT sector is facing the conundrum of hardware being pushed to its physical limits in terms of reducing product size, increasing functionality, and enhancing computing capabilities, companies also have to deal with the fact that there is a shortage of primary raw materials utilised from the construction of ICTs (Markovic, Zivkovic, Cvetkovic & Popovic, 2012). This section will shed light on the global perspectives of sustainability of the ICT industry.

The sustainability implications of the ICT industry on a global level are two-fold. On the one hand, the ICT industry contributes to the increasing levels of greenhouse gases (GHG) through developing ICT devices and machinery, recycling of electronic waste and energy consumption (Higón, Gholami & Shirazi, 2017). On the other hand, the ICT industry is also responsible for contributing to the development of smarter cities, transportation systems, electrical grids,

industrial processes, and energy-saving gains (Higón, Gholami & Shirazi). The emergence of environmental informatics, green ICT and Sustainable Human-Computer Interaction (HCI) are all disciplines formed which imply that technological efficiency alone will not produce sustainable development. Instead, efficiency and sufficiency strategies which stimulate innovations to support sustainability will help decouple economic growth from environmental impacts (Hilty, Lohmann, Wolfgang & Elaine, 2011).

An abundance of scholarly literature sheds light on how the ICT industries' impacts are a double-edged sword of positive and negative impacts. Bekaroo, Bokhoree & Pattison (2016) illuminate that ICT is a low-carbon enabler as it has allowed businesses and society to increase communication while reducing the GHG emissions which arise from commuting, where ICT has helped improve energy efficiency and reduce GHG in several sectors such as power generation, agriculture, manufacturing and more (Hilty, Arnfalk, Erdmann, Goodman, Lehmann & Wäger, 2006). Hilty et al. (2006) reveal that ICTs have first-order, second-order and third-order effects based on environmental indicators and economic sectors (GHG emissions, the energy intensity of the economy, the volume of transport to gross domestic product, etc.). First-order effects are the effects of the physical existence of ICT (e.g. increasing electronic waste streams); second-order effects consist of indirect environmental effects of ICTs (e.g. improving energy efficiency of production); and third-order effects consist of medium- or long-term adaptation of behaviour (e.g. product-to-service shift in consumption) (Hilty et al., 2006). Aggregated, Hilty et al. (2006) illuminate that these positive and negative impacts may cancel each other out.

Malmodin & Lundén (2016) illuminate that although the ICT sectors continue to increase energy and carbon footprints worldwide, Sweden is showing the opposite trend despite continuing exponential increase in data traffic. Nonetheless, they reveal that the embodied carbon footprint from electronic equipment manufacturing abroad is the largest source of ICT-related carbon emissions (Malmodin & Lundén, 2016). As the Global Carbon Project (2022) quantifies that 60% of Sweden's total emissions originate from abroad, Sweden has made a big step to becoming the first country to target consumption-based emissions to take responsibility for the carbon footprint of imported goods (Climate Change News, 2022). Nonetheless, from a life cycle perspective, Sweden has one of the highest rates for collecting and recycling electrical and electronic equipment waste. This helps avoid emissions from producing new equipment and allows Sweden to benefit from adopting a circular economy (Ericsson, 2016).

2.1.3 What is 5G

5G is the 5th generation of wireless mobile phone networks and is up to 100x times faster than 4G. Whereas 1G was used by massive phones for short conversations, 5G could be used to advance society in ways that we can't think of right now and improve our day-to-day lives. It provides new opportunities for ground-breaking technologies to emerge and can power a connected more sustainable world. 5G will be a new paradigm shift, as seen by the four previous generations (Andrews et al., 2014). This world is getting increasingly connected with massive

numbers of sensors, 5G will enable these sensors to simultaneously work together to increase things like safety, health, carbon emissions, security, and energy efficiency (Shehab et al., 2022). 5G can be used for more than connecting your mobile phone to the high-speed internet (Shehab et al., 2022). It will enable the connection of numerous intelligent devices to the same network to communicate with each other to form a smart grid of IoT devices (Ericsson, n.d.a). This will, for instance, make drone delivery or automated cars available, which will lead to fewer and safer cars on the road. This thesis will be focused on the diffusion of 5G as an innovation, as this technology enables other innovations to happen in the field of sustainability.

Ericsson (2021a) predicts that in 2026 half of the world's mobile data traffic will be on the 5G network. 5G will be used in more devices than only the mobile phone, it can power consumers and businesses across a wide range of industries (Ericsson, 2021a). 4G was not optimised for devices with small batteries or applications where a fast response time is needed, this is where the use case of 5G will create a unique type of value (Ericsson, 2021b). 5G will create a world where everything will be connected, where small Internet of Things (IoT) devices will be communicating with each other.

So how is 5G different from 4G? It is a combination of improvements like antenna design, cell tower improvements, and a larger frequency range. However, it is still unclear which changes will create the most disruption (Engadget, 2020). These changes lead to a decrease in latency, the time between the action and the response, more capacity, more connected devices, and a higher speed. The big difference between 5G and 4G is that 4G is only focused on the mid-band frequency, and 5G can use more frequencies. A 4G antenna sends signals over a wide area, while the signal should only be pointed at the receiver. 5G is more efficient, as its signal is more precise. Therefore, more devices can be connected to the network simultaneously (Ericsson, n.d.a). This also means that it costs less power to connect a device. A 5G tower can also decide to turn off antennas if the traffic is low and switch them back on when traffic is higher.

5G also introduces new technologies like network slicing, where the network can be split up into different slices. For some industries, it is important to have their own network separate from the public, as sharing it with the public can cause issues in speed and reliability (Ericsson, 2021b). A network slice can be ‘built’ on the current infrastructure and can be tailored to the user's needs. Multiple virtual networks can be created and applied for specific requirements, including extra focus on speed, latency, reliability, and security (Nokia, 2022). For example, a public responder like an ambulance can have its own extra reliable network slice, which can be very useful in an emergency. Even when thousands of people would use the network to stream the event of the emergency, the ambulance can still receive information and even send information directly to the hospital. Another use case could be a city that wants to control the energy use and needs a whole arrange of IoT devices that needs to communicate with each other.

What is 5G capable of? 5G will include more capacity, better security, higher speeds, more availability, and more reliability (Qualcomm, 2022). Ericsson (2021b) sees six key use cases for 5G because of the benefits it will bring. These include:

- *Enhanced mobile broadband*, where network speeds and capacity will increase. This could bring cloud services to the next level. The 5G network can distribute high processing tasks to a data centre, which then sends the data back to the device almost instantly. This takes the processing power away from the device, improves performance and battery life, and makes the device weigh a lot less. This could make AR glasses possible that are lightweight with a full day of battery life that can process even the hardest of tasks.
- *Fixed wireless access*, where more availability can ensure that people in remote places have access to fast and reliable internet. This can boost things like online work from remote locations.
- *Massive Internet of Things*, the application of 5G enabling a huge amount of small sensors that can send information between each other. This is less focused on speed and more on scale. This can create use cases like having more grip on the supply chain and effectively growing crops.
- *Broadband Internet of Things*, this is a step up from massive IoT and is more focused around speed and lower latency. This is for application that needs to work together but require a stronger and more reliable connection. Applications like drone deliveries would make us of this, but it could also create a network for a smarter electricity grid that reduces carbon emissions.
- *Critical Internet of Things,* is the use of IoT that needs to do critical tasks and therefore wants an instantaneous and reliable connection. This could be for applications for remote surgery, or autonomous vehicles that can communicate with each other.
- *Industrial Automation Internet of Things,* is the use of IoT devices for automatising industrial applications. The applications could need much broadband to replace wired connections. This could make devices in machines capable of predictive maintenance.

These use cases could advance societies, transform industries and elevate experiences (Ericsson, n.d.b). 5G will be the significant enabler of the Internet of Things.

2.1.4 Sustainability 5G

5G can be seen as ‘sustainable’ as it will create a smart world that will stir environmental sustainability benefits. Considering this, 5G can be seen as a sustainability enabler. It will bring new opportunities to put sensors in factories, cities, and farms to drive innovation and decarbonisation. Ericsson (2021a) predicts that 5G in combination with IoT will reduce global emissions by up to 15% in 2030 while only being responsible for 1.4 per cent of the global emissions.

To understand how these environmentally positive ICT solutions, in combination with 5G, could make the world more sustainable, it is essential to understand some critical use cases:

- *Smart Transport*, this could include technologies like self-driving cars that can drive smoother and can communicate with other self-driving cars to be more energy efficient

but also safer to drive in. It could also be used for fleet management and route optimisation, where IoT devices communicate to reduce fuel use and improve driving performance (Malmodin & Bergmark, 2015). Traffic congestion in metropolitan areas is caused for 23-45% by traffic lights. “Smart” traffic lights could be programmed to lead traffic in the most sustainable and optimal way possible at the right time of the day (West, 2016).

- *Smart agriculture*, this could include technologies where crops could communicate and sensors that measure soil quality, rainfall, and temperature to monitor how the crop is growing (Osseiran, Monserrat & Marsch, 2016). This can lead to less water use, less pesticides, and increased crop yields.

- *Smart energy grid*, nowadays everyone needs energy, and the distribution of this energy could be more efficient. It is expected that in the future, more consumers will become producers of green energy, and a connected energy grid could make use of sharing this energy and making sure there is more energy when people need it and less when they don’t (Osseiran, Monserrat & Marsch, 2016). It could also make energy cheaper for consumers, with time-of-day pricing that makes the prices cheaper when energy is available (Malmodin & Bergmark, 2015).

- *Smart factories*, what about robots that can use 5G to have nearly instant communication to improve productivity, efficiency, energy use and could even reduce the need for a lot of inventory and therefore warehouse space (Gupta & Effraimidis, 2021).

There are many more applications in the pipeline for 5G and IoT to make organisations more sustainable and at the same time, save cost and improve productivity. We are only at the start of the IoT era. Innovations we have not thought about yet will enhance a diverse range of sectors, such as construction, finance, health, manufacturing, media, retail, etc. (Osseiran, Monserrat & Marsch, 2016).

5G is also more sustainable than 4G as it implements new technologies that make it more energy efficient. Ericsson (2021a) wants to achieve a 5G product portfolio that is ten times more energy efficient per transferred data than 4G by 2022. Shehab et al. (2022) even anticipates that the energy efficiency will increase by 100x in comparison to 4G. This in turn will make IoT devices way more energy efficient and last longer on the same battery.

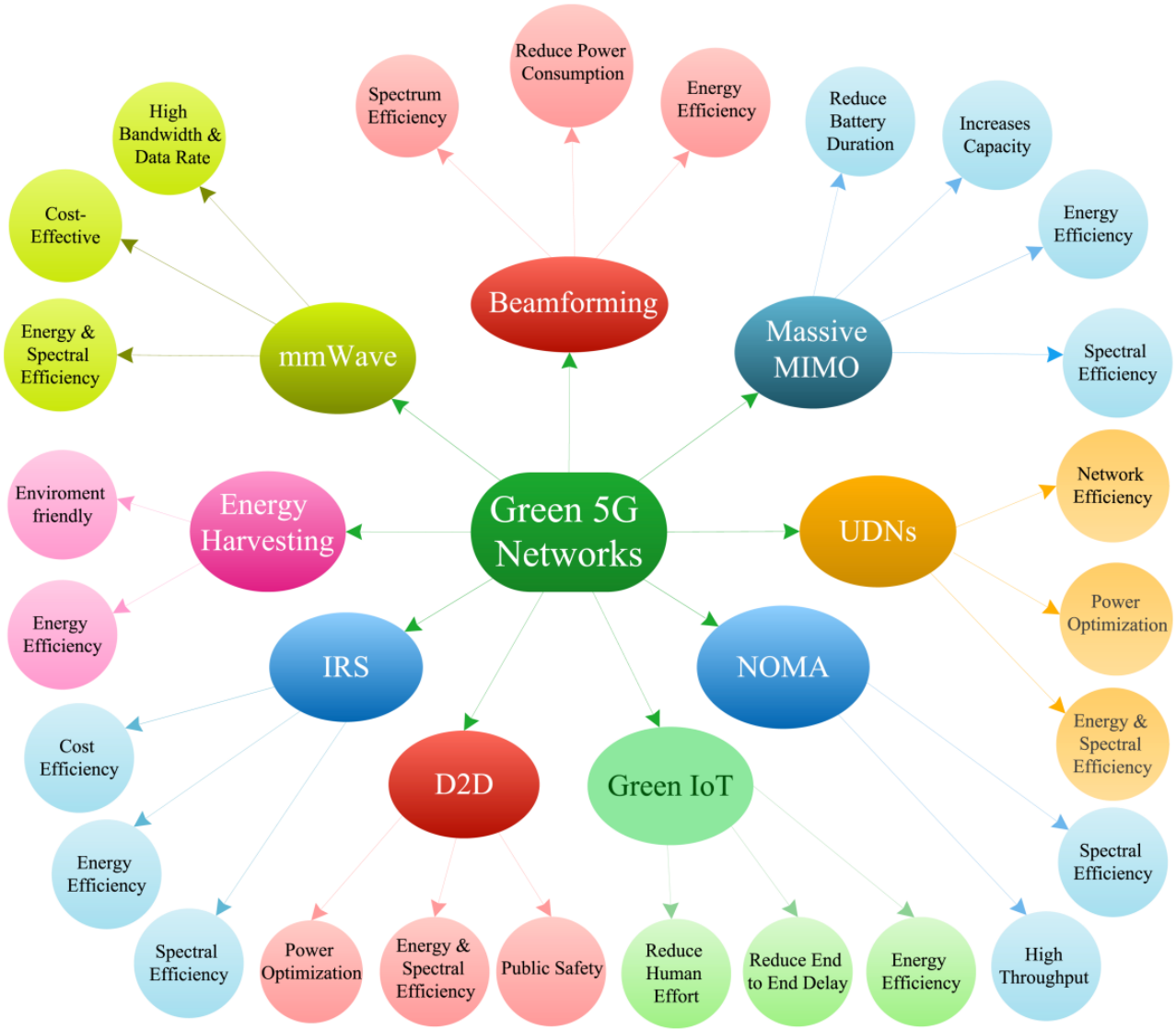

Figure 1. A list of 'green' 5G technologies and the sustainability indicators (Source: Shehab et al., 2022)

So, what technologies does 5G use which make it more sustainable? Besides making the signal more precise and more energy efficient, there are other numerous sustainable 5G applications. Figure 1 above shows a variety of sustainable or green 5G technologies, coupled with respective sustainability indicators. These new technologies will bring new use cases for IoT devices connected to 5G, with a focus on sustainability. Devices connected to 5G will use less power and have an improvement in speed and coverage. 5G will bring connectivity to a new level and with the right incentive solve some of our toughest global problems.

2.1.5 Sustainable 5G Innovation at Ericsson

Ericsson is a leading provider of telecommunications and network equipment, which has offices located in over 50 countries and is headquartered in Sweden. The Fortune 500 company is at

the forefront of 5G, Internet of Things (IoT), edge computing and cloud network infrastructure and claims to develop innovations with "enable society to take the leap towards a smarter, safer and sustainable future" (Ericsson, 2021c; Fortune, 2021). Ericsson aims to be net zero by 2030 in its own activities and net zero by 2040 across its value chain (Ericsson, 2021a). By taking responsibility throughout the value chain, Ericsson aims to drive real and long-lasting positive impact (2021a). This is revealed in Figure 2.

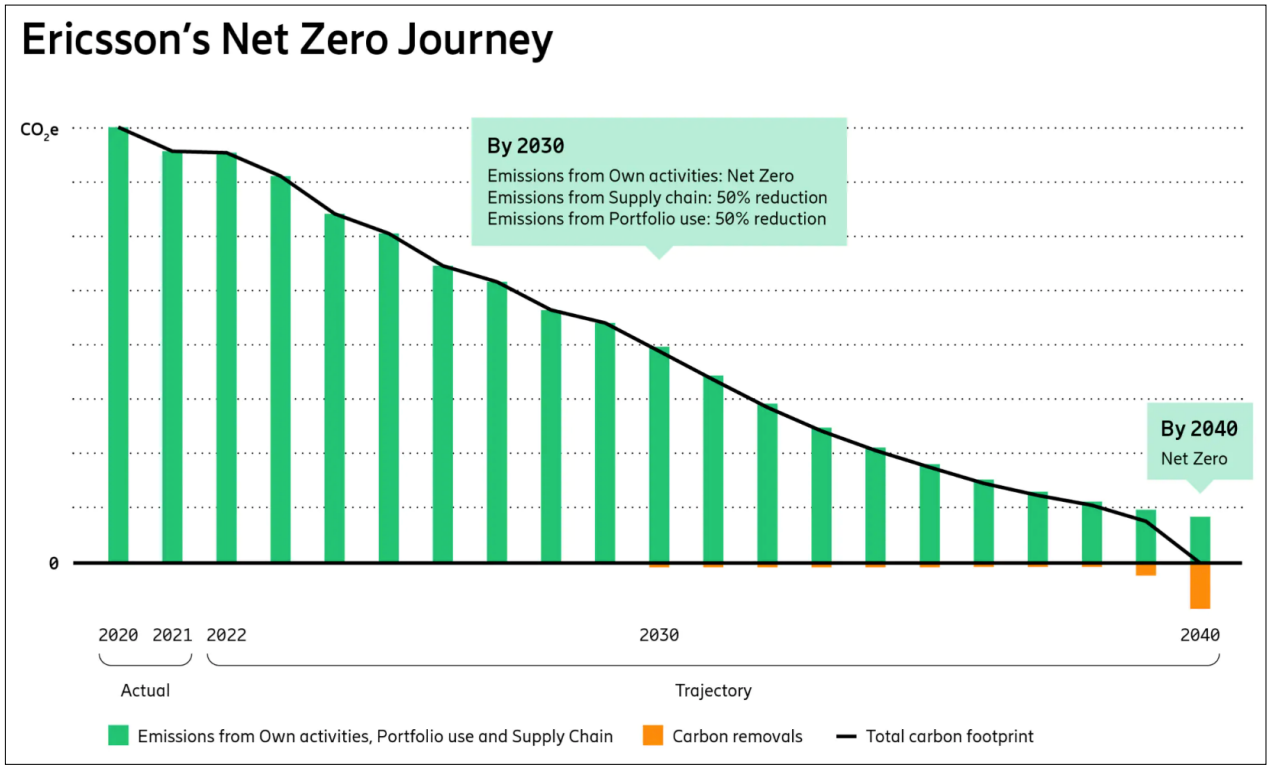

Figure 2. Ericsson's Net Zero Journey (Source: Ericsson, 2021a)

Ericsson was founded on the premise that access to communication is a basic human need and should be available to all (Ericsson, 2021a). Ericsson's vision to improve lives, redefine business and pioneer a sustainable future is built on the power of mobile connectivity to deliver positive impact (Ericsson, 2021a). Therefore, the company focuses on multiple types of improvements. For instance, the company wants to decrease the digital divide by getting more people connected to 5G, therefore growing the countries' economy and the people in it. Ericsson strives to make 5G ten times more energy efficient than 4G by 2022 and, at the same time, seeks to reduce carbon emissions from other sectors by 15%, as their 5G technology could redefine their businesses (Ericsson, 2021a). The ICT firm is focused on developing 5G and rolling out the infrastructure and less on creating the applications that 5G could enable, as they do that in combination with other companies. Considering this, collaboration is a crucial focus of the company.

Ericsson's ambitious sustainability goals build upon collaborative efforts, as signified by the firm's involvement in the Exponential Climate Action Roadmap (2022). This roadmap reveals what's needed in each sector to halve greenhouse gas emissions by 2030. Through this involvement, Ericsson is working with other companies (e.g. Potsdam Institute for Climate

Impact Research (PIK), Stockholm Resilience Centre, World Wildlife Fund (WWF), International Chamber of Commerce) and policymakers to scale solutions to enable the reduction of carbon emissions globally. As presented in Bergmark's (2019) blogpost, the Exponential Climate Action Roadmap members translate scientific knowledge into practical advice for countries, cities, companies, and individuals. Considering this, Ericsson's involvement in academia, business and civil society are at large. In the next section, we introduce 5G's socio-technical system within Sweden, where we gain a more holistic perspective on how 5G connects people and technology.

2.1.6 5G in Sweden: a Socio-Technical System

Our world is made up of complex systems. Sociotechnical systems are an approach that takes a holistic perspective on the development of engineering projects that involve the interaction between people and technology (System Innovation, 2014). With this approach, we can visualise the development of Sweden's 5G system, considering the complex interaction between technology and social interaction. 5G's socio-technical system is complex as it has multiple elements, such as technological elements (wireless technology, networks, radios, cloud technologies, etc.) and social elements (markets/users, culture, policy, etc.). To overcome this complexity, visualising the socio-technical system for 5G, as seen in Figure 3 (inspired by Geels, 2005), is useful. It reveals the complexities of the system, considering social factors like the culture and symbolic meaning of 5G (e.g. freedom of communication, knowledge) and technical elements such as 5G infrastructure itself (e.g. networks, radio signals).

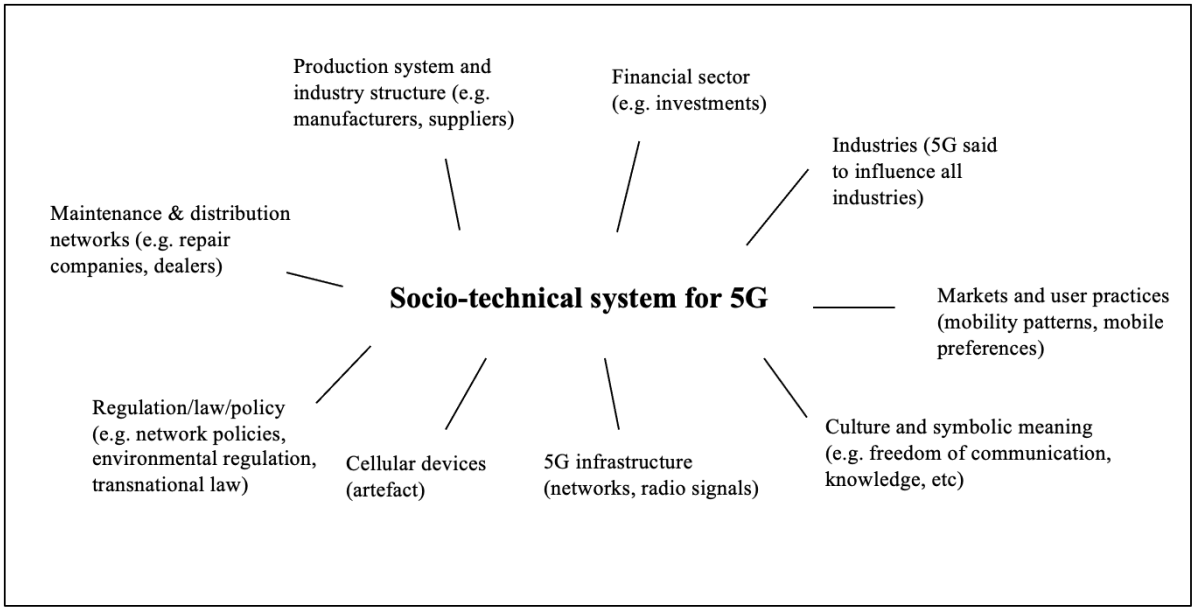

Figure 3. Socio-technical system for 5G (Inspired by Geels, 2005)

5G's socio-technical system represents an interaction between a technical system and a social system. Technological systems comprise of materials, machines and processes to convert inputs to outputs (Fox, 1995). Social systems include of occupational roles and are institutionalised

by the operation of the technological system, meaning that whichever technology is utilizedutilised, the social system needs to adapt to it (Fox, 1995). For 5G to function fully, the design requires both of these areas to work together. The 5G Infrastructure Public Private Partnership (5G PPP), an initiative between the European Commission and the European ICT industry (European Commission, 2020), reveal how the 5G infrastructure is interconnected between several elements (e.g. people, things, transportation, health, etc.) as seen in Figure 4 (5G PPP, 2020). It also reveals how the incentive of 5G spans connectivity but also considers saving energy by 90% (5G PPP, 2020).

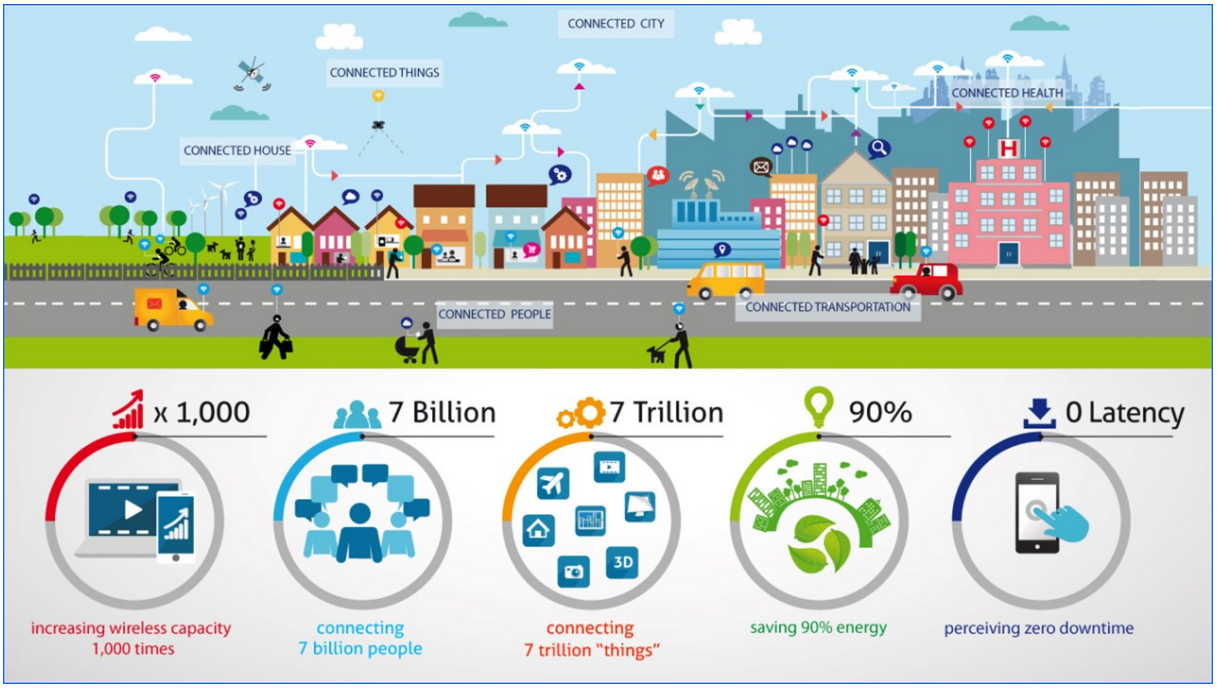

Figure 4. 5G System (Source: 5G Infrastructure Public Private Partnership, 2020)

Sociotechnical systems represent a highly integrated set of diverse elements. The designers of this system need to think about how 5G will function on a technological level and how the end-users might wish to use the system for multiple different functions (Systems Innovation, 2014). The technical components of the 5G network are examples of systems on the micro to meso scale. At the same time, macro scale elements such as environmental considerations (System Innovation, 2014). Together, the micro, meso and macro elements can be visualised through a multi-level perspective, as seen in Figure 5 (Geels & Kemp, 2000; Rotmans et al., 2001). The *multi-level framework* was constructed to analyse change of socio-technical systems, which considers different levels of aggregation - the landscape (macro level), the regime (meso level), and the niche (micro level) (Geels & Kemp, 2000; Rotmans, Kemp & Van Asselt, 2001; Geels & Schot, 2007). This thesis will take the lens of this framework and consider how managers at Ericsson are shaping the transition from 4G to 5G, as described further in Section 2.2.

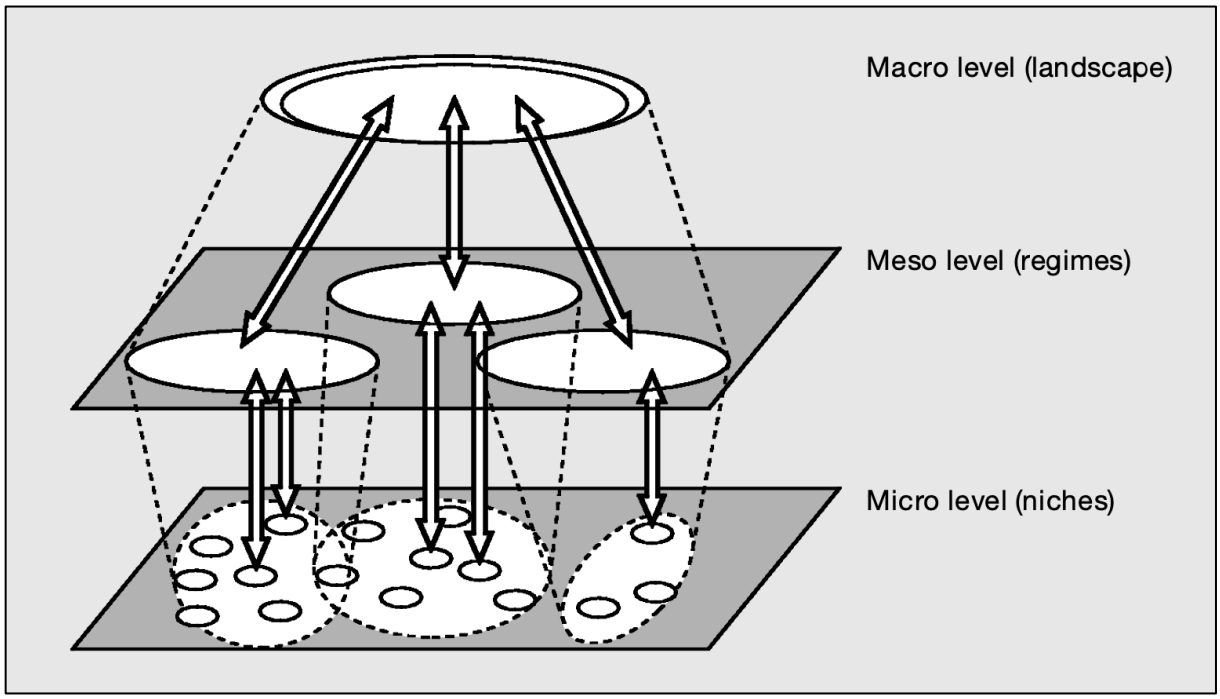

Figure 5. Multi-level perspective (Source: Geels & Kemp, 2000; Rotmans, Kemp & Van Asselt, 2001)

5G Landscape

The landscape forms an exogenous environment beyond the direct influence of the niche and regime actors (Geels & Schot, 2007). It relates to material and immaterial elements at the macro level, such as material infrastructure, social values, worldviews and paradigms, demography, and the natural environment (Rotmans et al., 2001). In the case of 5G, this may be climate change, pandemics, urbanisation, etc. Geels & Schot (2007) illuminate that the landscape changes slowly, over the course of decades, as they are built up from macro-political developments, macroeconomics, and deep cultural patterns.

5G Regime

Socio-technical regimes are the shared cognitive routines in an engineering community and explained patterned developments along a technological trajectory (Geels & Schot, 2007). Bijker (1995) also argues that scientists, policy makers, users and special interest groups contribute to the development of the socio-technical regime. Regimes are stabilised when there are cognitive routines that blind engineers to developments (Nelson & Winter, 1982), policies and regulations in place (Unruh, 2000) and lifestyle adaptations to fit the technical systems (e.g. sunk investments in machinery, infrastructure) (Tushman & Anderson, 1986; Christensen, 1997).

Each regime is unique and bound by its context and can be defined on many levels. The 5G domain regime is a strong example, where primary networks (bandwidth, radio waves, etc.) or on the system level (production, supply, consumption). A collective shift from one socio-technical regime to another regime is considered a socio-technical transition. In this case, the collective shift from the 4G regime to the 5G regime is considered. Multiple elements must be considered within the socio-technical regime and transitions (e.g. market/user preferences, industry, policy, science, culture and technology) (Geels & Schot, 2007).

5G Niche

The niche considers a micro-level perspective and is where fundamental innovations exist, existing below the regime and forming the locus where novelties emerge (Geels, 2005). Geels (2005) illuminates that niche innovations flourish in protected spaces, acting as incubation rooms. 5G developed by Ericsson can be seen as a niche as it is developed in a protected space and learning processes occur on many levels to better understand the technology, user preferences, regulation, symbolic meaning, infrastructure, and production systems (Geels, 2005). The niche provides a protected space for to grow, casting the uncertainty of harsh selection away and instead gaining opportunity for reconfiguration (Schot, Hoogma & Elzen, 1994). Internal niche processes have been analysed and described under the terminology of strategic niche management and built upon strategies for shifting technological regimes (Schot, Hoogma & Elzen, 1994; Kemp, Schot & Hoogma, 1998; Kemp, Rip & Schot, 2001; Hoogma, Kemp, Schot & Truffer, 2002). This thesis explores strategies for shifting technological systems, using 5G as a case. Although the developed insights and strategies can be taken from the perspective of the government, expert groups, policy makers and so forth, we take a firm perspective - more specifically, a managerial perspective.

Strategies for shifting technological systems

Strategic niche management is useful for understanding how intentional transformation processes of regimes may function, in turn helping the transition process for more sustainable technologies (Kemp, Schot & Hoogma, 1998). The strategy is relevant for any actor who seeks to push new and sustainable technologies toward the market, whether the manager is policy makers, a regulatory agency, local authorities, NGOs, private companies, an industry organisation, or a special interest group (Kemp, Schot & Hoogma, 1998). Kemp, Schot & Hoogma (1998) illuminate that niche management is not the responsibility of a single actor, but instead a collective endeavour. However, some are more likely to take a dominant role as niche managers. Therefore, it must be noted that this thesis takes the perspective of managers at Ericsson in their endeavour to strategically position 5G to diffuse into Sweden's socio-technical regime. Technological change is not determined by these actors alone, but is also bound to the process of development, economic incentives, legal standards and more (Kemp, Rip & Schot, 2001).

Schot (1992) illustrates the importance of three factors in shifting technological systems, that being, (1) the creation of new alliances (technological nexus); (2) experiments geared towards niche developments and upscaling; and (3) modification of the selection environment due to strict regulations. This illuminates the importance of being aware of stringent regulations when exploring new expectations about future technological systems. A technological nexus, the creation or utilisation of institutional links, helps translate criteria into specifications used in technology design (Schot, 1992). With that being said, it is crucial to consider if and how managers at Ericsson interact with institutional actors to solidify a technological nexus and how 5G innovation uses experimental processes to upscale the technology.

Hekkert, Suurs, Negro, Kuhlmann & Smits (2007) argue that a selection of functions needs to exist to embed cleaner technologies successfully into the innovation system. These functions include experimentation by entrepreneurs, knowledge development and diffusion, providing orientation to search processes, creating markets, mobilising resources, and securing policy legitimacy (Hekkert et al., 2007; Smith, Voß & Grin, 2010). This reveals that a mixture of initiatives both within the firm and outside the firm are necessary to make sustainable technological innovations more widely available.

2.1.7 Mindset Literature

The world is getting increasingly more complex, with many different systems operating at the same time. Sustainability problems are often so complex that they cannot be solved by simply breaking the parts of the problem down into smaller pieces. Sustainability problems have many interrelated relationships between the different components and solving them requires looking at them from different perspectives. One way you could look at them is through systems thinking, as Kim (2018) explains that systems thinking is one of the most important managerial skillsets for today. Systems thinking could be used to see different perspectives and help better understand how various systems work and how they influence each other. A system is a complex combination of interacting parts that work together to achieve a specific purpose (Kim, 2018). Systems thinking can be described as behaviour and is a useful method of somewhat understanding the complex world we live in.

Kahneman (2011) explains that there are two systems of thinking, system 1 thinking and system 2 thinking. System 1 thinking is the fast way of thinking; it happens automatically and intuitively. System 2 thinking is the slow, conscious, and deliberate way of thinking. System 1 lets us do our routines automatically, like riding a bike, without consciously thinking about it. System 2, however, requires mental effort to make decisions about our choices based on who you are. System 1 thinking is made possible by your long-term memory and is the sum of experiences you have had. System 2 thinking is only operating within your operating memory and therefore can only think about four or five things at a time (Veritasium, 2017). This means that system 1 relies on heuristics, biases, and mental shortcuts, while system 2 is about multi-criteria analysis to make rational choices (Kahneman, 2011). To deeply change the mindset, it is essential to be aware of these systems and to ensure that system 1 doesn't unconsciously take

over when you want to change. However, it takes mental effort to focus on system 2 thinking and therefore a lot of people often let system 1 do as much as possible without them being aware. This leads to people falling into the same behaviour repeatedly, although wanting to change (Kahneman, 2011).

To change your mindset, it is essential to understand your behaviour and the big assumptions one has. If people don't change, even though they want to, they probably have a hidden competing commitment (Kegan & Lahey, 2001). It is not easy to change, as it requires a person to question beliefs that could already been there since childhood and overcome their limitations (Kegan & Lahey, 2001). Dweck (2016) introduces a mindset called the growth mindset, this is the opposite of a fixed mindset. People with a growth mindset believe their talents, intelligence, and abilities can be developed through effort. People with a fixed mindset believe that these talents and abilities are fixed. The big difference is that, with a growth mindset, the past doesn't define the future and therefore, you are more likely to change your behaviour accordingly. When companies embrace a growth mindset, the employees become more committed, stimulating collaboration and innovation (Dweck, 2016). However, everyone has a combination of fixed and growth mindsets, and it is easy to fall back into the fixed mindset when we face challenges.

For managers to deal in this complex world, they need to focus on what they have to do and how they have to think. Everything a manager does should be in between action and reflection (Gosling & Mintzberg, 2003). If there is action but no reflection, then what you are doing is thoughtless. If there is reflection but no action, then you are passive. By diving into how managers at Ericsson are thinking, we understand how managers at Ericsson are operating.

2.2 Theoretical Framework

Addressing the role of innovation in transforming our systems towards a more just and sustainable future is crucial for many stakeholders, from managers to scholars and policy makers. To understand how transformations towards more sustainable socio-technical systems occur, this thesis will employ the MLP as a theoretical framework. The MLP theory draws upon scholarly literature from evolutionary economics, sociology of innovation and institutional theory (Geels, 2018). From a bottom-up perspective, communities of people and niche innovations put pressure on local and state governments whilst from above, finance and the acknowledgement of environmental degradation put upward pressure on innovation processes. Therefore, this thesis adopts the MLP framework to convey the pressures and pathways that managers at Ericsson need to deal with when integrating 5G into the socio-technical system - Sweden's ICT system.

2.2.1 Multi-Level Perspective

A multi-level perspective is a theoretical framework utilised to understand socio-technical transitions or systems changes, often synonymous with scholarly terms, e.g. regime transformation (Van de Poel, 2003), technological revolutions (Perez, 2002), technological transitions (Geels, 2002), system innovation (Elzen, Geels & Green, 2004; Geels, 2005) and transition management (Rotmans, Kemp & Van Asselt, 2001). The MLP is motivated by the fact that greater society is shaped by persistent environmental problems (e.g. climate change, biodiversity and resource problems) and builds upon the idea that the existing socio-technical systems need to transition towards more sustainable ones.

There are three reasons why the MLP is a relevant theoretical framework for this research. Firstly, the MLP assists in explaining how technological transitions come about within the field of 5G. More specifically, it helps one visualise the opportunities and hindering forces for the technological transition from 4G to 5G. Secondly, the framework helps one understand the interaction between actors, environments, and innovations. Ultimately, this is useful for understanding how managers at Ericsson interact with the complex environment. Third, the MLP framework allows one to gain a holistic perspective of the complex environment in which managers interact and take a systemic approach to complex problems instead of a more linear approach. Traditional organisational models are not suitable in today's complex world, one which needs interdisciplinary solutions and requires stakeholders from multiple perspectives. Although the study itself takes a managerial lens, mapping out the complex system and envisioning stakeholders helps one in understanding the integrative nature of the system, revealing any potential discrepancies. With this in mind, the MLP will be applied through the perspective of managers at Ericsson, shedding light on transition pathways.

The MLP framework illustrates that socio-technical transitions result from alignments between developments on three levels: niche innovations, socio-technical regimes, and socio-technical

landscape. These three interrelated conceptual dimensions are presented in systems with various actors involved in them, as well as institutions which guide actor's perceptions and activities (Geels, 2004). The alignment of these levels is illustrated in Figure 6, along with activities between the levels. The MLP will assist in the exploration of transitions to 5G within Sweden, where the combination of these three perspectives shed light on "micro-level processes of constructing new technologies, with a view on emerging macro and meso-level patterns of culture, organisation, markets, regulation and infrastructures" (Smith, Voß & Grin, 2010, p. 436; Rip and Kemp, 2007; Schot 1998; Geels, 2002).

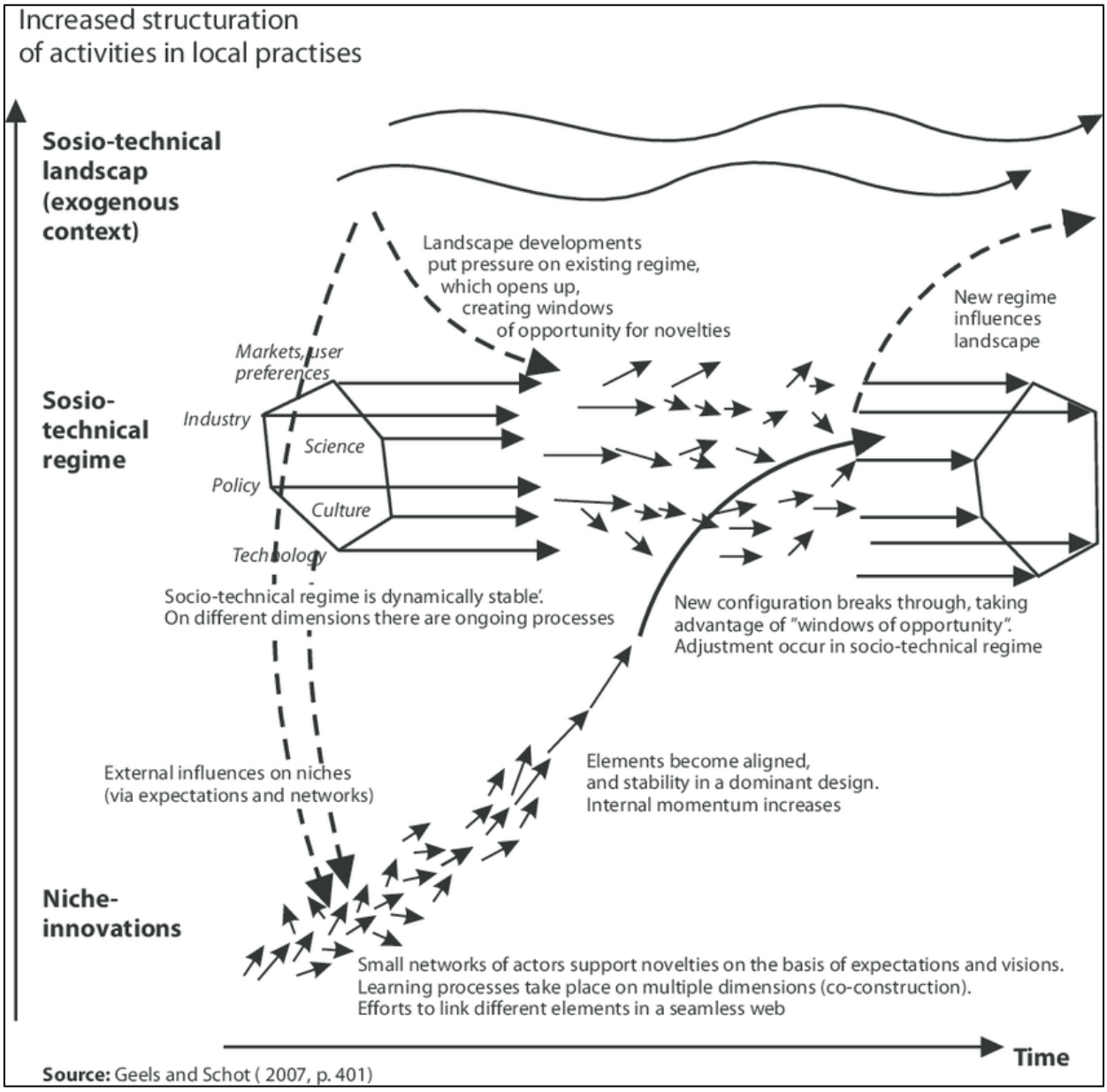

Figure 6. The Multi-Level Perspective (MLP) Framework (Source: Geels & Schot, 2007, p. 401)

2.2.2 Socio-technical landscape

The socio-technical landscape consists of the exogenous environment that lies beyond the reach of the regime and niche innovations, that is, macro-economics, and deep cultural patterns of political developments (Geels & Schot, 2007). To contextualise this further, this may come in the form of climate change, civil political unrest, and pandemics.

2.2.3 Socio-technical regime

Built upon Nelson & Winter's (1982) work on technological regimes, sociotechnical regimes are defined as "shared cognitive routines in an engineering community and explained patterned developments along technological trajectories" (Geels & Schot, 2007, p. 399-400). Socio-technological regimes are shaped and coordinated by a broader community of scientists, policy makers, subject experts and other relevant social groups (Bijker, 1995; Geels & Schot, 2007). These socio-technical systems are complex and comprise stakeholders from various communities, such as research, industry, policy, societal groups, users, finance, supply chain, etc. The combination of networks of actors, artefacts and institutions create path-dependency of socio-technical regimes (Geels & Schot, 2007), for instance, where centralized power generation is on the basis fossil and nuclear fuels.

2.2.4 Niche innovations

Niche innovations are radical novelties and exist on the micro-level, such as the 5G which Ericsson is currently developing. Due to the initial instability of novelties, the niches are developed in safe spaces such as R&D centers of incubation rooms – protecting against the mainstream market (Geels & Schot, 2007; Schot, 1998; Kemp et al., 1998). Niche innovations are nurtured through networks of dedicated actors who take on the development process of the novelties. The MLP emphasises that socio-technical transitions only arise when the following pre-conditions are present: (1) alterations on the landscape produce enough pressure on the current regime, and (2) the niche innovation is developed enough (Geels, 2011). Thus, the technological transition heavily depends on niche readiness (Falcone, 2018).

Managers at Ericsson who are supporting the development of sustainable 5G are considered relevant stakeholders for this research. By interviewing such stakeholders, our findings will identify potential pathways in supporting the empowerment of sustainable 5G niche innovation. By shedding light on this micro-level perspective, one will be able to localise relevant stakeholders on the regime level as well as determine the sustainable 5G niche readiness.

3 Methodology

The following section presents the methodology utilised in the research, technique for data analysis, limitations to the study, and problems related to validity, generalisability, and reliability.

3.1 Research Methodology

This thesis will consider various sources, more specifically, Ericsson's sustainability report, first-hand interviewees, and secondary sources such as articles from the literature review. The research will be conducted as a qualitative case study as the aim is to collect information on a specific activity in the business atmosphere (Sekaran & Bougie, 2016, p. 98), more specifically, what managers at Ericsson do to diffuse sustainable ICT innovations.

As the case study supports one in gaining a clear and realistic overview of a situation or problem found, whilst gaining multiple perspectives from various sources, it is deemed a suitable research strategy (Sekaran & Bougie, 2016, p. 98; Yin, 2009). The research here is done in a noncontrived setting with no interference with the normal work routine, as the exploration of how innovations diffuse is not manipulating any variables in the natural environment (Sekaran & Bougie, 2016, p. 100). Furthermore, an inductive approach is utilised in this paper to generate findings which apply to the understudied context of sustainable 5G diffusion. Inductive reasoning is the process of observing specific phenomena and, based on this, arriving at general conclusions (Sekaran & Bougie, 2016, p. 26). The research provides insightful empirical generalisations, where theoretical findings are highly based on the research. The inductive nature of the relationship between theory and research can be seen in a way that the theoretical ideas derive from the data rather than being formed before the data is collected (Sekaran & Bougie, 2016, p. 26). An inductive and iterative approach is utilised as it allows for new findings to feed into the analysis and, therefore findings (Bryman, 2016, p. 93).

Overall, case studies provide a valuable method as it is descriptive, allowing for the collection of contextual data – in this case, insights on how managers at Ericsson diffuse innovation into socio-technical systems. The method for participant recruitment will be purposive sampling. We are focused on interviewing managers knowledgeable on sustainability and innovation, and purposive sampling proves to be an effective method for gathering participants strategically (Bryman, 2016, p. 418). Semi-structured interviews will be utilised as several discussion subjects will be explored, while still leaving space for the interviewee to introduce new perspectives, allowing the interview to be both systematic and flexible (Bryman, 2016).

Recorded semi-structured interviews will be conducted on a sample who meet the following criteria:

1) are managers and/or part of leadership teams
2) working at Ericsson
3) work for departments that involve innovation and/or sustainability

Semi-structured interviews following the sample criteria above will be conducted online. Previous scholars have illuminated that a relationship of mutual trust can be built up in the digital environment. Researchers can easily reach back out to the interviewees for further information or reflections, which is difficult to do with face-to-face interviews (Mann & Stewart, 2000, p. 138). The interviews will be conducted until there is theoretical saturation, that is, when no more new insights feed into the data gathering process (Bryman, 2016, p. 419).

Considering ethics is vital in guiding the researcher to conduct ethical business research. Therefore, the researchers are aware of ethical conduct which applies to the organisation and is reflected in the behaviour beforehand, giving the interviewee access to research questions at least 24-hours before the interview (research questions can be found in *Appendix A*), paying attention to what the results indicate and surrendering ego and self-interest. To ensure participant consent, the interviewee is asked to verbally consent to being interviewed while informed that they are allowed to retrieve their interview content at any given time. Nonetheless, it must be stressed that the participants are not allowed to manipulate the analysis of content in the interview itself, as the analysis is bound to the interpretations of the researchers' interpretations.

Lastly, the snowball sampling method will be used to recruit participants as it is effective for gathering a sample knowledgeable on the niche topic of how to diffuse sustainable innovations into the system (Bryman, 2016, p. 203). Bryman (2016) illuminates that by reaching out to a small sample of participants at first, one can then leverage this network to find more participants to interview that are knowledgeable on the niche topic.

3.2 Data Analysis

As for data analysis, the interviews will be transcribed and analysed using qualitative methods, where the Miles and Huberman Framework will be adopted as it is a suitable framework for analysing qualitative data (Punch, 2005, p. 171). The Miles & Huberman framework is presented in Figure 7, where data is handled through four fundamental steps: data collection, data reduction, data display and conclusion drawing/verification.

Firstly, data collection involves gathering data from the semi-structured interviews, all of which will be placed into NVivo, a qualitative data analysis software that helps one organise, analyse, and find insights from interviews (Bryman, 2016, p. 591). Data reduction involves the process of editing, segmenting, and summarising data, while using coding, memoing and theme

identification to locate patterns. Through this, the data will be conceptualised. Data display then refers to how the data is presented (Sekram & Bougie, 2016, p. 333).

Finally, conclusions can be drawn from the data presented in quote form, illustrating patterns and themes identified during the research. Once the conclusion is finalised and sharpened, one must double-check that all data has been analysed. In all of this, it is essential to remain open-minded about the trends based on this sample - as there may be limitations to the study (e.g. sample size, cultural miscommunication, etc.). Nonetheless, the iterative nature of the method allows for new insights to feed into the findings.

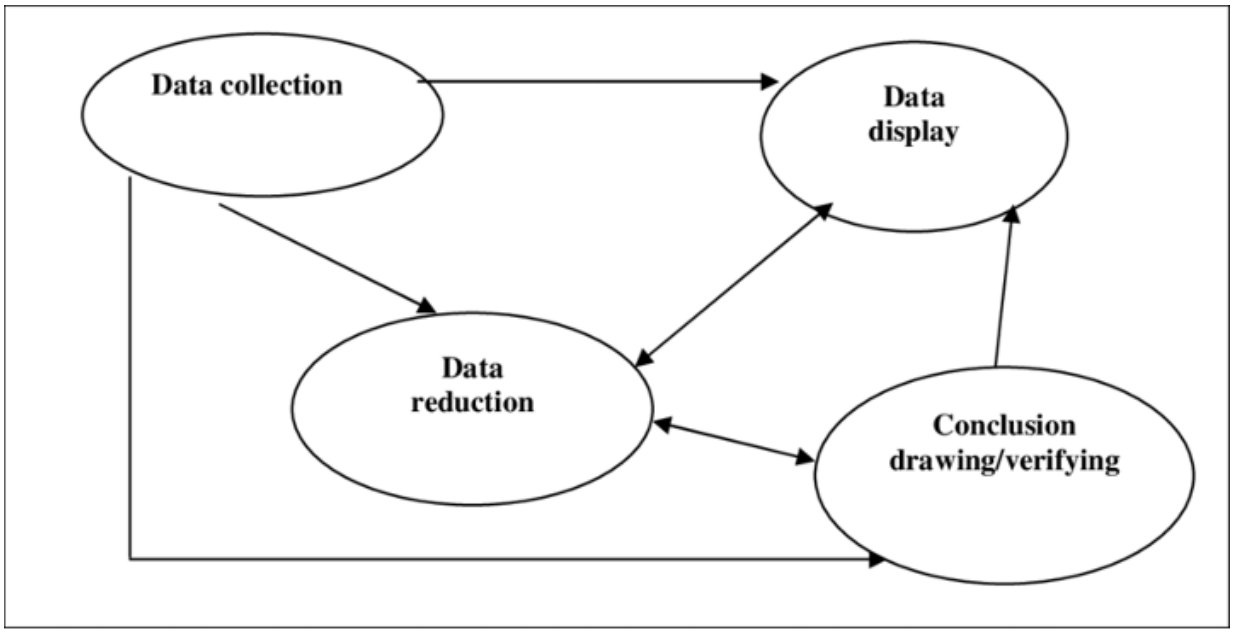

Figure 7. The Miles & Huberman Framework (1984)

3.3 Limitations

This research is bound to limitations due to several reasons, such as the bias of sample, limitations in sampling, disadvantages of online interviews and biases of the researchers. Firstly, it must be noted that this thesis only takes the perspective of one actor within the socio-technical regime, that being, managers who work with sustainability and innovation of 5G at Ericsson. Technological change and socio-technical transitions are not determined by these actors alone but are bound to several external stakeholders such as policy makers, institutional actors, other firms, politicians and more. Therefore, the findings illuminated are bound by the bias of the interviewees and their positions as managers within the field of innovation and sustainability at Ericsson. Nonetheless, the specified sample criteria serve the purpose of gaining specific insights into the managerial perspective at Ericsson.

Secondly, one cannot generalise the findings of the managers at Ericsson to the entire firm, as other managers may have a unique perspective which is not captured within this study. To minimise bias in response, the interview questions have been framed in an unbias manner. Nonetheless, due to snowball sampling, the sample may be limited by homogeneity. Despite the study being set up in pursuit of interviewing managers at Ericsson who are component and knowledgeable within the field of sustainability and innovation, other internal actors (managers) may still have knowledge relevant to the topic of diffusing 5G. On top of this, the small sample size (3) must also be considered as a factor which could affect the findings of the result due to bias. To counter this bias, the researchers attempted to conduct interviews until theoretical saturation was prevalent and no new information arose from the data collected. Nonetheless, the conducted interviews were of very high quality as they were in-depth, detailed, and descriptive. We see this as an advantage.

Third, there are both disadvantages and advantages to utilising online interviews. Disadvantages are that nonverbal cues cannot be read, the interviews must be kept short and respondents can terminate the interview more easily at anytime (Sekaran & Bougie, 2016, p. 123). Nonetheless, the advantages are that online interviews are less costly and speedier, can reach a wide geographic area, and there is greater autonomy than face-to-face interviews (Sekaran & Bougie, 2016, p. 123). On top of this, to establish more clarity and motivate the respondents, the researchers sent out the interview questions at least 24-hours before the interviews. This way, there is an opportunity to clarify any questions and doubts – as often easily done in person.

Lastly, it must be stressed that the researchers are bound by personal biases and assumptions, which may influence the subsequent findings (Bryman, 2016, p. 40). The position of the researchers, based on gender, race, age, personal values and whatnot, influences the choice of theory, method, formulation of research design, implementation of data collection, analysis of data, interpretation of data as well as gathered conclusions (Bryman, 2016, p. 40). Due to this, the researchers exhibit reflexivity by being self-reflective of one's position and understanding the deeper connotations implied by the decisions made (Bryman, 2016, p. 394). This is done by being sensitive to one's own cultural, political, and social context.

3.4 Generalisation, Validity and Reliability

This study is the first of its kind, and by opening doors to new research, we are laying the foundation for potential future research on how strategies utilised by managers within the ICT sector may help diffuse sustainable 5G innovations. Nonetheless, the degree of research quality must be considered and cannot be underestimated when doing so. Three factors are considered when referring to the quality of the research and research process, namely, the generalisability, validity, and reliability of the study.

Firstly, given the small sample in the research, one cannot generalise the findings from the study by considering them factual or applicable to all companies in the ICT sector – where generalisability is defined as "the scope of applicability of the research findings in one organisational setting to other settings" (Sekaran & Bougie, 2016, p. 22). In other words, the findings signify no causality for all sectors, but they simply reflect the strategies perceived by managers working within the field of innovation and sustainability at Ericsson as of 2022. Considering the specified scope and the research purpose, the findings are appropriate and applicable to Ericsson's context – especially as the sample is representative of the target group. If the findings are backed up by previous literature, it can be assumed that the findings are useful or of value and may therefore be generalisable to other identical or similar settings - such as other organisations innovating sustainable 5G technologies or other firms within the ICT industry. With this being said, one needs to be mindful of restricting the generalisability of the findings to other industries and instead see how the findings may be of value to Ericsson or other similar ICT organisations (Sekaran & Bougie, 2016).

Although findings cannot be generalised beyond the scope, as a case study, we see that this research offers strong practical knowledge and that we exhibit transferability, that is, the opportunity to utilise the given methods and research conclusions to decide what to apply for other research circumstances (Flyvbjerg, 2006). We tap into individual perceptions and can point out tensions from the research on the diffusion of innovation. These are important and useful in other contexts and may help understand the innovation transition topic itself. The study sheds light on relevant methodologies to use for analysing innovation transitions.

Moving forward, the reliability of the research must be considered – more specifically, the extent to which the data collection and analytical procedure would reproduce consistent findings if repeated (Sekaran & Bougie, 2016). The consistency in results may vary between employees within the firm as managers have expertise within their own respective domains. Nonetheless, the researchers interviewed individuals who have more profound expertise within the field of sustainability and innovation as this pertains to the research question and previously stated sample criteria. By having a strongly stated sample criterion, we limit ourselves to the perspectives of managers at Ericsson who work with innovation and/or sustainability. We must stress that there may exist other managers at Ericsson who have expertise within these fields and this study may not consider all sustainability and innovation expertise within the firm. Therefore, as Sekaran & Bougie (2016) illuminated, we encourage similar studies to be conducted to ensure a strong retest-test coefficient (ensuring that the repetition of the study would lead to the same or similar insights).

Lastly, the internal and external validity of the research must be considered. That is, to be aware of the issue of the authenticity of the cause-and-effect relationships (internal validity) as well as their generalisability to the external environment (external validity) (Sekaran & Bougie, 2016, p. 220). We ensure that the interview questions represent the overall research question and are unbiased when framed during the interview to secure internal validity. Several people have reviewed the research questions outside of the study (colleagues, students, etc.) to review the extent to which they represent the research question. An iteration of feedback led to the

tweaking of the interview questions. Furthermore, the study's external validity is highlighted above as we consider the generalisability of the studies' findings and limit them only to Ericsson's context and other firms with strong similarities, especially when backed by previous research.

All in all, we hope that by considering the quality of the research and being aware of limitations, we are critical and avoid drawing untrue or misleading conclusions. A thorough understanding of biases and limitations is crucial to shed light on as it may affect the studies' results and overall conclusions. On top of this, by being aware of our biases, we can undertake all possible actions to reduce or minimise the deviation from the truth.

4 Analysis and Discussion

This chapter presents and analyses the data gathered from the semi-structured interviews with various managers at Ericsson. First, the themes identified from the semi-structured interviews are presented. Secondly, the findings from the data analysis are presented. Lastly, there is a critical discussion regarding how the findings relate to the literature. All in all, this section focuses on answering the previously stated overarching research question, "*What strategies are managers at Ericsson using to influence the socio-technical transition towards more sustainable 5G?*".

4.1 Research findings

This section introduces the themes identified through the data and uncovers the core findings of the research. The qualitative data has been categorised into themes, all of which will be further discussed and reflected upon. The ten themes identified were (in no particular order): (1) *behavioural/organisational change,* (2) *5G as an emerging innovation,* (3) *hindering factors,* (4) *role of institutions,* (5) *role of knowledge sharing,* (6) *mindsets,* (7) *partnerships,* (8) *niche interaction,* (9) *landscape interaction and* (10) *regime interaction. As indicated in Appendix C, these ten themes are identified in the qualitative data*.

To summarise the findings, we found that managers utilise the following strategies at Ericsson to help the sustainable 5G innovation process:

- Managers at Ericsson utilise both exploration (e.g. internal incubator) and exploitation (e.g. collaborating with previous customers) in the 5G innovation process.
- Managers utilise collaboration in various forms: with other companies (e.g. suppliers or competitors), with the start-up ecosystem as well as with expert groups (e.g. Exponential Roadmap Initiative).
- Managers utilise knowledge sharing and education to understand the latest trends and better understand where 5G can be applied.
- Managers make it a personal habit to be more sustainable in their daily practices, which creates a ripple effect throughout the whole organisation.

As for factors that hinder the innovation process, we found that managers are subject to various barriers. These hindering factors are synthesised as follows:

- Managers are subject to the path-dependent nature of the previous regime (4G), as opportunities are mainly consumer-driven as opposed to industry-driven.
- Industrial settings vary in terms of market maturity, where industrial actors are not entirely sure of 5G's full potential.
- Despite knowledge sharing education efforts existing, there is a lack of knowledge or understanding regarding the pitfalls of 5G applications within the regime due to immature markets.
- Institutional barriers, such as structural barriers and legislative barriers, hamper the innovation process.
- There is a strong focus on incremental innovations, as 5G innovations are closer to Ericsson's core offerings.

4.2 The MLP: Landscape, Regime & Niche

We live in a world which is made up of socio-technical systems. The MLP framework helps one understand systemic change and how novelties (in this case, 5G) in the niche level struggle against existing regimes. In the background, the landscape pushes forward broader trends. This section introduces key findings of how managers are interacting within the niche as well as with the regime and landscape, including the dynamics found between these multiple levels.

4.2.1 Landscape

The landscape consists of the exogenous environment which is beyond the direct influence of regime and niche actors (Smith, Voß, Grin, 2010). On the macro level, managers are aware of variables in the landscape (e.g. environmental degradation, global inequalities, geopolitical happenings) and how they may influence different actors (in this case, users) in their adoption of 5G technologies. One of the managers takes note of the landscape by shedding light on the sustainability "movement" which is fuelled by vested interests in social and economic sustainability. This is illuminated through the following quote,

> *"When we approach the users, in our case being enterprises, I see they are more and more concerned about sustainability because they know that they need to be much more sustainable to be an attractive employer. We see this movement through the rise of green bonds as well. There is a global movement that will open opportunities for that type of solution, because suddenly it is a matter of survival. If we are not doing it, we have a risk on our ROI and risk of irrelevance. So, to*

stay relevant, we need to be much more engaged and much more innovative in sustainability solutions."

- Erik (Engagement Lead)

In this case, the manager sheds light on how sustainability is becoming an increasing trend, changing the selection environment in which niches and regimes interact. The landscape developments, in this case, shaped by the values of the general user base, appear to be putting pressure on existing socio-technical regimes. This is exemplified by the rise of green bonds, which reveals that the financial sector is beginning to react to landscape pressures. The rise of green bonds can be considered an immaterial element at the macro level, showing the change in social values, worldviews, and paradigms (Rotmans et al., 2001). The same manager also illuminates variables in the landscape which play a role in shaping the application of sustainable 5G,

"*I think this planet has bigger problems that can be solved by 5G, such as poverty, food production, fake news, climate change, climate disasters and so on*."

- Erik (Engagement Lead)

This is in line with the findings of scholars such as Smith, Voß & Grin (2010), which illustrate that the growing environmental awareness is a socio-cultural development which can be considered a landscape process which feeds into the performance of multiple regimes whilst generating opportunities for niche actors such as managers at Ericsson. The landscape's ability to put pressure on the regime allows for the eventual opportunity of regime destabilisation, opening windows of opportunity for sustainable niche innovations to thrive (Geels & Schot, 2007).

Nonetheless, it is only until the alignment of processes on the three multiple levels (niche, regime and landscape) which enables the breakthrough of novelties in the mainstream market to occur, one which is yet to fully emerge within the 5G sphere (Geels & Schot, 2007). The MLP argues that transitions arise from interactions between processes at the following three levels, "(a) niche-innovations build up internal momentum, through learning processes, price/performance improvements, and support from powerful groups, (b) changes at the landscape level create pressure on the regime, and (c) destabilisation of the regime creates windows of opportunity for niche-innovations. (Geels & Schot, 2007, p. 400)". Considering this, the breakthrough of Ericsson's sustainable 5G technologies may take time due to the slow and steady changes that the landscape bring about (Geels & Schot, 2007), in turn lagging the diffusion of sustainable 5G novelties as it appears to take more time before they break into the mainstream market.

4.2.2 Regime

Socio-technical regimes result from established and dominant ways of realising a particular societal function (Smith, Voß, Grin, 2010). They constitute the co-evolutionary accumulation and alignment of knowledge, investments, objects, infrastructure, values and norms (Geels, 2002). Regimes are subject to path-dependency as there are strong institutional and material interdependencies, one which is difficult for niche actors such as managers at Ericsson to overcome. The struggle to overcome the path-dependent nature of the current regime and markets is illuminated in a quote with an Engagement Lead manager who reflects on why the diffusion of 5G is still relatively immature,

> "*I think (the diffusion of) 5G is still quite immature. So far, it has mainly provided a bit of speed for your mobile phone. That has been driven by operators to show how faster networks are. I think in the next coming years, you will see much more good use cases on how you utilise the full power of 5G to make things differently. ... It's a combination of the maturity of the end users as well as what the capabilities of the technology that needs to be matched. 5G as a technology is more advanced than the market is for the moment and that is why I talk about educating others on what all the possibilities are with this technology to stir the diffusion of innovative services, new ways of organising capabilities in society, new business models and so on. I think it will take a few more years before we see the results of that.*"
>
> - Erik (Engagement Lead)

Considering this, although efforts to educate actors on the regime level regarding the high potential of sustainable 5G are underway, it is difficult to break through the innovation into the regime. Smith, Stirling & Berkhout (2005) argue that "without at least some form of internal or external pressure in the diverse senses discussed above, it is unlikely that substantive change to the developmental trajectory of the regime will result" (p. 1495). Selection pressures such as economic pressure (taxes, regulations, etc.), broad socio-political and economic landscape developments and pressures from niche actors need to occur for regime adaptation and eventual socio-technical transitions to occur (Smith et al., 2005). In this case, selection pressure by managers at Ericsson may feed in through educating operators on utilising 5G for more sustainable purposes. As managers at Ericsson educate regime actors on the possibilities of 5G, it is still crucial for other broader incentives to feed into the process for sustainable 5G diffusion. On top of this, for transformation to occur, the coordination of resources available inside and outside the regime needs to adapt to these pressures (Smith et al., 2005). Considering this, it seems thatit may take time until sustainable 5G technologies hit the market.

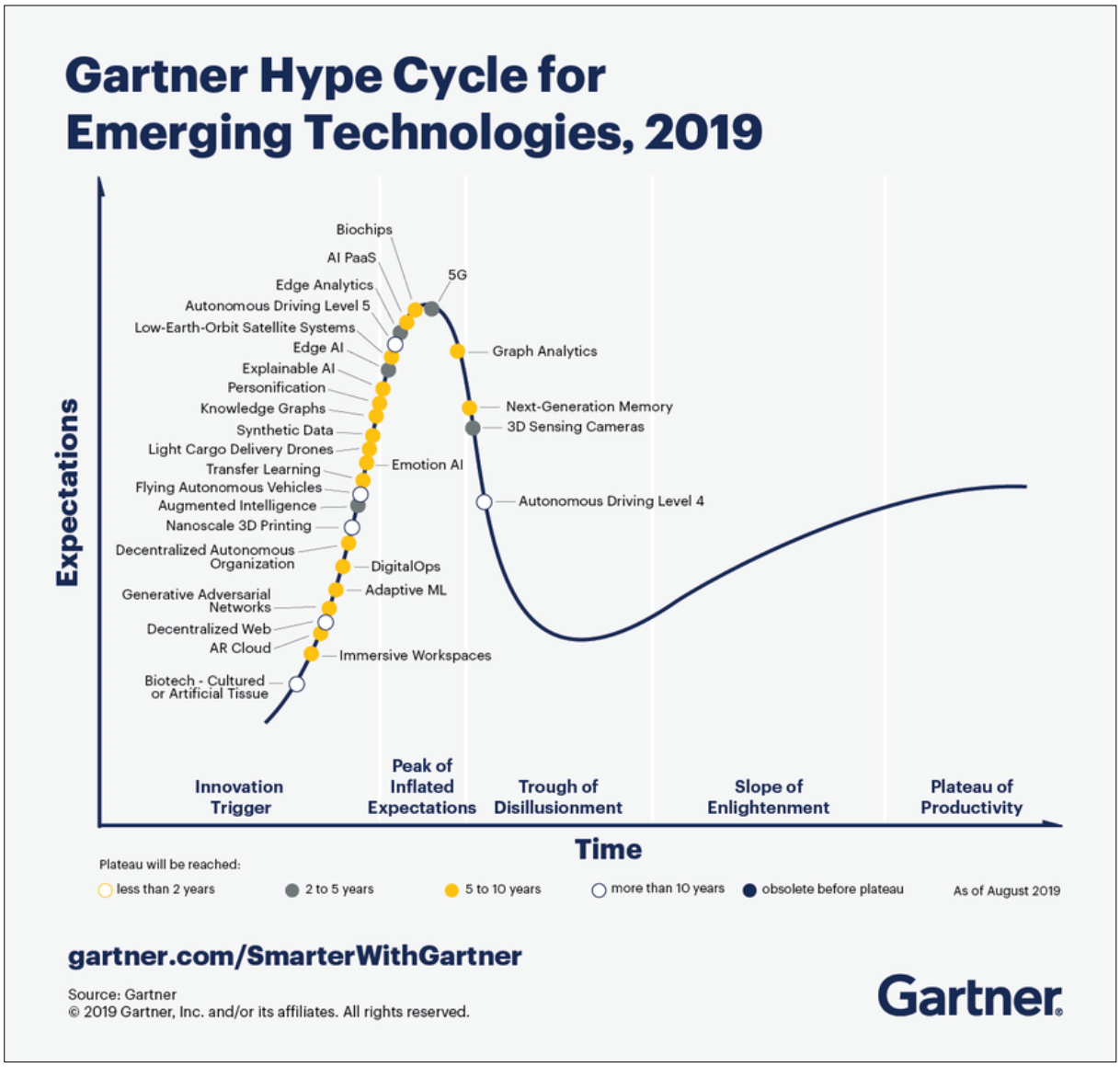

Figure 8. Gartner's Hype Cycle for Emerging Technologies (Gartner, 2019)

Gartner's hype cycle is commonly utilised to represent the maturity, adoption and social application of technologies (Gartner, 2019). It considers two factors, the expectations and value of an innovation over time, moving through five predictable phases as illustrated in Figure 8. According to the Gartner Hype Cycle for Emerging Technologies (2019), 5G hit the "peak of inflated expectations" in 2019. Considering this statement in the contemporary market, 5G would likely fit in the next stage known as the "trough of disillusionment", where the employees at Ericsson acknowledge that 5G can be used for good, but are still not entirely sure of 5G's full potential and if the market is ready. This occurs when the original excitement of 5G wears off, and early adopters report predictable performance issues (Gartner, 2019), as exemplified in the previous quote. Such performance issues are also acknowledged by another manager who works at Ericsson's internal incubator:

> "*We've had seven projects come out of this entire pipeline, we've had about 120 projects go in through the process and drop out at various stages … For instance, one we closed due to various problems with the supply chain and not being able to develop, the timing was totally off and customers wanted it, but we couldn't really meet the speed at which to deliver*."
>
> - Shampa (Business Developer and Ecosystem Manager)

Considering this quote, it seems as if it is still difficult to comprehend the timing that 5G technologies take to fully penetrate the market and actors in the market are not equipped to handle the deployment of sustainable 5G innovations. Therefore, 5G is currently going through the "trough of disillusionment" phase. For the slope of enlightenment to occur, the early adopters need to find benefits of 5G technology, and other companies need to understand how to adapt the technology to their situation.

Managers at Ericsson try to bridge that gap in the market by shedding light on what companies can and cannot do with 5G, in turn helping increase the speed to make it market-ready. With improper education and a clear focus, there is a chance for 5G technologies to become part of the regime without enabling sustainable innovations. Nonetheless, this is not an easy task if 5G is still considered a niche innovation struggling to overcome the current regime. The struggle is well depicted in the following quote,

> "*It'll be a while before the structural changes take place, and you can't do it in a silo, Ericsson enforcing these changes within is only going to go so far. This is something that needs to happen across*."
>
> - Shampa (Business Developer and Ecosystem Manager)

The manager acknowledges that structural changes need to take place throughout the entire system before sustainable 5G innovations can take off. This is aligned with the works of Smith, Voß & Grin (2010) who explain that for a niche innovation to become part of the regime, they need a growing network of actors and therefore niche actors need to perform cognitive, institutional, economic and political work. The expectations of the niche innovation should align with the expectations of the regime, something which constrains the regime as it needs to break the powerful structures of the regime (Smith, Voß & Grin, 2010). Such powerful structures in the regime need to be tackled by various actors from different directions, whether it be cognitive, institutional, economic or political. Altogether, this confirms that the expectations of the regime and the niche actors are not fully aligned – something which may lag the socio-technical transition towards sustainable 5G. It is also worth considering the characteristics of 5G itself, which is highly complex and struggles with observability (i.e. extent to which potential users of innovation can see clear benefits arising from using the innovation) (Smith, 2015). These characteristics may hamper the rate of diffusion (Smith, 2015).

4.2.3 Niche

Niches are considered protected spaces which support emerging innovations (Geels, 2011). In this case, managers at Ericsson are seen as niche actors as they are working with emerging innovations such as 5G. Managers at Ericsson hope that promising novelties, in this case, sustainable 5G, are eventually used within the regime. Nonetheless, this is not easy as the existing regime is stabilised by lock-in mechanisms, as previously discussed (Geels, 2011). Managers at Ericsson often utilise exploitation of opportunities with traditional channels to fuel the innovation process, as highlighted by a manager,

> *"Right now, the biggest opportunity is with the operators like Ooredoo who are going to cover the World Cup games and create the first fully 5G enabled stadium to make the games come alive … A lot of these opportunities are low hanging fruits. These are customers we already work with. They're not necessarily in sectors I personally feel are going to make the biggest impact when it comes to some of the most urgent problems we have in the world that need solving. … Most of them I feel are through traditional channels, which are operators who are going to take this technology out to the end-users and then together with the end-users unlock what 5G is capable of. I am not a big fan of low hanging fruits though. I think we need to work harder to get what the world needs, trying to get this (5G) into places where it's not going to be a "natural fit", where maybe 3G or 4G didn't even really flourish, for instance within elderly care.*"
>
> - Shampa (Business Developer and Ecosystem Manager)

Although niches are seen as vital for socio-technical transitions as they provide "the seeds for systemic change" (Geels, 2011), managers at Ericsson reveal how the largest opportunities as of now are with actors existing in "traditional channels" such as operators. This illustrates that managers are subject to the lock-in effect of the previous system (4G), where they are primarily subject to "low hanging fruits" instead of opportunities where the technology can provide a much more sustainable impact (e.g. industries). Considering this, it seems that managers exploit readily available opportunities through previous work.

As Chen & Katila (2008) illuminated, it is critical to withhold a balance between exploration and exploitation for the innovation process to unfold. Companies that emphasise exploitation tend to produce innovations that incorporate only minor improvements and miss out on more significant changes taking place (Smith, 2015). Benner & Tushman (2003) reveal that large well-established firms tend to put too much emphasis on exploitation, resulting in over-exploitation of already existing products, leading to innovations that are simply enhanced versions and only incorporate modest improvements. This is well exemplified by Ericsson, as there is too much focus on exploiting ideas that already fit the company's product portfolio. Smith (2015) emphasised that one long-term risk of too much exploitation (e.g. through too much marketing and a lack of investment in R&D) is that a company's product portfolio becomes outdated. This is illuminated as a fear by another manager at Ericsson who works as an Engagement Lead,

> *"We are focusing on our core offering, but we tend to forget that we are extremely innovative. I think we are missing out on fantastic opportunities... so far, we have a tendency of being quite tightly connected to our core business, instead of seeing the bigger picture on our core capabilities and that we could actually move into a totally different area with our core knowledge. Sometimes I ask myself, am I stupid, or is the rest of the organisations stupid?*"
>
> - Erik (Engagement Lead)

It is difficult for larger firms to deviate from a natural organisational tendency towards exploitation as firms tend to become set in their well-established routines that favour the familiar rather than the unknown (Chen & Katila, 2008; Smith, 2015). Larger firms also tend to over-exploit as they are focused on short-term financial performance (e.g. low hanging fruits) and the implementation of process management techniques aimed at improving efficiency and quality (e.g. latency) at the expense of exploratory work (e.g. high hanging fruits such as healthcare industry).

Failure to adopt new technologies and developments may risk a company being left behind (Christensen, 1997). According to Ericsson (n.d.f), Jan Uddenfeldt (previous Vice President of Ericsson) noted that Ericsson, along with other mobile phone actors such as Nokia, made this kind of investment mistake in the 1990s-2000s when phone companies began to develop something that nobody wants. Instead, companies such as Research in Motion (RIM) (which produces the "Blackberry") and Motorola took off. With this being said, staying relevant and re-inventing oneself to align with the dynamic world that is exhibited by the ICT sector is vital. Nonetheless, the fact that Ericsson has an internal accelerator that aims to fuel disruptive innovations reveals that it may have learned from previous mistakes and tackled some of the over-exploitation tendencies that larger firms have. Adopting an internal accelerator that allows for more exploration puts Ericsson at a competitive edge.

With this being said, managers at Ericsson are attempting to balance both exploitation and exploration activities to make 5G innovations diffuse. Nonetheless, it is sometimes difficult for larger firms to avoid exploitation tendencies (Chen & Katila, 2008; Smith, 2015). This is also illuminated in the following quote,

> "*At the end of the day, it's money driven. We have to just be more creative and think of ways of doing things that that are very different for how we've done things before, but that's very tough and working for Ericsson. Smaller companies can be a bit more agile. For bigger companies it's more difficult to be agile, no matter how much the leadership wants it to be, it's more difficult to switch things around. No matter how good the culture is and how driven it is, it's tough, the structure is tough. The whole shareholder driven structure that we have in the industry right now is making it hard to push sustainable practices in general.*"
>
> - Shampa (Business Developer and Ecosystem Manager)

This manager acknowledges that the current regime is difficult to change due to the shareholder driven structure which exists in the industry. This makes it challenging to introduce sustainable 5G innovations in areas where they have the potential to create the most impact, especially within the larger firm context, as they often lag in agility. This is well in line with the findings of Carrillo-Hermosilla et al. (2009), who reveals that barriers to innovation include economic barriers, technological barriers and institutional barriers. In this case, Ericsson's ability to bring sustainable 5G innovations to the market are hampered by institutional barriers such as the shareholder driven structure, which acts as a strong social and technological fabric (Carillo-Hermosilla et al., 2009). Economic barriers can also be perceived as prevalent, as the shareholder driven structure is fixed, which hints that initial investment costs are not willing to be spent. Considering this, it seems that more purposeful changes are needed within the system to allow for 5G to be diffused. Weber and Hemmelskamp (2005) also reveal that large changes in the production and consumption chain, the institutions and their structures, and the behaviour of actors involved in it (e.g. shareholders) need to be changed for transitions to occur. The short-term focus of shareholders tends to leave larger companies at a disadvantage, as short-term gains may hamper long-term opportunities (Chen & Katila, 2008). All in all, sustainable 5G innovations are difficult to diffuse due to the path-dependent nature of existing regimes, characterised by interdependence and interaction of a variety of diverse agents (Antonelli, 2009).

4.2.4 Conclusions on MLP

All in all, it seems the landscape brings about slow and steady movement, which may pressure the regime to adopt more sustainable practices (Geels, 2002). Although some regime actors are starting to react to landscape pressures, such as the finance community (e.g. issuance of green bonds), it may take more time for sustainable practices to break through into the regime as many factors need to align for a transition to occur (Geels & Schot, 2007). Such factors include niche-innovation momentum (via learning processes, powerful groups, etc.), changes at landscape level, which pressure the regime, and eventually regime destabilisation. It is not until interaction and alignment of such processes that the regime will allow for windows of opportunity for 5G niche innovations.

Moving forward, the path-dependent nature of the regime makes it difficult for sustainable 5G innovations to break into the market. The maturity of the end users, which may connect to entirely different socio-technical regimes, influences the pace of diffusion. In this case, the markets are still immature, as illuminated by managers at Ericsson and supported by Gartner's (2019) hype cycle for emerging technologies, showing that 5G is currently in the third phase of innovation maturity – the "trough of disillusionment". This means that as predictable performing issues begin to arise regarding 5G and confusion regarding 5G's full potential, managers at Ericsson show an effort to fill the confusion void by shedding light on the possibilities that exist with 5G. The managers pave a pathway for strategic leadership within the emerging technology market by being a knowledge source.

Nonetheless, the seeds for systemic change take time to grow, and managers at Ericsson are often hampered by the structural barriers that larger companies are frequently posed with (Chen & Katila, 2008; Smith, 2015). Over-exploitation of these "low hanging fruits" (opportunities closer to Ericsson's core offerings) makes it difficult for managers to embrace exploration opportunities and accelerate its capabilities within more impactful application areas (Smith et al., 2015). Lastly, the shareholder-driven structure that appears within the large firm fuels a web of institutional, economic, and technological barriers in adopting more impactful application of 5G technologies (Carillo-Hermosilla et al., 2009). Such barriers make it difficult to change the direction of the 5G innovation application.

4.3 Strategic Collaboration

Managers at Ericsson are engaged in various strategic collaborations with other companies (e.g. companies outside Ericsson's traditional core offerings, competitors and suppliers), the start-up ecosystem, and expert groups. The creation of Ericsson's collaborations plays an important role in their ability to shift technological systems (Schot, 1992). Such collaborations give managers at Ericsson a strong foothold in shaping socio-technical systems and potential socio-technical transitions. However, the variation of timing and nature of multi-level interactions should not be undermined (Geels, 2002). In this section, we dive deeper into how managers at Ericsson utilise collaboration as a strategy to be better equipped at diffusing sustainable innovations such as 5G and how they, through collaboration, are better positioned to target some of the world's larger issues.

4.3.1 Collaboration with other companies

One of the core activities Ericsson is doing for sustainable 5G is focused on collaboration with other parties. Managers at Ericsson engage in partnership with various companies, such as companies outside Ericsson's traditional core offerings, competitors, and suppliers. Firstly, our research found that managers collaborate with companies outside Ericsson's offerings to gain a stronger foothold in the industrial application of 5G. Ericsson is focused on developing the 5G technology itself and creating a technology as sustainable as possible, as 5G is an enabler for sustainability applications. This requires managers to work together with companies outside of their traditional core offerings (being user-focused) and instead with companies that can help with the industrial application of 5G technologies. This is illuminated well by one manager,

> *"What we have done so far is to treat the technology, as an improving technology, as an enabler, which we can hand over to people, companies, and societies that are going to use it. Now, if we should understand the requirements of what a network should be able to do, we need to learn from those players. That is what we're doing. Therefore, we are actively engaging with all other industries that's not part of the traditional core. I mean, Ericsson's core customers are the mobile operators, and then they also have customers. If we're going to understand how*

a flexible manufacturing site or the future of semi-autonomous vehicles behave, we need to work with them. That's the ideal world where we can act as an enabler, bring it to the right partners, and then get active in working with the people, understanding their reality, and then jointly come up with disruptive solutions to solve problems. Then I'm sure that evolution will continue."

- Jonas (Head of Innovation and Sustainability)

This quote exemplifies that Ericsson is collaborating with companies outside of their core offerings to gain a stronger foothold in the industrial application of 5G, an area which promises to bring about immense sustainability opportunities by decarbonising various industries (MIT Technology Review Insights, 2021). Firms need to collaborate with other firms to access each other's capabilities (Grant, 2021). These applications will have specific requirements that require different capabilities, and through industrial collaboration, Ericsson and its collaborators can make these disruptive solutions a reality. Ericsson is not only focused on creating new innovations with collaborations but also focused on learning from each other and continuously improving the technology. By collaborating with companies that fit the company's long-term strategy, Ericsson looks beyond the traditional and short-term focused way of working, opening learning opportunities. Managers at Ericsson utilise collaboration with such actors to explore the different use cases 5G could bring to the world, allowing them to gather knowledge on the application of sustainable 5G technologies.

Prior to delving into the application of sustainable 5G, managers at Ericsson show a solid ability to understand the industry and are continuously learning how they can operate within it. By scanning the periphery and staying informed about upcoming and potential changes, managers at Ericsson are better equipped to react to the external trends and developments which feed into the scenario building process (Day & Schoemaker, 2005). Scenario planning paints multiple futures and lays out a picture of what may happen in the future of your business (Roxburgh, 2009). As managers at Ericsson engage in scenario planning, they can expand their thinking and gain deeper insights into underlying drivers of change (e.g. demographic trends, economic action and reaction, the reversal of unsustainable trends, and scheduled events) (Roxburgh, 2009) and assess how they can react to such changes. We see that managers at Ericsson utilise scenario planning and strategic alliances with companies to be better equipped to embrace changes, preparing them for opportunities within the emerging field of industrial 5G applications. Another way managers at Ericsson expand their thinking is by asking different questions.

"I work with business development that is key to our networks, where you need to educate the customer on what 5g can enable. At the same time, you need to understand the enterprise, and their pain points, and look into more futuristic stuff. What could come within two, or three years, or if you can combine our technology with a start-up technology. What kind of services could you create that the customer is unaware of and maybe shouldn't be aware of because they should focus on their business?"

– Erik (Engagement Lead)

Asking different questions will create a new way of looking at things. These new perspectives can be used to understand new ideas. Asking questions can be a powerful tool that increases innovation, collaboration and even mitigates risks (Brooks & John, 2018). One way managers at Ericsson use this is to come up with new business ideas and new ways of working together with other companies. When companies want to collaborate, it is essential to understand the company you wish to the work with and the products they make. Gosling & Mintzberg (2003) explain that reflection needs to happen afterwards to find new insights. This combination of asking different questions with reflection expands the way managers at Ericsson are thinking.

Secondly, managers at Ericsson collaborate with their suppliers to help sustainable 5G innovations diffuse. Ericsson (2021a) illustrates that part of their sustainability strategy is to proactively manage topics related to climate action and the environment. A manager at Ericsson illuminated that collaboration for impact goes beyond their own company as they are aiming to work with their suppliers to minimise GHG emissions,

> "*Scope 3 emissions are indirect emissions, which is a more difficult thing because you are dealing with the emissions of external companies and suppliers (e.g. from goods and services, capital goods, fuel, energy, transport, distribution, waste in operations, etc.) … We're working with the closest couple of 100 suppliers to have them sign up to the same ambition to reduce emissions or work with them to make that happen*."
>
> - Jonas (Head of Innovation and Sustainability)

Besides aiming to halve emissions by 2030, the manager reveals that engagement with parts of the value chain to reduce emissions is highly strategic. The engagement aims to reduce the emissions from all parts of the value chain. By working with their suppliers, they can reduce their environmental impacts and emissions from operations, portfolio, and society. From direct supplier collaboration, managers at Ericsson can get Ericsson's suppliers onboard with their goal of halving their own carbon emissions by 2030 and setting yearly reduction rates. Considering this from a socio-technical system perspective, one can observe that managers are interacting with parts of the socio-technical regime to allow for socio-technical transition to occur, taking advantage of "windows of opportunity" through their suppliers, all with the overarching goal to make the system more environmentally sustainable (Geels & Schot, 2007). As illuminated by Geels & Schot (2007), the alignment of processes enables the breakthrough of novelties in mainstream markets where they can compete with the existing regime. Managers at Ericsson engage in regime changing activity by incentivising their suppliers to shift selection towards more environmentally sustainable solutions while also coordinating resources available from within Ericsson to help the regime adapt to these pressures (Geels & Schot, 2007; Smith et al., 2005).

Third, managers at Ericsson are focused on creating the best for the customers, even if that means working with the competitors. The foundation of Ericsson is to make access to communications a basic human need (Ericsson, 2021a). A manager further illuminates this,

> *"We work with our competitors, like Huawei and ZTE, to make the platform more seamless. We have always maintained that communication should be available to all, and it's a democratic form of communicating. It's like having water, everybody should have access to potentially being able to communicate seamlessly. It should be free, as much as possible for the end user and cheaper."*
>
> - Shampa (Business Development & Ecosystem Manager)

The manager illuminates that Ericsson is willing to do what it takes to increase customer satisfaction. This increase in collaboration and knowledge sharing among the companies leads to better access to information and knowledge integration, leading to overall better operations (Grant, 2021). All in all, such teamwork with the competition will increase the speed at which the regime needs to change to the niche innovation, putting the customer first. This is supported by scholars such as Schot (1992), who explain the importance of building a technological nexus, that is, the creation of new alliances, to shift technological systems.

Schot (1992) also reveals the importance of nurturing safe spaces which allow for niche developments and upscaling whilst also modifying elements of the innovation to adhere to regulations. With this being said, we see how managers at Ericsson embrace collaboration through this technological nexus, helping the experimental process to upscale sustainable 5G technologies. This technological nexus is well established and touches many stakeholders of the regime. We explore the topic of managers engaging with the technological nexus by diving into their affiliations with Expert Groups.

4.3.2 Collaboration with Expert Groups

Although innovations are often connected to single individuals or one lone heroic inventor, the fact is that innovation is often a team effort as it requires a range of knowledge, skills, and expertise (Smith, 2015). Therefore, having a space for scientists, engineers, policy makers, academia, and other relevant actors to collaborate is vital. A manager at Ericsson illuminates how the companies' involvement in global innovation networks can create sustainable change across industries. This is revealed in the following quote,

> "*We have cross-industry initiatives, like the Exponential Roadmap or the 1.5 Degree Playbook*, *bringing together the ICT as a collective to meet the Paris Agreement. There is a way forward, and the idea here is to halve emissions every decade. Ericsson has signed up for this kind of collaboration, and I've done some of the initial work here. By collecting an assembly of ICT-based solutions, of things that are available, and we scale*

these up, we can reduce global emissions by 15% even though the ICT is just responsible for 1.4% of emissions."

- Jonas (Head of Innovation and Sustainability)

Ericsson plays a central role in accelerating exponential climate action and solutions through groundbreaking projects to halve emissions before 2030. Together with other Exponential Roadmap members, managers at Ericsson illustrate their active involvement in an expert group that "brings together innovators, transformers and disruptors taking action in line with the 1.5°C ambition, with the mission to halve emissions before 2030 through exponential climate action and solutions" (The Exponential Roadmap Initiative, 2022). This global innovation network helps companies integrate climate deeper into their business strategies and propels climate action in society, as symbolised by their endorsement of the 1.5°C Business Playbook (Ericsson, 2021a). Several authors and contributors of such works come from managers at Ericsson, revealing that the company is engaged in collaboration with expert groups.

Smith (2015) illuminates that such networks help firms exploit new knowledge on a global scale to foster innovation activities. Again, one can note how the technological nexus brings about the opportunity for change and a larger potential to upscale sustainable technologies (Schot, 1992). All in all, this gives managers at Ericsson a stronger possibility to influence the socio-technical regime, increasing the potential for transformations towards more sustainable solutions (Geels, 2002).

4.3.3 Collaboration through Ericsson Start-up Ecosystem

For years the business was done in a way where companies invested a lot in internal R&D and hired the smartest people to come up with the greatest number of ideas to get to the market first. However, nowadays there are many different ideas and smart people, and it is impossible to have everyone working for your company. Therefore, a focus on external ideas outside of the company's boundaries, is key to creating new ideas (Chesbrough, 2003). Managers at Ericsson were found to utilise an internal accelerator to build a start-up ecosystem which would allow for the firm to absorb opportunities which could give Ericsson a competitive edge, as described by a manager,

> "*Our internal accelerator, copied very much from the outside world, takes project ideas through three investment stages. The investor, in this case, is Ericsson itself. So you'll start with a small sum and maybe 10% of your time as an employee, exploring this new idea that you might have. Then when the idea grows a little bit, and we think it has potential, you get a little bit more so that you can develop a minimum viable product, maybe we'll help you connect to other colleagues within Ericsson …. And take it into the last stage for a sizable investment where you present it in front of the heads of our various organisation - like the VP level, right under Börje Ekholm (Ericsson's CEO).*"

- Shampa (Business Development & Ecosystem Manager)

The main point is that managers at Ericsson have a strong system to form novelties through an internal start-up ecosystem, which thrives from interactions with individuals with brilliant ideas. This reveals that managers at Ericsson are engaging in experimentation with entrepreneurs and provision of orientation for innovation search processes, functions that support the deployment of sustainable technological innovations (Hekkert et al., 2007). According to Geels & Schot (2007), such patterned interactions help form transition pathways. Through the internal accelerator at Ericsson, managers and top executives are understood to have what Geels & Schoot (2007) refer to as a rational choice, formed by self-interest, objectives, preferences and possibly a cost-benefit calculation to select optimal project choices. Change and project developments are then understood as outcomes of the investments (Geels & Schot, 2007). According to Geels & Schot (2007), such processes and sequences of events, combined with optimal timing and conjunctures of event chains, allow for strong reinforcing relationships to occur. A manager also illuminates the strong focus on interaction in the following quote,

> *"So the ideal 5g world (A) unlocks collaboration, but it also (B) only going to be unlocked through collaboration."*
>
> - Shampa, Business Development & Ecosystem Manager

Managers at Ericsson engage in exploration activities, which is according to Smith (2015), one of the most creative phases of the innovation process as it requires qualities of openness, creativity, vision to inquisitiveness and the ability to improvise. By engaging with the start-up ecosystem, the collaboration fuels more "out of the box thinking" which goes against the conventional wisdom at the firm (Galbraith, 1958). Through collaborating with the start-up environment, managers at Ericsson are also able to interact with a variety of diverse agents which breaks away from any path-dependent behaviour which may exist at Ericsson. Mokyr (1990) argues that innovations do not always obey previous laws and do not respond to incentives, but instead defy most attempts to relate to external variables. Through the internal incubator, managers at Ericsson engage in exploration activities as they depart from existing skills and capabilities and instead open new doors for opportunities (Smith, 2015).

4.4 Education and Thought Leadership

This section examines the role of education and thought leadership in pushing the innovation process forward. Knowledge sharing and education are deemed as important as they allow for managers to explore the use cases for sustainable 5G. Managers at Ericsson also use thought leadership to push through on the sustainability agenda, revealing that behavioural change plays a large role in creating a ripple-effect.

4.4.1 Education and Knowledge Sharing

Knowledge plays a large role in the innovation process. Hekkert et al. (2007) argues that knowledge development is important to deploy sustainable technological innovations successfully. This is deemed likely as one of the findings from the research is that managers utilize knowledge sharing to explore the possibilities of 5G application. This is exemplified by one of the managers in the following quote:

> *"There is a responsibility of our industry to listen and educate the users. I would say my biggest fear is that 5g would be treated as consumer technology and not so much in the industry."*
>
> - Erik (Engagement Lead)

Managers at Ericsson are aware that collaboration is not enough, but that one also needs to focus on knowledge sharing and educating other companies regarding the possibilities of 5G, more specifically, that it can play a large role in creating sustainable change within the industrial setting as opposed to the consumer industry. Antonelli (2009) argues that innovation growth is shaped by technology trajectories which are bound by systems of localized technological knowledge, distributed knowledge and innovation networks with specific competence. Breaking the cycle and introducing new ways of thinking or applying the innovation is difficult due to the path dependent nature of innovation (Antonelli, 2009, p. 613). Nonetheless, by creating a safe space that allows managers at Ericsson to share knowledge on risks and opportunities, the sustainable 5G innovations are able to flourish.

Dahmén (1988) states that transformation pressure helps the innovation process as there is a strong felt necessity to adjust and adapt. Managers fuel transformation pressure with their stakeholders by educating them on the potential which 5G can bring in order to unlock new opportunities, such as increased production, new applications of 5G or advancement in 5G technological development. Since new technological applications can push forward the development in scientific understanding (Nemet, 2008), managers find it important to share knowledge and educate their stakeholders on the potential use cases.

Knowledge sharing plays an important role in understanding the issues which may arise from the application of sustainable 5G. This is well illuminated by Shampa, a business Development and Ecosystem Manager, who shares:

> *"It's our job to help explain what 5g is, but also what it is potentially not".*
>
> - Shampa (Business Development and Ecosystem Manager)

The role of knowledge sharing and educating is especially important for an innovation like 5G, considering that one of the characteristics of 5G is its complexity. Smith (2015) argues that characteristics (e.g. complexity, compatibility, observability) of the innovation itself influence the rate of diffusion. Managers at Ericsson reveal that users often require guidance to understand the benefits of 5G, signifying that it has characteristics of low observability.

Considering this, one of the strategies managers use to stir the 5G innovation process is educating stakeholders and sharing knowledge on the innovation itself. This is illustrated by Shampa, who reveals that there is still much to learn regarding the application possibilities of the technology,

> *"I think some of the limits of the technology, we won't even know until we have created 5G. We won't know what you can do with it until we try."*
>
> - Shampa (Business Development and Ecosystem Manager)

This signifies that managers at Ericsson are staying up to date on the limits and potential applications of the technology. Nonetheless, Erik who works as an Engagement Lead argues that 5G technology is already very advanced and that industrial markets are not mature enough to take on the innovation,

> *"5G's technology is more advanced than the market is at the moment and that is why it is important to educate the customer on what 5G can enable. With all the possibilities for the diffusion of innovative services, new ways of organizing capabilities in society, new business models and so on, I think that will take a few years because before we see the results of that"*
>
> - Erik (Engagement Lead)

Smith, Voß & Grin (2010) explain that for a niche innovation to become part of the regime, they need a growing network of actors to perform cognitive, institutional, economic and political work. The expectations of the niche innovation should align with the expectations of the regime, but this constrains the regime as it needs to break the powerful structures from within (Smith, Voß & Grin, 2010). Education will assist companies in understanding what they can and cannot do with 5G, therefore increasing the speed of market readiness. With education and a clear focus, managers accelerate the rate of 5G technology adoption and the ability to become part of the regime.

4.4.2 Leading by Example

Do we need to change our minds to change our behaviour? Due to the amount of information people need to process and the biases that come into play, they prefer not to change their habits or behaviour unless they absolutely have to (Mont, Lehner & Heiskanen, 2014). This is one of the reasons that sustainability developments are moving not as fast as people expect. Nudging could help people change their behaviour by subconsciously promoting the desired outcome. Nudging is a way that influences system 1 thinking (automatic) to choose an option without it passing system 2 thinking (deliberate). Mont, Lehner & Heiskanen (2014) suggest that this is even more effective when it is helping people to do what they ideally would like to do. One way Ericsson is using nudging is explained in the following quote:

> *"It's a behavioural change as well. We are working a lot with that. What does it mean for me, as an Ericsson employee in Gothenburg, to be part of that transition towards a more sustainable or save the world sort of environment? We're working with one of the start-ups called carbon cloud, which is measuring the CO2 impact on all the food dishes. Not only how many calories you eat, but every dish that is on the lunch display is also telling you what the most climate friendly alternative is. By bringing that information there is stronger awareness of sustainable options, which creates a little nudging effect that hopefully gets many people to reconsider their options."*
>
> - Jonas (Head of Innovation and Sustainability)

In this case the person that wants to change their behaviour towards a more sustainable one will automatically pick the dish with the lowest CO2 impact. This will depend on the person and the food options, but system 1 thinking will automatically choice an option and send it to system 2. If the CO2 impact was not displayed, then system 2 had to make the decision.

If a manager wishes to improve a more environmentally sustainable workplace, one of the best practices is to try to change their own behaviour in their daily activities (Boiral, Talbot & Paillé, 2013). Leading by example can create a ripple effect on the whole organization because it shows that sustainability is important for both the manager and the organization. Boiral, Talbot and Paillé (2013) also argue that a strong personal commitment from top management in environmental programs can lead to managers becoming more involved by participating in environmental committees and programs, which ripple down to managers encoring their employees to integrate sustainability practices in their daily lives. Ericsson not only focusses on their own activities, but also on the activities of their supply chain and therefore creating an even bigger ripple effect that causes a more sustainable supply chain. This is exemplified by a manager,

> "*It (sustainability initiatives) has this sort of ripple effect, but it must start with information and then a desire to change something. That is also now being done at the top level of Ericcson. It's been on our CEO's agenda for a while and I know it's not just empty words. Now I can see that trickling down to the levels beneath him… So, it's asking about what managers are doing. I think it's a lot about being a role model and stating that it does make a difference*."
>
> - Jonas (Head of Innovation and Sustainability)

Managers at Ericsson make it a personal habit to become more sustainable. The combination of nudging people to change their behaviour in combination with seeing everyone around you change their behaviour, creates a culture that improves their society. Ericsson believes part of their value comes from the focus on sustainability and their impact across different sectors of society (Ericsson, 2021a). Factors on the landscape level, such as climate change and rise of sustainable consumer culture, are pushing managers and workers at Ericsson to adopt more sustainable practices on the behavioural level. Embedding such sustainable practises reveals

that a deeper cultural pattern is emerging, one which embraces living by sustainability principles such as by choosing more climate-friendly food alternatives. This reveals that the landscape pressures are creating changes on actors on the regime and niche level (Geels, 2002). The landscape provides an influential backdrop, sparking change and a new set of demands regarding how to establish socio-technical configurations that truly serve societal needs (Geels & Schot, 2007; Smith, Voß, Grin, 2010). Smith, Voß & Grin (2010) state that the regimes are being confronted with a sustainability criteria which was not considered during the installation of previous socio-technical systems. They argue that multiple actors on the regime level are starting to wake up to growing environmental awareness, a socio-cultural development on the landscape level, leaving opportunity for niche-actors to embed sustainability into their business practices.

Another way in which managers at Ericsson help stir the innovation process within the field of sustainable 5G is by setting ambitious targets. Managers reveal that embedding ambitious targets in a manner which is well aligned with Ericsson's business strategy helps stir technological advancement towards more sustainable solutions. This is depicted well by one manager,

> *"We set a target for 2021 to be 10 times more efficient in the 5G product portfolio. We measured by several transferred data, because that's usually what the networks are used for, data transfers. The baseline for that was 2017. We had a target of 10 times, and we came in at 9.3 times more energy efficient 5G compared to 4G across the portfolio that we shot"*
>
> – Jonas (Head of Innovation and Sustainability)

Managers at Ericsson embed sustainability targets into their strategy. Through embedding sustainability targets into their decision-making processes, they enable more sustainable outcomes in Ericsson's 5G portfolio to be achieved. Managers are aware of such goals, are consistent with the direction of innovation and act in a way that bends circumstances towards their desired outcome, in this case being 10 times more energy efficient in the 5G product portfolio.

4.5 Hindering Factors

4.5.1 A Changing Business Model

Ericsson's business model can be considered quite complicated, especially in this changing world. The message for 4G was to bring connection to as many people as possible, while the message for 5G goes beyond that by enabling a new business model with an exponential number of devices that influences businesses in all sectors (Fireman, 2019). The focus needs to shift from consumer revenue to more business-to-business revenue. However, there are hindering factors to change this business model. There are 3 key challenges of monetizing 5G, lack of

clarity on the use cases, reaching a new customer base, and outdated monetisation systems (Abraham, 2019).

> *"We work with partners through traditional channels. It's difficult to find a new way of engaging with existing customers that's not transactional. Traditionally, we go in and we're like, this is our list of products, just mark which ones you want, and then we'll provide customer service. But when you're talking about innovation, we don't have these products, we're in the process of developing them."*
>
> – Shampa (Business Developer and Ecosystem Manager)

Firstly, there is a lack of clarity on the use cases. There are many different new use cases with 5G, like IoT, autonomous vehicles, smart factories, smart agriculture, etc. These new use cases create new revenue streams. However, the big problem is that these new use cases are only just emerging. To develop these new use cases companies that roll out 5G need to work together and create an innovative ecosystem of partners (MIT Technology Review Insights, 2020). This is especially necessary when finding ways to monetise these new use cases, because Ericsson in this case is the supplier, which supplies the technology and services to the service providers. Secondly, reaching a new customer base. Most of these new use cases are enterprise focused instead of customer focussed. This means a new customer base that is different from the current customers. Fireman (2019) predicts that the consumer will dominate the revenue streams at the beginning of 5G, but that this will shift towards more B2B. This will lead to new business models and new relationships between companies.

> *"I would say my biggest fear is that 5g would be treated as a consumer technology and not so much in industry."*
>
> - Erik (Engagement Lead)

Thirdly, an outdated monetisation system. Abraham (2019) explains that most monetisation systems that are being used are not made to scale or support new use cases and that these systems are expensive to maintain for supporting 5G use cases. Abraham (2019) also explains that changing these platforms is not being encouraged, since there is a high risk of disrupting existing services.

These challenges are hard to overcome. Carrillo-Hermosilla et al. (2009) explain that there are different barriers to innovation: economic barriers, technological barriers, and institutional barriers. Economic barriers are focused on the difficulty to make sustainable innovations economically advantageous (Carillo-Hermosilla et al., 2009).

> *"Ericsson has a history of in the last 10-15 years focusing on that our customer should make money all the time. That hinders some type of development, because then you listen to the customer and they always want technology cheaper, and much more efficient. We create that, but I think we need to think bigger than our*

technology and see it as a potential game changer for the sustainability of the planet."

– Erik (Engagement Lead)

Firstly, the economic barrier is about making green innovations economically attractive. Ericsson is focusing on creating the most amount of value in terms of money for their customers, which leads to less innovation in the sustainability development. However, the number of connected devices will outnumber the number of human subscribers. Ericsson predicts that in 2025 there will be 2,6 billion 5G users, while GSMA predicts that there will be 25 billion IoT devices (MIT Technology Review Insights, 2020). This means that new opportunities will arise, and that the old way of monetising needs some innovation. This innovation is positive for Ericsson as the business innovations can be created with sustainability in mind. Secondly, technological barriers are about the resilience to change dominant technical systems. As mentioned, the current systems are hard to change as there is a chance it will disrupt the existing services. However, there are many different new technologies rolling out with 5G, like network slicing, that creates personalised networks for businesses. Abraham (2019) explain that these network slices allow for new use cases with service-specific characteristics and is seen as the major disruptor for changing the economics of the connectivity business. The problem for Ericsson is that they are not the ones that sell the connectivity, Ericsson sells the technology.

"What happens with the technology is a little bit out of our hands because we develop the tool, and we maintain the tools so that it is always working. That's where sometimes with the projects we have a hard time when we talk to customers. We are very far down the value chain, like we are suppliers. And we are essentially working on a utility. It's like supplying water, what you do with that water, I can't know."

– Shampa (Business Developer and Ecosystem Manager)

Thirdly, institutional is about the norms, routines and structures that guide and influence human behaviour. In the end it is up to the service providers to change their behaviour. Many enterprises will adopt multi-dimensional chains and complex B2B2X systems (Abraham, 2019). This means that the business sells to another business that sells to someone else again, which will require advanced partner management. In the end it is up to the service providers to deploy new monetisation systems without knowing which use cases will be deployed.

4.5.2 Mindset

A big problem within the field of sustainability is that people are too focused on their old way of working, being more focused on profit rather than sustainability. Therefore, one of the biggest challenges sustainable 5G is facing is the change in people's habits and mindsets to focus on what is possible. 5G is seen as a new, faster, more reliable generation of internet, but

for real change to happen, people need to change the way they see 5G. Managers need to influence change to make stakeholders/their team/people see 5G as an enabler of sustainable innovations. Now 5G is seen as a new enabler of profit with use cases that companies could use to develop new technologies that improve their own profit.

> *"We are very much set in our ways internally, as well as the external partners. We only know how to work in a certain way, and that is still very profit driven. We've been working for the past 70 years since World War II, and I think the biggest challenge is changing habits and changing mindsets of what we can do. And I think 5G is not only a question of what 5G can unlock, but also a question of what you can do? What are you chasing? Is it really selling more and more things? And I think the issue when it comes to sustainable practices, in general, or working more on the preventive side is, at the end of the day money driven."*
>
> – Shampa (Business Developer and Ecosystem Manager)

People don't like change and changing behaviour can cost a lot of effort, specially to overcome limiting beliefs (Kegan & Lahey, 2001). If there is a certain mindset in the company for 70 years it is hard to change, especially since habit takes over, which has the tendency to use old solutions (Carillo-Hermosilla et al., 2009). Carillo-Hermosilla et al. (2009) also explain that investment decisions are linked to earlier investments and experiences on how the technology performed. Since Ericsson's core business has not changed, and their technology gets a significant upgrade approximately every ten years, the innovation that led out of that technology tends to focus on what they already did in the past. That is focused on profit and improving its core technology. When people encounter challenges, they tend to fall back into the fixed mindset (Dweck, 2016). If people have a fixed mindset, they mostly look back at how they used to do things, which could even decrease innovation. Innovation will still happen, but maybe not in the places that make the most impact. A fixed mindset hinders collaboration, learning from feedback, and sharing information, but a growth mindset would stimulate these and increase innovation (Dweck, 2016). People with a growth mindset are less focused on the past and more focused on a long-term future, leading to more long-term investments. Everyone has a mixture of these mindsets, which becomes clear from the following quote.

> *"Now, we are focusing on technology leadership. We are focusing on our core offering, but we tend to forget that we are extremely innovative. We do lots of innovation in our core business. I think we are missing out on fantastic opportunities because, if you have a solution, it always starts small and then has a tendency to die because it doesn't affect the result of Ericsson's finances. We don't see long term investments. We don't make big bets on the future except for our core offerings."*
>
> – Erik (Engagement Lead)

A problem with environmental innovations is that it is hard to see benefits back for the company. These innovations release pressure on the environment, but this doesn't mean it gets

translated into lower costs (Carillo-Hermosilla et al., 2009). Compared to the traditional way of doing things, innovations are almost always more expensive in the beginning. Innovations need time before it becomes cheaper than the conventional way of doing things. Still, since the mindset of the employees is focused on money, these innovations never really get into the next phase as they prefer to take a 'safer' approach that is directly in line with their core offering.

The problem is not that Ericsson doesn't innovate, it is that there is a focus on making a profit and therefore, the innovations do not happen in the right place to ensure 5G as a sustainability enabler. 5G is consequently seen as a sustainable technology that, in the end, would be used for non-sustainable applications, whereas Ericsson's (2021a) goal is to use 5G in a way that increases environmentally positive outcomes.

> *"I think the biggest risk is that we are looking at our technology in isolation that we make 5G extremely efficient. We have a circular economy, bringing back the base stations to recycle. We aim for more and more software instead of hardware. So, it becomes an isolated thing, just like all enterprises are looking at their carbon footprint with business travelling. It becomes just a small part. But I think technology companies like Ericsson, and other big technology companies around the world, can use digital technology differently to see it as a platform for our own innovation and other parties' innovation, and support more sustainable innovation. Not only our core technology but our technology as a platform for creating new types of solutions."*
>
> – Erik (Engagement Lead)

Ericsson mainly focuses on their core offering, enabling the world with radio frequencies, or as Erik says: "*complex distributed systems*". Since they want to improve the energy efficiency of their radio frequencies, they do not focus on creating an application that can drastically reduce global emissions in other sectors. Employees of Ericsson look at the technology in isolation and try to improve that by making it more sustainable. However, their technology could solve many problems, leading to positive environmental outcomes as Ericsson (2021a) expects that ICT solutions could decrease global emissions by 15% in 2030.

4.5.3 Legislation and Structural Barriers

When asking managers about factors they may have to deal with when working on diffusing sustainable 5G, it became clear that the immaturity of other markets contributed to hampering the development of sustainable 5G. This was mainly due to two factors: legislation and structural barriers. Legislation and structural barriers are seen as strong institutional barriers that exist within the current regime and external regimes that managers at Ericsson interact with (e.g. customers within industrial settings) (Carrillo-Hermosilla et al., 2009).

First of all, some legislations outside of the ICT industry are seen as structural barriers for managers at Ericsson who are looking to apply sustainable 5G technologies within the industrial

setting. Existing socio-technical regimes are stringent, with a tendency to not favour innovation which can be seen as disruptive or radical (Geels, 2002). One manager illustrates that although legislation and policy are in place for valid reasons, it hampers the development of commercial implementation and upscaling sustainable 5G. This is revealed in the following quote,

> *"(Policy and legislation is a) barrier in the sense that it can definitely hold back some sort of commercial implementation or the upscaling of things… Certain types of policies need to be aligned with fast-paced innovation.*"
>
> - Jonas (Head of Innovation and Sustainability)

This illuminates that institutional barriers, such as policy and legislation, make it difficult to experiment with the development of technological innovations. As Carillo-Hermosilla et al. (2009) argued, institutional barriers can be seen as a fabric embedded into society that hinders the innovation process. This suggests that policy and legislation may be factors that are more static and difficult to change. Nonetheless, Weber & Rohracher (2012) instigate that transformation policy which mobilises actors and creates a space for experimentation is essential to spark innovation. Although innovation policies emphasise economic growth and industries to generate innovations, there are significant challenges when it comes to creating transformative change (Alkemade et al., 2011). The same manager well exemplifies this,

> "*In some cases, you have a structural sort of legacy. … For example, we have been working on self-driving cars for quite some time and in order to drive and you normally measure how autonomous the self-driving cars are on a scale from one to five where five is completely autonomous and one is basically nothing … but in order to actually scale up tests, there is isolation and a great deal of regulations that are not always in sync with the technology developments being done."*
>
> - Jonas (Head of Innovation and Sustainability)

This quote reveals that regulations hamper the technology process of autonomous vehicles. Considering that managers at Ericsson believe 5G has the most potential to create sustainable impact within the industrial setting, such as the automotive industry, it is important to consider other industries' socio-technical regimes and complex systems. Smith (2015) argues that structural features often place one or more groups in a particularly influential position where they can lobby effectively for the retention of established technologies. These vested interests are powerful, and, in some cases, those in power even have the resources to lobby regulators and legislation, something which may slow the adoption of other technologies (Smith, 2015). According to Kemp (2005), such intense lobbying has been historically prevalent by car manufacturers and oil companies, which were able to lower emission targets. It is important to understand structural barriers in various industries that may hamper new innovations from flourishing.

According to Smits et al. (2010), innovation policies need to focus more on optimising the structure of innovation systems which allow actors to generate new knowledge and technology. This would allow for the transformation of innovation systems, such as the transformation in production and consumption within the automobile industry. Weber & Rohracher (2012) also illuminate that innovation policies require strategic orientation with other policy fields, such as within or between industries. Several managers at Ericsson acknowledge that policies in several industrial settings can be stringent, such as within the automobile industry, healthcare industry or education industry. This is illuminated by another manager,

> "*Policy for the different sectors, like education and healthcare, make it difficult to scale technology. We've been hearing for a long time that there are no incentives there, really."*
>
> - Shampa (Business Developer and Ecosystem Manager)

It is challenging to scale up technologies within industrial settings as it is difficult for technologies to break into areas they haven't touched previously - something that managers exemplify by referring to examples within the healthcare, education, and automobile industry. Smith et al. (2015) argue that due to the technological lock-in that occurs throughout industries, it is difficult for new innovative systems to break into the market. Köhler et al. (2008) note that the automotive industry has become locked into the technological regime that has brought it power, leading to incremental innovations surrounding the combustion engine (e.g. safety features, vehicle performance technologies). This makes it difficult for electric cars to break into the system (Köhler et al., 2008), even more so for autonomous ones. This hints that the market's push and pull factors alone will not be able to fuel the innovation process for sustainable innovations such as 5G, but that regulations and policies need to incentivise the innovation process. Integrating innovation policy puts additional demands on other actors within the socio-technical regime, such as governments, to ensure that innovation policies do not simply just focus on economic growth but also help extend innovation systems towards more sustainable ones.

Secondly, structural discrepancies appear to be associated with the large size of the firm. As illuminated previously, larger firms are known for having strong internal innovation systems and investment capabilities, characterised by R&D departments and the internal incubator which exists at Ericsson. Nonetheless, as previously mentioned, there is a tendency for larger companies to over-exploit existing resources and chase incremental innovations over the exploration of new products (Chen & Katalia, 2008; Smith, 2016). Two managers at Ericsson acknowledge some structural problems of larger firms,

> "*In some cases there is a lead time from discovery to be able to scale something up is could be faster. In some cases, you have structural sort of legacy*."
>
> - Jonas (Head of Innovation and Sustainability)

> *"For bigger companies it's more difficult to be agile in that way, no matter how much the leadership wants it to be, you can't just switch things around. No matter how good the culture is and how driven it is, it's tough, the structure is tough. … the challenges I face are not unique, it's working in a big organisation. The structures are inherently not really made for trying something new and different."*
>
> - Shampa (Business Developer and Ecosystem Manager)

These managers acknowledge that due to the structural discrepancies which larger firms such as Ericsson are prone to, it lags the development of scaling innovation, being agile and trying something different. This may be associated with the path-dependent nature of technological trajectories, which are all defined by interconnected systems of localised knowledge, innovation networks and competence (Antonelli, 2009). Although strong leadership and human capital may exist within Ericsson, the organisational structure of larger firms is deemed as inhibiting innovation processes. Chen & Katila (2008) illuminate that there is an organisational tendency to over-exploit and that firms tend to become set in their well-established routines, favouring the familiar rather than the unknown. Christensen (1997) argues that large firms operating in mature industries are especially prone to this. This is important to understand as it may hamper managers at Ericsson from being able to engage in the innovation process of sustainable 5G, something which has the potential to spark sustainable cross-industrial change.

Smith (2015) reveals that managers may also be reluctant to break from revenue generation mechanisms they are familiar with, a factor Chesbrough & Rosenbloom (2002) believe stems from cognitive biases. Considering such insights, managers at Ericsson may feel structural dilemmas for a variety of reasons – such as the difficulty of breaking away from existing revenue streams (Smith, 2015), cognitive biases (Chesbrough & Rosenbloom, 2002), localised systems of knowledge and competence (Antonelli, 2009), or the prevalence of influential actors with vested interests (Smith, 2015).

5 Conclusion

The purpose of this thesis was to explore what strategies managers at Ericsson are using to influence the socio-technical transition towards more sustainable 5G. This research was motivated by three sub-aims: (1) to understand the role of managers in the transformation towards more sustainable systems, (2) to understand which factors hinder the diffusion process of sustainable 5G, and (3) to understand the manager's ability to mobilise relevant stakeholders using the multi-level perspective (MLP). Building on the works of previous literature, this research sheds light on what strategies managers within Sweden's ICT industry can take to enforce socio-technical transitions towards more sustainable systems. On top of this, the research also considers what hindering factors managers within the ICT industry may come across during the innovation process.

To summarise the findings, we found that managers utilised the four main strategies at Ericsson to help the sustainable 5G innovation process. Firstly, managers at Ericsson use both exploration (e.g. internal incubator) and exploitation (e.g. collaborating with previous customers) activities to spark the 5G innovation process. Although the risk of over-exploitation and incremental innovation process is present, as common with larger firms, managers attempt to find a balance between exploration and exploitation activities. Secondly, managers at Ericsson fuel the innovation process of sustainable 5G by collaborating in various forms - with other companies (e.g. suppliers or competitors), with the start-up ecosystem, and with expert groups (e.g. Exponential Roadmap Initiative). This allows for new ideas to feed into the firm, something which has the potential to spark novelties.

Third, managers embrace knowledge sharing to understand the latest trends and potential application areas of 5G. They listen to the perspectives of customers and industrial actors to try to understand better where there is the opportunity for 5G to create sustainable impact while also bearing the responsibility to educate stakeholders who are unaware of 5 G's potential. Lastly, managers make it a personal habit to be more sustainable in their daily practices, which creates a ripple effect and inspires further sustainability thought leadership.

As for factors that hinder the innovation process, we found that managers are subject to various barriers. These factors are synthesised as four barriers to the innovation process. Firstly, managers at Ericsson are subject to the path-dependent nature of the previous regime (4G), as opportunities are mainly consumer-driven as opposed to industry-driven. This makes it challenging to embrace new applications, even if they promise to withhold greater sustainable impact. Secondly, the managers face some clients in immature markets, where several industrial actors are not entirely sure of 5G's full potential. This makes it more difficult to bring sustainable 5G to the market. Despite the fact that strong knowledge sharing and education efforts are prevalent, there is in some cases still a lack of knowledge or understanding regarding

5G applications within other industrial settings and their socio-technical regimes. On top of this, as with most innovations, some of the learnings and pitfalls might not be noticeable until 5G has been installed.

Third, institutional barriers, such as structural and legislative barriers, were found to hamper the innovation process. Factors such as structural dilemmas within the firm are acknowledged by managers and legislative barriers from the industrial setting. Lastly, one of the barriers to the innovation process is the strong focus on developing innovations closer to Ericsson's core offerings and existing capabilities, which induces a cycle of incremental innovations as opposed to more radical and disruptive innovations. These factors may be hindering the innovation process of more sustainable 5G applications but can also be embraced as opportunities.

All in all, these findings contribute to the scholarly research fields of innovation studies, sustainability studies and management studies. The research exemplifies how the MLP can help one understand socio-technical transitions and barriers to transitions, all without undermining the complexity that managers are faced with. In this research, the complexities of 5G's socio-technical system and the systemic nature of 5G are acknowledged. Moving on, the research also inspires business leaders within the ICT industry to take responsibility for their sustainability journey. By being aware of strategies that help stir the innovation process of sustainable solutions and factors that hinder the innovation process of sustainable innovations such as 5G, managers are better equipped to manage the innovation process to their advantage. The final section will consider some practical implications and areas for further research.

5.1 Practical Implications and Future Research

The findings illuminate strategies managers at Ericsson are using to influence the socio-technical transition toward more sustainable 5G. These findings are helpful and have some practical implications. Firstly, it is important for managers to be aware of the strategies and understand underlying problems on a deeper level. By understanding pain points, one can find improvements in the innovation process. Secondly, managers at Ericsson alone cannot enforce changes to diffuse sustainable 5G as the socio-technical system is highly complex. Thus, a wide range of stakeholders in the socio-technical system should be mobilised for socio-technical change. Lastly, the MLP proves itself to be a robust framework which helps one understand socio-technical systems without undermining complexity. Considering this, our study exemplifies how the MLP framework can be used by scholars, managers, policymakers, and actors on the firm level to understand their respective innovation processes better.

Although this study provides some insights into strategies utilised by managers in the ICT sector to diffuse sustainable 5G innovations, the research field is still emerging, and there is much room for further research. Firstly, it would be important to examine international and cross-

cultural differences between strategies utilised by managers to enforce sustainable innovations. Gaining more diverse international perspectives would enable managers and researchers worldwide to gain new perspectives on strategies to enforce sustainable innovations. Secondly, it is also important to research the role other stakeholders in the socio-technical system have in making sustainable 5G innovations more widely available and understand if they address any of the hindering factors (e.g. policy, immature markets). Lastly, future research using quantitative methods would complement the qualitative study well. Quantitative insights would help support this research as it is a powerful tool for gaining reliable and objective insights from data. It would offer the opportunity to cross-check this study's findings and understand if any other clear trends persist.

6 References

Abraham, J. (2019). Modern Monetisation Systems are Crucial to Enable the Effective Monetization of 5G, Available online: https://foryou.ericsson.com/rs/891-BLC-619/images/Ericsson_5G_WP_250119_Final.pdf [Accessed 20 May 2022]

Andrews, J. G., Buzzi, S., Choi, W., Hanly, S. V., Lozano, A., Soong, A. C. K., & Zhang, J. C. (2014). What Will 5G Be?, *IEEE Journal on Selected Areas in Communications*, vol. 32, no. 6, pp.1065-1082

Antonelli, C. (2009). The Economics of Innovation: From the Classical Legacies to the Economics of Complexity, *Economics of Innovation and New Technology*, 18(7), pp.611-646.

Bekaroo, G., Bokhoree, C., & Pattinson, C. (2016). Impacts of ICT on the Natural Ecosystem: A Grassroot Analysis for Promoting Socio-Environmental Sustainability, *Renewable and Sustainable Energy Reviews*, 57, pp.1580-1595.

Bergmark, P. (2019). Why You Need to Read the 2019 Exponential Roadmap on Climate Action. Ericsson web blog post, Available online: https://www.ericsson.com/en/blog/2019/9/2019-exponential-roadmap-climate-action [Accessed 18 April 2022]

Bijker, W.E. (1995). Of Bicycles, Bakelites and Bulbs: Towards a Theory of Sociotechnical Change, Cambridge: The MIT Press

Boiral, O., Talbot, D., & Paillé, P. (2013). Leading by Example: A Model of Organizational Citizenship Behavior for the Environment, *Business Strategy and the Environment*, vol. 24, pp. 532-550

Boston Consulting Group. (2021). Inside COP26: Kickstarting the Decade of Delivery, Available at: https://media- publications.bcg.com/BCG-Executive-Perspectives-Inside-COP26-Kickstarting-Decade-of-Delivery.pdf [Accessed 18 April 2022]

Breschi, S., & Malerba, F. (1997). Sectoral Innovation Systems: Technological Regimes, Schumpeterian Dynamics, and Spatial Boundaries, *Systems of Innovation: Technologies, Institutions and Organizations*, 1, pp.130-156.

Brooks, A. W., & John, L. K. (2018). The Surprising Power of Questions, *Harvard Business Review*, Available online: https://hbr.org/2018/05/the-surprising-power-of-questions [Accessed 18 May 2022]

Bryman, A. (2016). Social Research Methods, 4th edn, New York: Oxford University Press

Carlsson, B. (1997). Technological Systems and Industrial Dynamics, *Springer Science & Business Media*, vol. 10

Carlsson, B., & Stankiewicz, R. (1991). On the Nature, Function and Composition of Technological Systems, *Journal of Evolutionary Economics,* vol. 1, no. 2, pp.93-118.

Carrillo-Hermosilla, J., González, P.R.D., & Könnölä, T. (2009). Barriers to Eco-Innovation, *Eco-Innovation,* London: Palgrave Macmillan, pp.28-50

Chen, E. L., & Katila, R. (2008). Rival Interpretations of Balancing Exploration and Exploitation: Simultaneous or Sequential?, *S. Shane (ed.) Handbook of Technology and Innovation Management*, Chichester: John Wiley and Sons, pp.197–214

Chesbrough, H. W. (2003). The Era of Open Innovation, *MIT Sloan Management Review*, Available online: https://sloanreview.mit.edu/article/the-era-of-open-innovation/ [Accessed 3 May 2022]

Climate Change Conference (UK COP26). (2021). Available online: https://ukcop26.org/ [Accessed 18 April 2022]

Climate Change News. (2022). Sweden Set to be Worlds First Country to Target Consumption Based Emissions, Available online: https://www.climatechangenews.com/2022/04/08/sweden-set-to-be-worlds-first-country-to-target-consumption-based-emission-cuts/#:~:text=The%20Global%20Carbon%20Project%20calculates,and%20are%20embedded%20in%20imports. [Accessed 18 April 2022]

Coutard, O. (1999). The Governance of Large Technical Systems, vol. 13, London: Routledge

Dahmén, E. (1988). 'Development Blocks' in Industrial Economics, *Scandinavian Economic History Review*, vol. 36, no. 1, pp.3-14

Day, G.S. and Schoemaker, P.J. (2005). Scanning the Periphery, *Harvard Business Review*, vol. 83, no. 11, pp.135

Dodgson, M., Gann, D.M. & Salter, A. (2008). The Management of Technological Innovation: strategy and practice, New York: Oxford University Press

Dweck, C. (2016). What Having a "Growth Mindset" Actually Means, *Harvard Business Review*, Available online: https://hbr.org/2016/01/what-having-a-growth-mindset-actually-means [Accessed 28 April 2022]

Elzen, B., Geels, F.W. & Green, K. eds. (2004). System Innovation and the Transition to Sustainability: theory, evidence and policy, Cheltenham: Edward Elgar Publishing Limited.

Ericsson. (2016). Carbon Footprint of ICT in Sweden - a detailed case study. Available at: https://www.ericsson.com/en/reports-and-papers/research-papers/the-energy-and-carbon-footprint-of-the-ict-and-em-sector-in-sweden-1990-2015-and-beyond [Accessed 18 April 2022]

Ericsson. (2021a). Sustainability and Corporate Responsibility Report 2021, Available at: https://www.ericsson.com/492fee/assets/local/about-ericsson/sustainability-and-corporate-responsibility/documents/2022/ericsson-sustainability-and-corporate-responsibility-report-2021_eng.pdf [Accessed 4 April 2022]

Ericsson. (2021b). This is 5G, Available online: https://www.ericsson.com/49f1c9/assets/local/5g/documents/07052021-ericsson-this-is-5g.pdf [Accessed 11 April 2022]

Ericsson. (2021c). Sustainability and Corporate Responsibility. Climate Action. Available at: https://www.ericsson.com/en/about-us/sustainability-and-corporate-responsibility/environment [Accessed 18 April 2022]

Ericsson. (n.d.a). 5G vs 4G, Available online: https://www.ericsson.com/en/5g/5g-vs-4g [Accessed 11 April 2022]

Ericsson. (n.d.b). 5G by Ericsson, Available online: https://www.ericsson.com/en/5g [Accessed 11 April 2022]

Ericsson. (n.d.c). T-Mobile Pursues a Multi-Band 5G Spectrum Strategy, Available online: https://www.ericsson.com/en/reports-and-papers/mobility-report/articles/t-mobile-5g-spectrum [Accessed 12 April 2022]

Ericsson. (n.d.d). Pioneering a Sustainable Future, Available online: https://www.ericsson.com/en/about-us/new-world-of-possibilities/pioneering-a-sustainable-future [Accessed 13 April 2022]

Ericsson. (n.d.e). About us, Available online: https://www.ericsson.com/en/about-us#:~:text=About%20us,-Available%20in%20English&text=Ericsson%20is%20one%20of%20the,in%20a%20fully%20connected%20world [Accessed 13 April 2022]

Ericsson. (n.d.f). The Problematic Mobile Phone Sector, Available online: https://www.ericsson.com/en/about-us/history/changing-the-world/the-future-is-now/the-problematic-mobile-phone-sector [Accessed 16 April 2022]

European Commission. (2020). Europe Shaping 5G Vision, Available online: https://ati.ec.europa.eu/news/europe-shaping-5g-vision [Accessed 18 April 2022]

Exponential Roadmap Initiative. (2022). Halving Emissions Before 2030 Through Exponential Climate Action and Solutions, Available online: https://exponentialroadmap.org/ [Accessed 18 May 2022]

Fireman, M. (2019). Monetize 5G and IoT Business Models, Available online: https://www.ericsson.com/en/blog/2019/10/monetize-5g-and-iot-business-models [Accessed 20 May 2022]

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative inquiry*, vol. 12, no. 2, pp.219-245

Fox, W.M. (1995). Sociotechnical System Principles and Guidelines: past and present, *The Journal of applied behavioral science*, vol. 31, no. 1, pp.91-105

Geels, F.W. (2002). Understanding the Dynamics of Technological Transitions. A Co-Evolutionary and Socio-Technical Analysis

Geels, F.W. (2004). From Sectoral Systems of Innovation to Socio-Technical Systems: Insights about dynamics and change from sociology and institutional theory, *Research policy*, vol. 33, no. 6-7, pp.897-920

Geels, F.W. (2005). Technological Transitions and System Innovations: a co-evolutionary and socio-technical analysis, Cheltenham: Edward Elgar Publishing

Geels, F.W. (2006). Multi-level Perspective on System Innovation: Relevance for industrial transformation, *Understanding Industrial Transformation,* Dordrecht: Springer, pp.163-186

Geels, F.W. (2018). Socio-Technical Transitions to Sustainability, *Oxford Research Encyclopedia of Environmental Science*

Geels, F.W. & Kemp, R. (2007). Dynamics in Socio-Technical Systems: Typology of change processes and contrasting case studies, *Technology in society*, vol. 29, no. 4, pp.441-455

Geroski, P. A. (2000). Models of Technology Diffusion, *Research Policy*, vol. 29, no. 4-5, pp.603–625

GlobeScan. (2021). SustainAbility Survey 2021 Sustainability Leaders, Available online: https://bit.ly/3ueyZP4 [Accessed 18 May 2022]

Gosling, J., & Mintzberg, H. (2003) The Five Minds of a Manager, *Harvard Business Review*, Available online: https://hbr.org/2003/11/the-five-minds-of-a-manager [Accessed 5 May 2022]

Government of Sweden. (2009). ICT and Energy Efficiency in Sweden, Available online: https://www.government.se/contentassets/f496d0e0cc864e8fa57b22ea247a829e/report-ict-and-energy-efficiency-in-sweden [Accessed 18 May 2022]

Grant, R.M. (2021). Contemporary Strategy Analysis, 11th edn, New York: Wiley & Sons

Gupta, K., & Effraimidis, G., Environmental Sustainability and a Greener Economy: The Transformative Role of 5G, *Qualcomm*, Available at: https://www.qualcomm.com/content/dam/qcomm-martech/dm-

assets/documents/5g_and_sustainability-_the_transformative_role_of_5g_-_10.4.2021.pdf [Accessed 10 April 2022]

Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., Smits, R.E.H.M. (2007). Functions of Innovation Systems: a new approach for analysing technological change, *Technological Forecasting and Social Change,* vol. 74, pp.413–432

Hilty, L., Lohmann, W. & Huang, E.M. (2011). Sustainability and ICT-an Overview of the Field, *Notizie di POLITEIA*, vol. 27, no. 104, pp.13-28

Hilty, L.M., Arnfalk, P., Erdmann, L., Goodman, J., Lehmann, M. & Wäger, P.A. (2006). The Relevance of Information and Communication Technologies for Environmental Sustainability–a prospective simulation study, *Environmental Modelling & Software*, vol. 21, no. 11, pp.1618-1629

Hoogma, R., Kemp, R., Schot, J., & Truffer, B. (2002). Experimenting for Sustainable Transport: The Approach of Strategic Niche Management, London: Spon Press

How Exactly Does 5G Work? | Upscaled. (2020). YouTube video, added by Engadget [online], Available at: https://www.youtube.com/watch?v=9EgXz1CEfQw&t=197s [Accessed 15 April 2022]

Huberman, A.M. & Miles, M.B. (1984). Qualitative Data Analysis, Beverly Hills: Sage

Hughes, T.P. (1983). Networks of Power: Electrification in Western Society, 1880-1930, Baltimore and London: Johns Hopkins University Press

Hughes, T.P. (2012). The Social Construction of Technological Systems: New directions in the sociology and history of technology, Massachusetts: The MIT Press, pp.45-76

Hui, H., Ding, Y., Shi, Q., Li, F., Song, Y., Yan, J., (2020). 5G Network-Based Internet of Things for Demand Response in Smart Grid: A Survey on Application Potential, *Applied Energy*, vol. 257

Intergovernmental Panel on Climate Change (IPCC). (2021). Climate Change 2021: The Physical Science Basis, Available online: https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/ [Accessed 18 May 2022]

Kahneman, D. (2011). Thinking, Fast and Slow, New York: Farrar, Straus and Giroux

Kegan, R., & Lahey, L. L. (2001). The Real Reason People Won't Change, *Harvard Business Review*, Available online: https://hbr.org/2001/11/the-real-reason-people-wont-change [Accessed 15 May 2022]

Kemp, R., Rip, A., & Schot, J. (2001). Constructing Transition Paths Through the Management of Niches, in R. Garud, P. Karnoe (Eds), *Path Dependence and Creation*, Mahwah: Lawrence Erlbaum Associates, pp. 269-299

Kemp, R., Schot, J. & Hoogma, R. (1998). Regime Shifts to Sustainability Through Processes of Niche Formation: the approach of strategic niche management, *Technology Analysis & Strategic Management*, vol. 10, no. 2, pp.175-198

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime Shifts to Sustainability Through Processes of Niche Formation: the approach of strategic Niche management, *Technology Analysis and Strategic Management,* vol. 10, pp.175–196

Kim, D. H. (2018). Introduction to Systems Thinking, Available online: https://thesystemsthinker.com/introduction-to-systems-thinking/ [Accessed 14 May 2022]

Köhler, J., Whitmarsh, L., Michie, J. and Oughton, C. (2008). Can Car Makers Save the Planet?, in T. J. Foxon, J. Köhler and C. Oughton (eds), *Innovation for a Low Carbon Economy*, Cheltenham: Edward Elgar

La Porte, T.R. (1991). Responding to Large Technical Systems: Control or Anticipation, Dordrecht: Kluwer Academic Publishers

Levinthal, D. A. & March, J. G. (1993). The Myopia of Learning, *Strategic Management Journal,* vol. 14, pp.95-112

Malerba, F. (2002). Sectoral Systems of Innovation and Production, *Research policy*, vol. 31, no. 2, pp.247-264

Malmodin, J. & Lundén, D. (2016). The Energy and Carbon Footprint of the ICT and E&M Sector in Sweden 1995-2015 and beyond, *Advances in Computer Science Research*, pp.209-218

Malmodin, J., & Bergmark, P. (2015). Exploring the Effect of ICT Solutions on GHG Emissions in 2030, *Advances in Computer Science Research*, vol 29, pp. 37-46

Markovic, D.S., Zivkovic, D., Cvetkovic, D. & Popovic, R. (2012). Impact of Nanotechnology Advances in ICT on Sustainability and Energy Efficiency, *Renewable and Sustainable Energy Reviews*, vol. 16, no. 5, pp.2966-2972

MIT Technology Review Insights. (2020). The 5G Operator: Platform, Partnerships, and IT Strategies for Monetizing 5G, Available online: https://www.ericsson.com/assets/local/digital-services/doc/the5goperator.pdf?_ga=2.153986680.116029196.1653383984-1444030776.1649238533 [Accessed 20 May 2022]

MIT Technology Review Insights. (2021). Decarbonizing Industries with Connectivity & 5G. Available at: https://www.ericsson.com/4a98c2/assets/local/about-ericsson/sustainability-and-corporate-responsibility/environment/mit-technology-review-decarbonizing-industries-with-connectivity-and-5g.pdf [Accessed 16 April 2022]

Mokyr, J. (1990). Punctuated Equilibria and Technological Progress, *The American Economic Review*, vol. 80, no. 2, pp.350-354

Mont, O., Lehner, M., & Heiskanen, E. (2014). Nudging. A Tool for Sustainable Behaviour?, *Swedish Environmental Protection Agency*, report 6643

Nelson, R.R., & Winter, S.G. (1982). An Evolutionary Theory of Economic Change, Cambridge: Belknap Press

Nemet, G. (2008). Demand-Pull Energy Technology Policies, Diffusion and Improvements, *Innovation for a Low Carbon Economy: Economic, Institutional and Management Approaches*, p.47

Nokia. (2022). Network Slicing Explained, Available online: https://www.nokia.com/about-us/newsroom/articles/network-slicing-explained/ [Accessed 15 April 2022]

Osseiran, A., Monserrat, J. F., & Marsch, P. (2016). 5G Mobile and Wireless Communications Technology, Cambridge: University Printing House

Osseiran, A., Parkvall, S., Persson, P., Zaidi, A., Magnusson, S., & Balachandran, K. (2020). 5G Wireless Access: An Overview, *Ericsson White Paper,* Available online: https://www.ericsson.com/en/reports-and-papers/white-papers/5g-wireless-access-an-overview [Accessed 13 April 2022]

Perez, C. (2010). Technological Revolutions and Techno-Economic Paradigms, *Cambridge journal of economics,* vol. 34, no. 1, pp.185-202

Polman, P. (2014). Business, Society, and the Future of Capitalism, *McKinsey Quarterly*, vol. 1

Polman, P. & Winston, A. (2021). Becoming a Courageous, Net Positive Leader, *Leader to Leader*, vol. 2022, no. 103, pp.25-30

Punch, K.F. (2005). The Analysis of Qualitative Data, *Introduction to Social Research Quantitative and Qualitative Approaches*, 2nd edn, London: Sage, pp. 171-216

Qualcomm. (n.d.). Everything You Need to Know About 5G, Available online: https://www.qualcomm.com/5g/what-is-5g [Accessed 16 April 2022]

Raworth, K. (2017). Doughnut Economics: Seven ways to think like a 21st-century economist, Chelsea: Green Publishing

Rennings, K. (2000). Redefining Innovation—Eco-Innovation Research and the Contribution from Ecological Economics. *Ecological economics*, vol. 32, no. 2, pp.319-332

Rogers, E. M. (2003). Diffusion of Innovation, 6th edn, New York: The Free Press

Rotmans, J., Kemp, R. & Van Asselt, M. (2001). More Evolution Than Revolution: transition management in public policy, *foresight*, vol. 3, no. 1, pp.15-31

Roxburgh, C. (2009). The Use and Abuse of Scenarios, McKinsey Quarterly, no. November, pp.1–10

Schot, J. (1998). The Usefulness of Evolutionary Models for Explaining Innovation. The case of the Netherlands in the nineteenth century, *History and Technology,* vol. 14, no. 3, pp.173-200

Schot, J., Hoogma, R. & Elzen, B. (1994). Strategies for Shifting Technological Systems: The case of the automobile system, *Futures*, vol. 26, no. 10, pp.1060-1076

Schumpeter, J. (1911). The Theory of Economic Development, *Harvard Economic Studies,* vol. XLVI

Schumpeter, J. (1954). History of Economic Thought, London: George

Sekaran, U. & Bougie, R. (2016). Research Methods for Business: A skill building approach, 7th edn, Chichester: John Wiley & Sons

Shehab, M. J., Kassem, I., Kutty, A. A., Kucukvar, M., Onat, N., & Khattab, T. (2021). 5G Netowrks Towards Smart and Sustainable Cities: A Review of Recent Development, Applications and Future Perspectives, *IEEE Access*, vol 10, pp. 2987-3006

Smith, A., Stirling, A., & Berkhout, F. (2005). The Governance of Sustain-able Socio-Technical Transitions, *Research Policy,* vol. 34, pp.1491–1510

Smith, A., Voß, J.P. & Grin, J. (2010). Innovation Studies and Sustainability Transitions: The allure of the multi-level perspective and its challenges, *Research policy*, vol. 39 no. 4, pp.435-448

Smith, D. (2015). Exploring Innovation, 3rd edn, Berkshire: McGraw-Hill

Summerton, J. (1994). Introductory Essay: The Systems Approach. Changing large technical systems, pp.1

Swann, G.P. (2014). The Economics of Innovation: An Introduction, Cheltenham: Edward Elgar Publishing

Systems Thinking. (2015). YouTube video, added by Systems Innovation [online], Available at: https://www.youtube.com/watch?v=Miy9uQcwo3U&list=PLsJWgOB5mIMBinjH9ZAbiWiVxsizC5mU_&index=3 [Accessed 28 April 2022]

The Government of Sweden. (2010). ICT and Energy Efficiency in Sweden, Available online: https://www.government.se/contentassets/f496d0e0cc864e8fa57b22ea247a829e/report-ict-and-energy-efficiency-in-sweden [Accessed 18 May 2022]

The Science of Thinking. (2017). YouTube video, added by Veritasium [online], Available at: https://www.youtube.com/watch?v=UBVV8pch1dM [Accessed 14 May 2022]

Tidd, J., & Bessant, J.R. (2014). Strategic Innovation Management, Chichester: Wiley

Van de Poel, I. (2003). The Transformation of Technological Regimes, *Research policy*, vol. 32, no. 1, pp.49-68

Vlaskovitz, P. (2011). Henry Ford, Innovation and that "Faster Horses" Quote, *HBR Network Blog*, Available at: http://blogs.hbr.org/2011/08/henry-ford-never-said-the-fast/ [Accessed 18 May 2022]

Weber, M. & Hemmelskamp, J. (2005). Merging Research Perspectives on Innovation Systems and Environmental Innovation: An introduction, In Towards Environmental Innovation Systems, Berlin: Springer, pp.1-7

West, D. M. (2016). Achieving Sustainability in a 5G World, Massachusetts: Center for Technology Innovation at Brookings

Yin, R. (2009). Case Study Research: Design and Methods, 4th edn, Thousand Oaks: Sage Publications

7 Appendix

7.1 Appendix A. Interview Guide

Instructions: Interviewees are required to follow steps A-C in a scripted manner.

A. Introduce thesis topic

- This thesis looks into what strategies managers at Ericsson are using to influence the socio-technical transition towards more sustainable 5G.
- The researchers are curious about understanding the role which managers play in making 5G more widely available and readily available on the market.
- We are curious to learn more about the environment which the manager operates in as well as the opportunities and challenges presented in making sustainable 5G more widely available.
- Do you have any questions before we get started?

B. Ask for verbal consent (Yes/No)

- I understand the information about this thesis and I have been given the opportunity to ask questions about the project.
- I hereby voluntarily agree to participate in the project.
- I understand that I can withdraw at any given time without giving reason.
- I hereby agree to the data being used in research and publication.
- I allow for my name and my position to be used throughout the report.
- I hereby allow this interview to be recorded for the purpose of providing data for the interviewees' thesis.

C. List of interview questions

1. What's your role at Ericsson? How does your work align with topics of sustainability and innovation?

2. What does your ideal 5G world look like? How does Ericsson get there and which steps are you taking to get there?

3. What are the windows of opportunity for you as a manager when enforcing sustainable 5G?

4. In your work, what is the biggest challenge for diffusing sustainable 5G?

5. Can you describe what kind of stakeholders (internal/external) you interact with in your work? (when diffusing 5G)

6. Which work practices or methods do you feel help the most in diffusing 5G (making 5G more widely available in our systems)?

7. ICT industry is a double-edged sword with positive (e.g. connectivity) and negative impacts (e.g. e-waste, inequalities in terms of access to technology). Some scholars argue that they cancel each other out. What's your stance on this? How is Ericsson trying to solve the negative impacts of ICT, what role do you have in this issue?

8. What actions are managers at Ericsson pursuing to become more net-zero?

9. Do you have any other contacts at Ericsson that we could interview on the same topic?

7.2 Appendix B. Interviewees

This list provides information on the interviewees interviewed at Ericsson.

Name	**Position**	**Duration (min)**
Jonas	Head of Innovation and Sustainability	60
Shampa	Business Developer and Ecosystem Manager	60
Erik	Engagement Lead	60

7.3 Appendix C. Themes identification

This chart provides quotes paired with the themes identified from the qualitative data.

Themes	**Jonas**	**Shampa**	**Erik**
Behavioural/ organizational change	"What we have done so far is to treat the technology, as an improving technology, as an enabler, which we can hand over to people, companies, and societies that are going to use it. Now, if we should understand the requirements of what a network should be able to do, we need to learn from those players. That is what we're doing. Therefore, we are actively engaging with all other industries that's not part of the traditional core. I mean, Ericsson's core customers are the mobile operators, and then they also have customers. If we're going to understand how a flexible manufacturing site or the future of semi-autonomous vehicles behave, we need to work with them. That's the ideal world where we can act as an enabler, bring it to the right partners, and then get active in working with the people, understanding their reality, and then jointly come up with disruptive solutions to solve problems. Then I'm sure that evolution will continue." "It's a behavioural change as well. We are working a lot with that. What does it mean for me, as an Ericsson employee in Gothenburg, to be part of that transition towards a more sustainable or save the world sort of environment? We're working with one of the start-ups called carbon cloud, which is measuring the CO2 impact on all the food dishes. Not only how many calories you eat, but every dish that is on the lunch display is also telling you what the most climate friendly alternative is. By bringing that information there is stronger awareness of sustainable options, which creates a little nudging effect that hopefully gets many people to reconsider their options."	N/A	N/A
5G as an emerging innovation	N/A	"It's our job to help explain what 5g is, but also what it is potentially not". "I think some of the limits of the technology, we won't even know until we have created 5G. We won't know what you can do with it until we try."	"5G's technology is more advanced than the market is at the moment and that is why it is important to educate the customer on what 5G can enable. With all the possibilities for the diffusion of innovative services, new ways of organizing capabilities in society, new business models and so on, I think that will take a few years because before we see the results of that"
Hindering factors	N/A	"We work with partners through traditional channels. It's difficult to find a new way of engaging with existing customers that's not transactional. Traditionally, we go in and we're like, this is our list of products, just mark which ones you	"I would say my biggest fear is that 5g would be treated as a consumer technology and not so much in industry." "Ericsson has a history of in the last 10-15 years focusing on that our customer should make money all the time. That hinders

		want, and then we'll provide customer service. But when you're talking about innovation, we don't have these products, we're in the process of developing them." "What happens with the technology is a little bit out of our hands because we develop the tool, and we maintain the tools so that it is always working. That's where sometimes with the projects we have a hard time when we talk to customers. We are very far down the value chain, like we are suppliers. And we are essentially working on a utility. It's like supplying water, what you do with that water, I can't know."	some type of development, because then you listen to the customer and they always want technology cheaper, and much more efficient. We create that, but I think we need to think bigger than our technology and see it as a potential game changer for the sustainability of the planet." "I think the biggest risk is that we are looking at our technology in isolation that we make 5g extremely efficient, we have a circular economy, bringing back the base stations to recycle, we aim for more and more software instead of hardware. So, it becomes an isolated thing, just like all enterprises are looking at their carbon footprint with business travelling. It becomes just a small part. But I think technology companies like Ericsson, and other big technology companies around the world, can use digital technology in a different way to see it as a platform for our own innovation and other parties' innovation, and support more sustainable innovation. Not only our core technology, but our technology as a platform for creating new types of solutions."
Role of institutions	"(Policy and legislation is a) barrier in the sense that it can definitely hold back some sort of commercial implementation or the upscaling of things... Certain types of policies need to be aligned with fast-paced innovation." "In some cases, you have structural sort of legacy. ... For example, we have been working on self-driving cars for quite some time and in order to drive and you normally measure how autonomous the self-driving cars are on a scale from one to five where five is completely autonomous and one is basically nothing ... but in order to actually scale up tests, there is isolation and a great deal of regulations that are not always in sync with the technology developments being done."	"Policy for the different sectors, like education and healthcare, make it difficult to scale technology. We've been hearing for a long time that there are no incentives there really."	N/A
Role of knowledge sharing	"What we have done so far is to treat the technology, as an improving technology, as an enabler, which we can hand over to people, companies, and societies that are going to use it. Now, if we should understand the requirements of what a network should be able to do, we need to learn from those players. That is what we're doing. Therefore, we are actively engaging with all other industries that's not part of the traditional core. I mean, Ericsson's core customers are the mobile operators, and then they also have customers. If we're going to understand how a flexible manufacturing site or the future of semi-autonomous vehicles behave, we need to work with them. That's the ideal world where we can act as an enabler, bring it to the right partners, and then get active in working with the people, understanding their reality, and then jointly come up with disruptive	"We work with our competitors, like Huawei and ZTE, to make the platform more seamless. we have always maintained that communication should be available to all and it's a democratic form of communicating. It's like having water, everybody should have access to potentially being able to communicate in a seamless manner. It should be free, as much as possible for the end user and cheaper."	"I work with business development that is key to our networks, where you need to educate the customer on what 5g can enable. At the same time, you need to understand the enterprise, what their pain points are, and looking into more futuristic stuff. What could come within two, three years, or if you can combine our technology with a start-up technology. What kind of services could you create that the customer is not aware of, and maybe shouldn't be aware of, because they should focus on their business?" "There is a responsibility of our industry to listen and educate the users. I would say my biggest fear is that 5g would be treated as consumer technology and not so much in the industry."

	solutions to solve problems. Then I'm sure that evolution will continue.”		
Mindsets	“It (sustainability initiatives) has this sort of ripple effect, but it must start with information and then a desire to change something. That is also now being done at the top level of Ericcson. It's been on our CEO's agenda for a while and I know it's not just empty words. Now I can see that trickling down to the levels beneath him... So, it's asking about what managers are doing. I think it's a lot about being a role model and stating that it does make a difference.”	“We are very much set in our ways internally, as well as the external partners. We only know how to work in a certain way, and that is still very profit driven. We've been working for the past 70 years since World War II, and I think the biggest challenge is changing habits and changing mindsets of what we can do. And I think 5G is not only a question of what 5G can unlock, but also a question of what you can do? What are you chasing? Is it really selling more and more things? And I think the issue when it comes to sustainable practices, in general, or working more on the preventive side is, at the end of the day money driven.”	“Now we are focusing on technology leadership. We are focusing on our core offering but we tend to forget that we are extremely innovative. We do lots of innovation in our core business. I think we are missing out on fantastic opportunities because, if you have a solution, it always starts small and then it has a tendency of dying, because it doesn't affect the result of Ericsson’s finances. We don't see long term investments. We don't make big bets on the future except our core offerings.”
Partnerships	“Scope 3 emissions are indirect emissions, which is a more difficult thing, because you are dealing with the emissions of external companies and suppliers (e.g. from goods and services, capital goods, fuel, energy, transport, distribution, waste in operations, etc.) ... We're working with the closest couple of 100 suppliers to actually have them sign up to the same ambition to reduce emissions or work with them to make that happen.” “We have cross industry initiatives, like the Exponential Roadmap or the 1.5 Degree Playbook, bringing together the ICT as a collective to meet the Paris Agreement. There is a way forward and the idea here is to halve emissions every decade. Ericsson has signed up for this kind of collaboration and I’ve done some of the initial work here. By collecting an assembly of ICT based solutions, of things that are available, and we scale these up – then we have the opportunity to reduce global emissions by 15% even though the ICT is just responsible for 1.4% of emissions. ”	“Our internal accelerator, copied very much from the outside world, takes project ideas through three investment stages. The investor in this case is Ericsson itself. So you'll start with a small sum and maybe 10% of your time as an employee, exploring this new idea that you might have. Then when the idea grows a little bit, and we think it has potential, you get a little bit more so that you can develop a minimum viable product, maybe we'll help you connect to other colleagues within Ericsson .... And take it into the last stage for a sizable investment where you present it in front of the heads of our various organization - like the VP level, right under Börje Ekholm (Ericsson’s CEO)” “So the ideal 5g world (A) unlocks collaboration, but it also (B) only going to be unlocked through collaboration.”	N/A
Niche interaction	N/A	“Right now, the biggest opportunity is with the operators like Ooredoo who are going to cover the World Cup games and create the first fully 5G enabled stadium to make the games come alive ... A lot of these opportunities are low hanging fruits. These are customers we already work with. They're not necessarily in sectors I personally feel are going to make the biggest impact when it comes to some of the most urgent problems we have in the world that need solving. ... Most of them I feel are through traditional channels, which are operators who are going to take this technology out to the end-users and then together with the end-users unlock what 5G is capable of. I am not a big fan of low hanging fruits though. I think we	“We are focusing on our core offering, but we tend to forget that we are extremely innovative. I think we are missing out on fantastic opportunities... so far, we have a tendency of being quite tightly connected to our core business, instead of seeing the bigger picture on our core capabilities and that we could actually move into a totally different area with our core knowledge. Sometimes I ask myself, am I stupid, or is the rest of the organisations stupid?”

		need to work harder to get what the world needs, trying to get this (5G) into places where it's not going to be a "natural fit", where maybe 3G or 4G didn't even really flourish, for instance within elderly care." "At the end of the day, it's money driven. We have to just be more creative and think of ways of doing things that that are very different for how we've done things before, but that's very tough and working for Ericsson. Smaller companies can be a bit more agile. For bigger companies it's more difficult to be agile, no matter how much the leadership wants it to be, it's more difficult to switch things around. No matter how good the culture is and how driven it is, it's tough, the structure is tough. The whole shareholder driven structure that we have in the industry right now is making it hard to push sustainable practices in general."	
Landscape interaction	N/A	N/A	"When we approach the users, in our case being enterprises, I see they are more and more concerned about sustainability because they know that they need to be much more sustainable to be an attractive employer. We see this movement through the rise of green bonds as well. There is a global movement that will open opportunities for that type of solution, because suddenly it is a matter of survival. If we are not doing it, we have a risk on our ROI and risk of irrelevance. So, to stay relevant, we need to be much more engaged and much more innovative in sustainability solutions." "I think this planet has bigger problems that can be solved by 5G, such as poverty, food production, fake news, climate change, climate disasters and so on."
Regime interaction	N/A	"We've had seven projects come out of this entire pipeline, we've had about 120 projects go in through the process and drop out at various stages ... For instance, one we closed due to various problems with the supply chain and not being able to develop, the timing was totally off and customers wanted it, but we couldn't really meet the speed at which to deliver." "It'll be a while before the structural changes take place and you can't do it in a silo, Ericsson enforcing these changes within is only going to go so far. This is something that needs to happen across."	"I think (the diffusion of) 5G is still quite immature. So far, it has mainly provided a bit of speed for your mobile phone. That has been driven by operators to show how faster networks are. I think in the next coming years, you will see much more good use cases on how you utilise the full power of 5G to make things differently. ... It's a combination of the maturity of the end users as well as what the capabilities of the technology that needs to be matched. 5G as a technology is more advanced than the market is for the moment and that is why I talk about educating others on what all the possibilities are with this technology to stir the diffusion of innovative services, new ways of organising capabilities in society, new business models and so on. I think it will take a few more years before we see the results of that."