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Governing Urban Transformation: The case of Kiruna in Northern Sweden

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Summary

This research studies the urban transformation in Kiruna in Northern Sweden and aims to explain how the governance processes in the last thirty years have led to the town's relocation and economic restructuring to a diverse economy.

After studying theories that explain urban governance and urban transformation, including relocation and economic restructuring and their underlying theories such as transformation paths and (un)related diversification, we assume that transition management theory might offer an explanation to the urban governance leading to transformation.

The research is designed as a qualitative embedded-case study, using a three-step analysis method including process tracing, qualitative co-variational analysis, and congruence analysis. The data for this analysis was collected from semi-structured interviews with key-experts and from secondary data. This approach has been used to infer causality between urban governance and transformation.

The results of this study propose that there were three pathways of urban transformation. These pathways have different indications of self-organization, public private partnerships, and network governance, with some overlap in between them. The analysis has indicated that two governance approaches have resulted in two different forms of restructuring; the more networked governance has led to a high-tech economy related by technology and knowledge, while self-organization has led to the growth of the low-tech tourism sector. Analysis showed that the relocation was a result of a public private partnership, with a participatory approach.

The findings of the research show that transition management theory does not explain the governance of transitions in Kiruna, although its indicators fit the TM framework. Findings also suggest that the change in Kiruna is more incremental than transformational.

Because this case study is unique and its transformation is dominated by powerful actors, the research concludes by proposing to compare the finding with other context-specific case studies, in order to develop the transition management theory further.

Keywords

Mining, Space, Economic Restructuring, Urban Relocation, Transition Management

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I would like to dedicate this thesis to my partner and my second family in the Netherlands, who supported me unconditionally when I needed it the most.

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Foreword

This thesis was written for my master's in Urban Management and Development with specialization in Urban Competitiveness and Resilience. When I first heard of Kiruna, I thought it was a small touristic town being moved away, but with a little research I discovered that it is a space hub, it has the largest mines in the world, and is working to launch the first commercial spaceflights. This discovery motivated me to study Kiruna's urban transformation, especially that this topic is very relevant my major and specialization; it covers a very complex process of relocation and economic restructuring, and focuses on a wide range of interesting theories of urban governance and evolutionary economies.

With all the uncertainties faced throughout this period, writing this thesis was made possible by the continuous support of my supervisor Dr. Jan Fransen, the support of my family and friends, and the extraordinary cooperation of the experts from Kiruna. I would like to thank everyone who has encouraged me to complete this research and kept me motivated.

I hope you enjoy this research and learn more about Kiruna and its unique urban governance and transformation.

Katia Zahwi

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Abbreviations

IHS	Institute for Housing and Urban Development Studies
UMD	Urban Management and Development
UCR	Urban Competitiveness and Resilience
LKAB	Luossavaara-Kiirunavaara Aktiebolag
IRF	Swedish Institute of Space Physics (Institutet för rymdfysik)
EU	European Union
LTU	Luleå University of Technology (Luleå tekniska universitet)
UMU	Umeå University
SSC	Swedish Space Corporation
TM	Transition Management
IV	Independent Variable
DV	Dependent Variable

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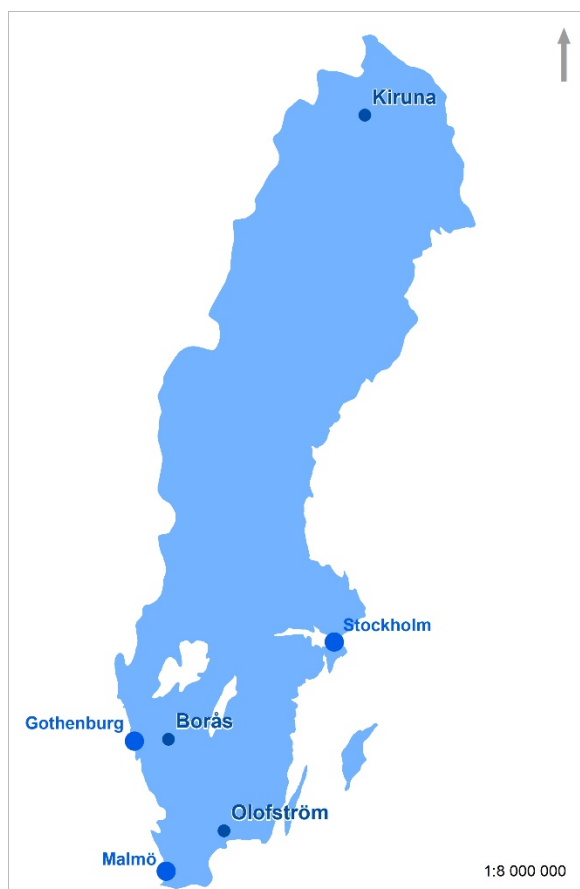
Chapter 1: Introduction

This study addresses the unique case study of a city undergoing spatial and economic restructuring, namely Kiruna in Northern Sweden. It aims to contribute to a growing body of work that studies contemporary urban transformations. By explaining the governance processes that have led to this transformation, and examining the relationship between spatial and economic restructuring, it becomes possible to examine which urban governance theory best explains the complex urban transformation of this town, which also serves policy-makers working in urban transitions. Knowing that the town is undergoing transformation due to the mining activities, and is diversifying its mining-dependent economy, this study also contributes to research bodies on the discourse of evolutionary economies, specifically path-dependency and lock-ins.

The sections below in this chapter, explain the rationale behind choosing the case study and the problem statement. They provide the background information about the case of Kiruna, focusing on its evolution and its recent radical urban transformation. This chapter explains why this case study is academically and professionally relevant. It includes the main research objectives, research question and sub-questions, and concludes with the conceptual framework that guided the study and a brief structure of the research.

1.1 Background

Figure 1: Map of Sweden showing the location of Kiruna



Source: acore-project.eu, 2020

Kiruna is an arctic town located in the northern part of Sweden. It has a population of approximately 23 thousand inhabitants (Kiruna Municipality, 2020). The city was established for mine extraction in 1890 by the state-owned private mining company LKAB (Luossavaara-Kiirunavaara Aktiebolag) who operated as the main employer in the area for a long time. In fact, Hjalmar Lundbohm's, the first manager of the mining company, is widely acknowledged as the founder of the town (Kiruna Municipality, 2020). Today, the town sits over the world's largest underground iron-ore mine (Nilsson, 2010).

The underground mine was 4 kilometres in length and around 2 kilometres in depth and was to continue expanding in volume in the upcoming decades (Nilsson, 2010). Luckily, the mining industry had not had any significant impacts on the infrastructure of the town, until 2004, when the LKAB realized that the inevitable continuation of mining would result in major threats to the physical infrastructure of the city center. This was a starting point for the urban transformation of Kiruna. In that year, LKAB informed the Kiruna municipality of the need to relocate the city center elsewhere (Kiruna Municipality, 2020). Between 2007 and 2013, stakeholders worked with the community to decide on the new location of the town and the to design the new city-center. In 2014, the new construction began with LKAB pledging an investment of 415.5 million euros. The relocation is expected to be completed by 2035, with the relocation of around 5000 households, representing one third of Kiruna's centre (Kiruna Municipality, 2020).

Figure 2: Map showing the relocation plan of Kiruna



Source: Insider.com, 2016

Besides being a mining-town, Kiruna accommodates many touristic activities such as midnight sun watching, snowmobiling, ice-hotel visits, skiing, hiking, aurora watching, mine tours, etc. due to its special location in the arctic (Nilsson, 2010). With time, these locational assets have triggered the emergence of two new industries: Space and tourism. There are many residents who work in seasonal and year-round tourism in Kiruna, which represents a source of livelihood for many households. Moreover, Kiruna has become well known for its space research and industry ever since the 1950s and 1960s when the “Swedish Institute of Space Physics” (IRF) and the Swedish Space Corporation (SSC) were built in the town for space research and rocket launching.). Space in Kiruna has been long focused on research and industry, until “Spaceport Sweden” was established in 2005 as an initiative to promote commercial flights to space and high-tech space-research in Kiruna (Spaceport Sweden, 2020).

The town is expected to become Europe's first hub for commercial spaceflight, as many space-related companies are locating in the town such as the British company "Virgin Galactic", due to the space and tourism related skills in the town (Kiruna Municipality, 2020).

In the past 30 years, the municipality of Kiruna has been working on strengthening its local economy, by focusing space education, industry, and year-long tourism (Nilsson, 2010). Today, the operations of the diverse economic activities are creating opportunities for innovative industries to emerge. This includes testing operations, such as the testing of the newest car models by brands like Renault, Volvo, Jaguar, and Aston Martin, as well as businesses related to space innovation and others (Kiruna Municipality, 2020).

1.2 Problem Statement

The urban transformation of the arctic town Kiruna represents a complex case-study of rapid economic restructuring and spatial relocation. While there are plenty of cases that focus on economic restructuring of cities or their urban re-invention, this case is unique because it combines the two processes over a period of 30 years. The shift from a single-industry economy (mining-industry) towards a diversified economy carries several socio-economic implications on the local and national labour market. Additionally, the municipality of Kiruna (2020) estimates that around 3000 new homes and 1000 new office spaces are needed as part of the spatial relocation, which will certainly have an impact on the local community and economy.

Although the Kiruna Municipality is the main formal governance body in Kiruna, it is impossible to disregard the strong position of mining company LKAB in decision making, and the complexity of other actors involved in the urban transformation, such as the IRF, SSC, universities, private businesses and the government. Given the complicated roles and levels of actors involved, the transformation leaves administrative and financial burdens on decision-makers, making the urban governance process more interesting from a management and decision-making perspective. By considering the transformation as an evolutionary process, it is critical to analyse the urban governance that has led to the spatial and economic shift of this path-dependent arctic town.

1.3 The relevance of the research topic

Despite the significant number of theories on urban governance (Campbell, Hollingsworth, and Lindberg, 1991; Healey et al., 1995; Rhodes, 1997; Pierre, 1999; Stoker, 2000; Castells, 2000; Klijn and Koppenjan, 2007; Edelenbos et al., 2008; Edelenbos and Teisman, 2013; van Dijk and Edelenbos, 2017) there seems to be a lack of literature focusing on governance of complex urban transformations. Most existing literature either focuses on describing governance in case studies focusing on economic restructuring processes (Chorianopoulos, 2002; Wu, 2002; Kratke, 2004; Schroder and Waibel, 2012; Zielke and Waibel, 2012) individually or managing spatial relocation (Rosenfeld, 2013; Tang, 2019). There, also, seems to be a shortage of case studies explaining how urban governance has led to urban transformation (Aarsaether et al., 2011; Degen and Garcia). This study is significant because it helps in understanding the how different types of transformation result from governance in the same context. Therefore, from an academic perspective, this study contributes to research on urban governance of complex urban transformation.

By comparing the two cases of transformation, this research also aims to close the theoretical gap found in studies over relocation processes, knowing that most empirical research on the process tend to examine the pre-conditions and the immediate outcomes of relocation instead of understanding the process involved (Kearns and Mason, 2013).

Additionally, this research contributes to a growing body of theory that link urban governance to urban transformation, such as transition management theory, which theorists (Kemp et al., 2007; Loorbach, 2010), consider vague and in need of validation through further empirical research in different contexts. This research would therefore contribute to the scientific validation of transition-management theory.

This research offers an additional case study for evolutionary economic theories, that focus on transformation paths and lock-ins (David, 1985; MacKinnon, 2008; Chaminade et al., 2019, knowing that urban development theory suggests that urban economic and spatial development are both path dependent. This case-study also adds to the empirical evidence of relatedness - or unrelatedness - in diversification (Hidalgo et al., 2007; Franken et al., 2007, Boschma and Capone, 2015) as a dimension of economic restructuring and adds to the scientific debate on whether diversification is emergent or targeted (Tykkyläinen et al., 1995; Berkhout et al., 2004; Grin et al., 2010).

Although the context is quite unique, relocation and economic restructuring are becoming more frequent today. Due to challenges posed by climate change and natural disasters, fast-changing economies, and pandemics, more cities will choose, or be forced to relocate and/or restructure their economies to be more resilient. This will require policymakers and urban managers to familiarize with recent theories and frameworks that link urban governance to transitions, such as transition management theory. This research provides practitioners with an example and an analysis of an ongoing urban transformation. This study may help urban managers and decision-makers working in governing transient cities, to improve their governance frameworks and take better long-term decisions that serve the transformation process.

1.4 Research Objectives

The main objective of this research is to explain how governance processes led to the complex urban transformation of Kiruna and to apply governance theory on the case study. Based on this main objective, in details, the research aims to:

- Explain the governance processes that have led to economic restructuring
- Understand whether the economic restructuring process is planned or self-organized
- Explain the governance processes that have led to spatial relocation
- Test whether transition management TM theory is applicable to the urban transformation of Kiruna

1.5 Main research question and research sub-questions

In the aim of meeting the research objectives, the main research question of this thesis is:

- “How did governance processes lead to the urban transformation in Kiruna?”

In this specific case, the urban transformation includes both economic restructuring and spatial relocation in a path dependent town. To properly answer the main research question, the following sub-questions are formulated and will be answered at the end of the research:

- How did governance processes lead to the economic restructuring of Kiruna over the past 30 years?
- Which transition path best explains economic restructuring in Kiruna?
- How did the governance processes lead to the relocation of Kiruna?
- Does urban governance theory explain the governance model of Kiruna’s transformation?

To answer the last sub-question, we test the following hypothesis:

H0: Transition Management (TM) theory explains the model of governance that has led to economic restructuring and to spatial relocation of Kiruna.

1.6 Structure of the research

The previous section introduced the research and its relevance, the research objectives and questions. In chapter 2, the concepts of the study will be presented, focusing on the discourse of urban transformation and urban governance, as well as the theories that link them together, followed by a conceptual framework that will guide the research. In chapter 3, the research design and methods will be presented focusing on the operationalization of variables and the data collection instruments, sampling and data analysis methods. It will conclude with the challenges and limitations of the research strategy. In chapter 4 a description of the findings will be presented through a process tracing of transformation, followed by an analysis studying the covariation of variables in each process, and a comparative analysis highlighting the causality between the independent and dependent variables. Chapter 4 will be concluded by a congruence analysis testing the hypothesis H_0 presented in the previous section. Chapter 5 provides a conclusion that starts by answering the research questions, and follows by an academic contribution of the research, as well as recommendations for policymakers and recommendations for further research.

Chapter 2: Literature Review

This chapter provides an overview of the relevant academic literature related to the discourse of urban governance, specifically in the context of urban transformation. First, it highlights the literature underlying urban transformation as an overarching concept, and its two dimensions, namely spatial relocation and economic restructuring, and relevant theories such transformation paths and restructuring. Then it moves to defining the second concept of urban governance, its complexity, and different models, focusing on network governance and transition management theory. After that, it highlights previous research linking the two concepts (urban transformation and urban governance) together. At the end of this chapter, a conceptual framework explains the relationship between the different concepts of this research, and the relationship between the independent and dependent variables.

2.1 Concepts of the study:

2.1.1 Urban Transformation

The discourse of urban transformation is closely related to that of urban development. Due to the evolving nature of world economies, cities are trying to sell themselves by transforming from the “welfare-state model towards the economic development model” (Kearns and Paddison, 2000, p 845).

According to Loorbach (2010), urban transformation or transition is the process of change when the dominant structure in society changes, either through external pressure or endogenous innovation. Similarly, van Dijk and Edelenbos (2017) define transitions as ‘transformational processes’ in which the fundamental ways of a society change over one generation or more. They are important in realizing sustainable governance (Rotmans et al., 2001; Loorbach, 2010).

However, there are different typologies of transformation processes as suggested by Berkhout et al. (2004). These include transformations that are either (a) accidental, (b) deterministic, (c) evolutionary, (d) dialectic, or (e) teleological or target-oriented transitions. These typologies are related to the context of transformation, and emphasize two different dimensions to determine the type of transformation occurring in a certain context: (i) *emergent transitions* characterized by low degree of coordination from actors and (ii) *targeted transitions*, characterized by a high degree of coordination (Grin et al., 2010).

Urban transformation could be studied from a multi-phase analysis perspective (Grin et al., 2010). This type of analysis emphasizes the S-curve which represents “an ideal transition, in which a system adjusts itself successfully to the changing internal and external circumstances, while achieving a higher order of organization and complexity” (Grin et al., 2010, p. 127). This type of analysis suggests that urban transformation is path-dependent and often ends up in a state of lock-in. However, it is important to mention that urban transformation is complex and does not occur in phases. These phases are often hard to demarcate within a time-line (Grin et al., 2010).

2.1.1.1 Transformation paths and restructuring:

Understanding transformation paths is very important in the discourse of evolutionary economic geography. The terms “path-dependency” and “lock-in” are two main concepts in transformation paths.

“Path dependence” means that the choices that were made in the past become embedded in the economy, organizations, skills and habits of a certain area (David, 1985). Consequently, path dependency could be defined as the process of economic development in which “important influences can be exerted by temporally remote events, including happenings dominated by chance elements rather than systemic forces” (David, 1985, p. 332). The term ‘lock-in’ describes how path-dependent systems can effectively become trapped in a certain economic path, making it impossible to change because it would be such a costly transition (MacKinnon, 2008).

Evolutionary economic theories also suggest that there are other forms of paths that cities follow to pivot from an economic lock-in such as path extension, path creation and path renewal.

Path extension suggests that in an existing predominant technological path, a transformation process can take place in the form of incremental innovations in this path. However, this poses the risk of local firm decline resulting from “path exhaustion”. Path renewal is another form of transformation where industries renew their activities into different, yet related activities. Moreover, path creation is the most extreme transformation where new sectors and new types of firms emerge in a region. These new sectors are very different from the standard existing sectors. (Chaminade et al., 2019).

To exit a lock-in, extend their path or create a new one, cities often plan to restructure their systems. Restructuring is “a process which leads to a new or different structure or arrangement in a system under consideration” (Tykkyläinen et al., 1995). The term “restructuring” is very flexible and is often used to describe the process of improving a firm’s competitiveness (Cooke, 1986). However, it is now used more to describe structural societal changes (Friedmann, 1991).

To argue with that, some theorists suggest that restructuring is not always planned. For instance, according to Tykkyläinen et al. (1995), restructuring is not a reaction to an economic factor or shock, meaning that other factors of other natures might explain economic restructuring. To understand restructuring, it is necessary to study the process from various perspectives. Consequently, restructuring follows the same typology as any urban transformation process; it could be either “targeted” or “emergent”, depending on the level of coordination of actors involved in the process (Grin et al., 2010).

Several theories explain restructuring in resource economies (for example, mining communities) (Tykkyläinen et al., 1995). Some of those theories emphasize supply-side policies, technology, information society, infrastructure, environment, and many more... However, Tykkyläinen et al. (1995) suggest that the restructuring of resource communities can only be explained through “multi-causality”. He divides the nature of these “elements” into four categories: (a) general conceptualization of restructuring, (b) sector-specific conceptualization, (c) local – specific features, and (d) policy-related factors.

This “multi-causality theory” implies that individual choices are as effective as policy-related factors, meaning that a decision made by a group of people is as important to the restructuring scheme as larger drivers. Their behaviour itself is a sign of restructuring (Tykkyläinen et al., 1995).

2.1.1.2 Relatedness and Diversification

From a transformation perspective, economic diversification represents an interesting concept in the discourse of economic restructuring. While the idea of targeted and emergent

restructuring is related to the degree of coordination of actors, “relatedness” is a notion introduced in evolutionary economies to explain the emergence of new industries in a region, also referred to as diversification.

After several theorists (Glaeser et al., 1992) have attempted to explain relatedness through geography using theories of regional specialization and agglomeration, Frenken et al. (2007) were the first to introduce the concept of “relatedness” of skills in economic diversification. They were the first to introduce what is called “related-variety” to explain regional economic growth. Because not all industries are seemingly related, Frenken et al. (2007) managed to transform the way we view emerging industries in a region. Relatedness of skills can explain not only the “related-variety” but also the “un-related”.

Their research was followed by a number complementary research, such as Hidalgo et al. (2007) who questioned whether diversification in a region benefits a certain industry by enhancing its own growth because of the spillover from related industries. Their research was followed by even further research that found that relatedness in diversified economies only benefit knowledge-intensive sectors.

Recently in 2017, Content and Frenken suggested that this theory of spill-over of knowledge across sectors is interesting and needs further empirical evidence. According to them, emerging industries in a region are often “technologically related” to existing industries. Referring back to the “relatedness of skills” discourse (Frenken et al., 2007), this means that relatedness of knowledge and technological skills could be what explains the unrelated industries.

Although it the discourse has been deeply studied, research that focus on relatedness and diversification use quantitative data analysis methods, and findings are not always consistent and some questions require further explanation. For instance, according to Frenken et al. (2017), some regions diversify better into “unrelated industries” than others. Some researchers such as Boschma and Capone (2015) found that this could be explained by the type of market. They suggest that coordinated-markets tend to diversify to related economies to leverage existing knowledge and collaborative relationships whereas liberal-market economies tend to diversify to unrelated sectors by re-allocating labor and capital among sectors.

2.1.1.3 Spatial relocation

One of the dimensions of urban transformation is spatial transformation of cities. There are many theories about spatial transformation including urban renewal, urban upgrading, urban reinvention, urban regeneration, etc. The discourse of spatial relocation or displacement often carries negative connotations due to its association with disaster induced, forced or involuntary mobility of large populations (Lasgorceix and Kothari, 2009).

According to Goetz (2002) there is a difference between ‘voluntary mobility’ and ‘involuntary mobility’. Voluntary displacement refers to the mobility of a community on its own without any reason, whereas forced displacement refers to when the community opposes the mobility, and induced mobility refers to when the relocation is accepted by the community due to certain circumstances (Lasgorceix, and Kothari, 2009). These types of mobility are classified based on the community’s “willingness of relocation”. However, some theories refer to another dimension of relocation from the perspective of the relocated or the displaced, which is the “desire for betterment” of living conditions (Gibson and Langstaff, 1982; Bond et al., 2011). Moreover, other studies also take into account another dimension, which is the “degree of approval” of relocation (Kleinhans et al, 2008; Bond et al., 2011), which is more relevant to cases where involuntary – or induced mobility – is inevitable.

Spatial relocation has other implications that are not only physical. Davidson (2008) argues that spatial relocation is not only about the physical process of displacement, but also often results in (a) *economic displacement*, because it affects asset value and cultural development, (b) *resource displacement* when displaced businesses lose their customers and associated local services, and (c) community displacement when communities lose their sense of place.

Literature also refers to implications of relocation on those who stay “in-situ” after the spatial restructuring process is completed, regardless of whether it is desired, voluntary or involuntary. Associated theories refer to four types of implications of displacement from the perspective of the “remainders”: physical, social, psychological and functional (Davidson, 2008; Bond et al., 2011).

According to Bond et al. (2011), most research concerning relocation only look at the pre-conditions and the immediate outcomes, while there is a large gap in theories that look at relocation from a process perspective. There is also an interesting relationship between spatial and economic transformation of urban areas. According to Fainstein (2008), since 1980s, while economic restructuring has often led spatial redevelopment, the latter does not often lead to any major economic growth.

2.1.2 Urban Governance

In the recent years, many academic articles emerged to highlight the shift from “urban management” to “urban governance” (van Dijk and Edelenbos, 2017), and frameworks related to have been developing ever since. However, before going into the discourse of urban governance, its theories and frameworks, it is necessary to differentiate between “government” and “governance”.

According to Edelenbos et al. (2008, p.614), a government is “an organization with formal goals and tasks, and clear lines of responsibility and accountability, and is therefore necessarily hierarchical”. Whereas, governance is more of a process, through which multiple inter-dependent organizations work together at multiple levels and under complex setting to achieve different objectives (van Dijk and Edelenbos, 2017). This makes governance a less formal process than traditional public management.

Due to this shift, several theories and studies emerged to explain the concept of governance in general, and urban governance in specific. This is because the government alone is no longer the sole agent in “governance”. Today, urban development is becoming more complex, and it now involves various stakeholders from different sectors, including institutions, private actors, non-governmental organizations and community participants (Healy, 1997; van Dijk and Edelenbos, 2017).

Nevertheless, the definitions have certainly changed over the past two decades. For instance, according to Rhodes (1997), governance refers to “processes of regulation, coordination, and control”. According to Pierre (1999), urban governance is a process in which public and private actors work in coordination to achieve collective goals and common interests. According to him, the role of local government in urban governance is essential, and the outcomes (i.e. policies, strategies, etc.) are highly influenced by the value systems and national policies of the specific urban context.

Similarly, Stoker (2000, p 93) defines urban governance as “a concern with governing, achieving collective action in the realm of public affairs, in conditions where it is not possible to rest on recourse to the authority of the state”. This theory also highlights the important responsibility of local government in coordination and collective action for reaching common goals.

Although it complies with previous theories, the most recent theory does not specify the role of the local government in the concept of urban governance and instead mentions the diversity of actors as a core dimension. For example, van Dijk and Edelenbos (2017, p 5) state that in urban governance “different actors control different types of resources (authority, knowledge, financial resources, networks, etc.) that can be brought in to support the pursuit of collective action and goals”.

It is necessary to emphasize that most theories of urban governance stress on the importance of outcomes rather than the process and focus more on public-private interaction over formal policy implementation (Pierre, 1999). This creates a gap that needs to be addressed in order to understand urban governance from a process perspective.

2.1.2.1 Models of Urban Governance

The different definitions of urban governance have led to the emergence and evolution of many models of urban governance over the course of years. According to Pierre (1999), four variables underline those different models: “the composition of *participants*, the *objectives*, the main *instruments* to reach them, and the *outcomes*”. In his paper “Models of Urban Governance” published in 1999, Pierre mentions the following four models: Managerial Governance, Corporatist Governance, Pro-growth Governance, and Welfare Governance.

At that time, the *New Public Management*, which was included under the Managerial Governance model, was the first multi-actor approach to governance, however later in 2007, Klijn and Koppenjan introduced a new model of urban governance, namely the *New Public Governance*, which suggests that stakeholders are not autonomous, but are rather interdependent and that effective decision-making relies on resource-exchange between actors (Klijn, 2007). The models that explain urban governance are still evolving, and in practice each model evolves in relation to its context and its complexity.

Complexity and Network Governance:

Urban trends such as economic growth, technology development and internationalization have resulted in the emergence of the complex network society (Teisman, 1992; Castells, 1996; Voss et al., 2006). At the same time, this modern complex society has caused even more complex and unstructured problems, rooted in different domains, different levels, different actors, and with different value systems. To deal with these problems and uncertainties, new concepts and approaches have emerged on how to deal with a network society: interactive, participatory, network, and process approaches (Loorbach, 2010).

According to van Dijk and Edelenbos (2017), the concept of urban governance has developed as a result of the growing complexities of cities. The older model of urban management that relied on control and hierarchy is not enough for solving today’s complex problems. There is no way to deny that urban governance is a complex process. It is a multi-level activity (Healey et al., 1995; Edelenbos and Teisman, 2013) that incorporates cooperation, partnership, participation, and self-organization. In other words, urban governance aims to “build strong cooperative relationships, to access and utilize local resources, to build local institutional capacity, and to develop social capital through which local problems can be solved” (van Dijk and Edelenbos, 2017).

Under the aforementioned *New Public Governance* model, emerged the concept of *Network Governance* which recognizes the several layers of complexity in networks and the complexity within each of the actors on an institutional level, as well as conflict of interests between all of them (Klijn and Koppenjan, 2012). There is a debate about the model of network governance in democratic systems, especially that they are of opposite natures. While network governance deals with the complexity of urban processes through less formal interaction between

stakeholder, democracy follows a vertical flow in decision-making across actors. This often creates tension, that is most obvious when the decisions of the network actors are not fully considered by higher actors. (Klijn and Koppenjan, 2012)

Transition Management

When dealing with transitioning systems, governance involves complex patterns of interaction between individuals, organizations, networks and regimes (Loorbach, 2010). To manage these transitions, new governance processes have emerged, including the concept of “transition management” that has come to light in the Netherlands in the year 2001 (Rotmans et al., 2001).

According to Grin et al. (2010), the concept of transition management is linked to two interrelated theories: “complexity theory” and “urban governance”. Complexity theory is centralized around the non-linearity, co-evolution, emergence, and self-organization. Whereas new urban governance theory describes the process as a “multilevel, adaptive, participative, interactive, and deliberative governance” (Grin et al., 2010, p. 140).

The main challenge in translating abstract governance approaches into a management framework was to acknowledge and preserve the complexity involved. Loorbach (2010) has managed to up with a framework as a combination of theoretical reasoning and practical experiment. In his opinion, transition management is “an analytical lens to assess how societal actors deal with complex societal issues at different levels but consequently also to develop and implement strategies to influence these “natural” governance processes” (Loorbach, 2010, p: 168).

There are four types of governance activities or spheres in societal transitions (Loorbach, 2010):

- a. Strategic, and includes the “processes of the vision development, strategic discussions, long-term goal formulation, collective goal and norm-setting, and long-term anticipation”.
- b. Tactical, including the dominant structures of a societal system, such as rules, regulations, networks, etc. at different levels, subsectors, or subthemes.
- c. Operational, including all actions that are short-term and can be referred to as innovation, whether technological, institutional, behavioural, etc.
- d. Reflexive, including activities of monitoring and evaluation of any ongoing policies or social change (Loorbach, 2010).

Figure 3: Transition management cycle



Source: Adapted from Loorbach, 2010

According to van Dijk and Edelenbos (2017), transition management is a “process-oriented philosophy that balances coherence with uncertainty and complexity”. Transition management focuses on a) Long term thinking to develop short term policies, b) it is multi-domain, multi-actor and multi-level, c) it focuses on learning-by-doing and doing-by-learning, d) it combines system improvement with system innovation, and e) it is resilient, flexible, and open (Rotmans et al., 2001).

Additionally, like the network governance theory, transition management is based on complexity theory and its framework focus on studying past transitions; it does not focus on predetermined outcomes. Instead, it focuses on managing the process that emerges from different factors and tries to steer it to reach sustainable development (Grin et al., 2010). It is important to emphasize that because every transition is unique in terms of context, actors, problems and solution, the process – or cycle – of transition management is flexible enough for practice (Loorbach, 2010).

A significant difference between contemporary urban governance theories and transition management is the *reflexive dimension*, characterized by learning-by-doing and doing-by-learning. Learning is an indicator of feedback mechanisms involved in the process management, such as monitoring and evaluation (Grin et al., 2010).

Kemp et. al (2007) describe TM as “a goal-oriented incrementalism”. Incrementalism is a theory that suggests that transitions happen through “do-able steps which are not immediately disruptive” to the system (Kemp et al., 2007, p 25). According to them, TM uses advantages of incrementalism by taking into account the critique against incrementalism such as the lack of orientation and the lack of feedback (reflexive dimension). This contradicts with the notion of radical transformation that TM aims to address because incrementalism suggests that change is evolutionary and not radical.

Even though TM theory is widely used in countries like the Netherland, UK and Belgium in order to develop transition policies in areas such as energy, mobility, water management, etc. (Kemp et. al., 2007). According to some researchers (Kemp et al., 2007; Loorbach, 2010), it is still unclear whether TM theory is applicable in practice, because it requires more case studies in other contexts. They argue that there could be an over emphasis on the theory and whether it really leads to or explains radical transformation.

To conclude the concept of urban governance, although governance is sometimes perceived as “autopoietic, self-organizing networks created to resolve common problems” (Campbell, Hollingsworth, and Lindberg, 1991; Rhodes, 1997), and although governments can play different roles in the network, or even be absent, there is a debate on whether local governments choose a certain governance model (Pierre, 1999) or simply self-emerging through the participation of actors (van Dijk and Edelenbos, 2017). It is also possible that there are more forms of urban governance emerging every day due to the growing complexity of urban networks and their multi-level activities (van Dijk and Edelenbos, 2017).

2.1.3 Previous studies on Governing Transformations

Although transition management theory is a form of governance that explains how governance processes may lead to urban transformation, there are a few empirical studies that study the link between urban governance and urban transformation outside the framework of transition management.

An example of these studies is a case-study by Degen and García (2012) that focused on Barcelona's urban restructuring. The findings of their research suggested that the unique culture that was deeply rooted in the politics in the city resulted in a unique governance style, through democracy and dialogue between public institutions and citizens. However, in this case, the local council had always been in control of the decision-making processes which questions the participatory approach in the governance, especially that this approach has become highly institutionalized. Democracy that relies on institutionalized participation contradicts with the notion of bottom up participation. The study concludes that the governance model that is based on participatory consensus is often diluted when steered by the local government (Degen and García, 2012).

Aarsaether, N. et al. (2011) also conducted a research linking urban governance to urban transformation in Norway. The study compared two different forms of governance in two cases in the same city and the same time-frame. The study found that one type of governance was characterized by strong entrepreneurial orientation and the other with a deliberative one, although the governance included the same municipal leadership and culture. The findings of this study suggested that the difference lies in the objectives of each process as well as the process itself. The more entrepreneurial form of governance was characterized by new methods of citizen participation, knowledge development, flexibility, and trust-building among many stakeholders. The more deliberative governance, was characterized by the “supposed” democracy because it was led by the local government, focused more on the objective of economic growth and less on the democratic process. This research shows that modes of governance with different objectives and approaches result in different forms of urban transformations, and that the “openness” of the process leads to better outcomes than the democratic representation (Aarsaether, N. et al., 2011).

To sum up, both studies verify that variations among the outcome of urban transformation depend on the variation of dimensions related to urban governance such as stakeholder participation, levels of interaction, objectives, openness, flexibility, democracy, etc. These dimensions are similar to those suggested by urban governance models mentioned in the previous section. This implies that the existing models of urban governance do not always explain governance, and context-specific variables could play a big role in determining governance.

2.2 Conceptual framework

The conceptual framework guiding this study is based on the literature review of the two main variables: “Urban Governance” as an independent variable (IV), and “Urban Transformation” as a dependent variable (DV). The framework considers the complexity of both of those variables while trying to explain how one has led to another within the context of path-dependency. The framework also acknowledges the existence of drivers and barriers of urban transformation as control variables.

Based on urban governance literature by several researchers (Campbell, Hollingsworth, and Lindberg, 1991; Healey et al., 1995; Rhodes 1997; Pierre, 1999; Stoker, 2000; Castells, 2000; Edelenbos and Teisman., 2013; van Dijk and Edelenbos, 2017), the following three dimensions of *urban governance (IV)* have been extracted:

Actors: a network composed of several actors or participants, from different *types* (public, private or other) on different *levels*, who have different *roles*.

Interaction: actors *participate at different degrees* and *interact at different levels* under a *complex setting* (formal, informal), and formulate a system of *rules*, and sometimes this interaction is led by a certain actor (*leadership*).

Decisions: actors have interrelated problems, and therefore have different *objectives* or goals. The process of urban governance makes use of *instruments* at different levels to reach its *outcomes*.

By taking into account that transformations are never complete, but ongoing temporal evolutionary processes, we can only understand them by taking a specific moment of time, for instance at the moment, and try to measure the present state as an outcome. The dependent variable (DV) in this research is the outcome “*Urban Transformation*”. As seen in figure 4, the conceptual framework differentiates between two dimensions relevant to this case study, namely the “*spatial relocation*” and the “*economic restructuring*”. These two dimensions are interrelated in the context yet have different indicators and theoretical underpinnings. Relevant indicators of these dimensions are extracted from the literature and presented in the figure below.

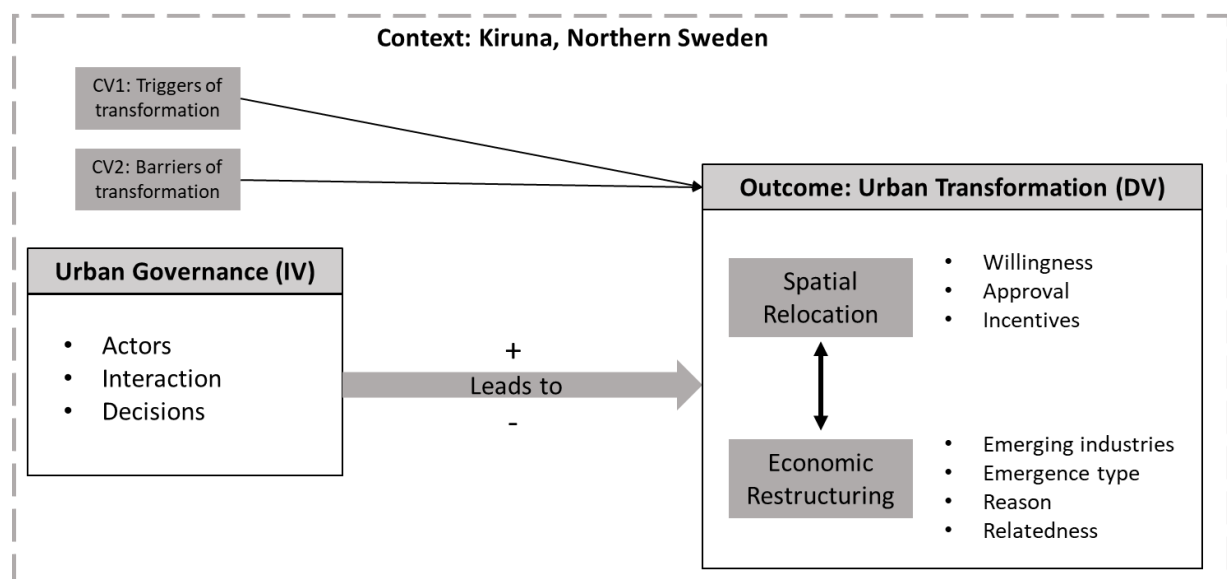
Indicators of *Spatial Relocation* include *willingness to relocate*, *degree of approval* by the community and type of *incentives*.

Indicators of *Economic Restructuring* include: Type of *emergent industries*, *relatedness* to existing industries, *emergence type* (targeted, self-emergent) and the *reason of restructuring* (diversification, specialization, growth, etc.).

The context from which the transformation started taking place is clearly a path-dependent context, so it is important to take into account the variables that are outside this context but may have an effect on the governance of urban transformation. These control variables (CV) include the following sub-variables and indicators:

Triggers (CV1) and *Barriers* (CV2) of urban transformation: could be of different *types* (environmental, social, etc.), and could have different *characteristics* (shock-driven, policy-driven, laws), and at different *levels* (local, municipal, national, etc.)

Figure 4: Conceptual framework



Source: Author, 2020

Chapter 3: Research design and methods

In this chapter, the variables that were presented in the conceptual framework in the end of chapter 2, are operationalized along with their indicators to be measured and analysed later in chapter 4. This chapter also provides a detailed description of the research design, including data collection methods, instruments and techniques, sampling and data analysis. It aims to set the strategy which would provide the best answer to the research questions and sub-questions displayed in chapter 1. This chapter ends with the limitations and challenges of the research as including relevant issues of reliability and validity.

3.1 Operationalization: variables, indicators

In line with the conceptual framework at the end of chapter 1, this research focuses on urban governance that has led to the urban transformation in the context of Kiruna and tests urban governance theories that could be applicable in the process. Based on information from relevant literature and based on the scope of the research, the concepts and variables are operationalized in aim of facilitating the data collection procedure and ensuring proper analysis (van Thiel, 201).

3.1.1 Operationalization of Urban Governance (independent variable):

In this research, the dimensions referring to urban governance are in line with the conceptual framework extracted from the literature review. One of the hypothesis of this research is that the urban governance model applicable to this case is transition management theory, meaning that it could be a theory that explains the relationship between the independent and dependent variables, however transition management itself is not considered as a variable in this research. The operationalization of urban governance integrates transition management's indicators because those indicators overlap with those of urban governance.

In this research, the independent variable (IV) includes the following dimensions:

Actors: any entity whether it is an organization, collective, individual, etc. that was involved actively or passively or had a role on any level in any decision that later led to urban transformation (only focusing on spatial and/or economic)

Interaction: Refers to the overarching dynamics of the network of actors involved in each decision involved in the governance process. It could be formal or informal, and could be managed, flexible or self-organized, etc.

Decisions: interim decisions, for instance a plan or reform, that constituted milestone leading to spatial and/or economic transformation. It could be a physical intervention, a policy, a new law, etc.

Table 1: Operationalization of urban governance (IV)

Dimensions	Indicators	Value	Data Collection Method + Source
Actors	Type of actors	Private, public, community	Semi-structured interviews with key-informants (Annex 1). Secondary data from desk research (Annex 2)
	Level of actors	local, municipal, provincial, national, regional	
	Roles of actors	financial, directive/management, planning, policy-making, implementation	
Interaction	Setting	Formal/informal	
	Leadership	Self-organized, managed by certain actors, participatory	
	Rules	Flexible, strict, enforced, defined, undefined	

	Degree of participation of each actor	no participation, weak participation, strong participation	
Decisions	Objectives	Long term, short term	
	Instruments	policy reforms - sector reforms, physical intervention, financial, social	
	Level of decisions	local(sectorial), municipal, provincial, national, regional	

Source: based on the researcher's understanding of urban governance literature

3.1.2 Operationalization of Urban Transformation (dependent variable):

In this research, urban transformation is considered as the dependent variable (DV), and is divided into two interrelated dimensions due to the context of the case study:

Spatial relocation: Physical relocation of infrastructure affecting communities and businesses. This relocation is characterized by the willingness to relocate, incentives and approval by community.

Economic restructuring: shift into a new economic system characterized by new emerging industries, that may be related or unrelated to the existing industries. This shift is characterized by economic initiative/activities.

Table 2: Operationalization of urban transformation

Dimensions	Indicators	Values	Data Collection Method + Source
Spatial Relocation	Willingness to relocate	Voluntary, involuntary, forced, induced	Semi-structured interviews with key-informants (Annex 1). Secondary data from desk research (Annex 2)
	Degree of approval by community	Happy, unhappy with relocation Agree, neutral, disagree with relocation plans	
	Type of Incentives	Financial, physical (more space), No incentives	
Economic Restructuring	Type of emerging Industry	Space, tourism, mining, education, etc.	
	Relatedness to existing industries	Related by type, related by skills, unrelated	
	Emergence type	Planned Self-organized Evolutionary	
	Reason of restructuring	Job creation, strategy for economic diversification, strategy for specialization, profit-making, market demand	

Source: based on the researcher's understanding of urban transformation concept

3.1.3 Operationalization of control variables (triggers of urban transformation):

In this research, triggers (CV1) and barriers (CV2) of urban transformation are accounted for as control variables because they could explain transformation but are outside the indicators of urban governance, and therefore data related to their indicators are collected. By including these control variables in the data analysis, their influence on the dependent variable will be made clearer (van Thiel, 2014).

Table 3: Operationalization of control variables (CV)

Variable	Indicators	Values	Data Collection Method
triggers of urban transformation (CV1)	Type of trigger	Environmental, social, economic, etc.	Semi-structured interviews

	Characteristic	Shock driven, policy-driven, self-organized	with key-informants Secondary data from desk research (official documents, articles, etc.)
	Level	Local (sectorial), municipal, provincial, national, regional	
barriers of urban transformation (CV2)	Type of barrier	Environmental, social, economic, etc.	
	Characteristic	Shock driven, policy-driven, self-organized, law	
	Level	Local (sectorial), municipal, provincial, national, regional	

Source: based on the researcher's understanding of urban transformation concept

3.2 Research Design

The research is of qualitative and represents a unique case study of urban transformation, therefore, the research was conducted using a combination of two strategies: single embedded case study and desk research. In this research qualitative data was collected throughout online interviews with experts and stakeholders, and from existing secondary data such as official stakeholder websites, published academic articles and media articles, as well as official stakeholder reports.

3.2.1 Research Strategy

The reasons behind choosing a single embedded case study as a strategy are (a) the uniqueness of the case, knowing that Kiruna is undergoing a spatial and economic transformation (b) the complexity of the case which involves a multi-level, multiple actor process, and (c) the limited time dedicated for the research.

In this case study, two units of analysis were studied as separate embedded case studies (economic and spatial transformation). The reason for choosing this approach is the complexity and overlap of these two different units of study. Using an embedded case study made the comparison of the two study units less complex, and resulted in a deeper understanding of the case study as a whole. This approach also serves in increasing the internal validity of the research (Yin, 2003).

The embedded case study approach was combined with desk research to collect further data, and triangulate the results (van Thiel, 2014). The use of secondary desk research was beneficial as it was time and cost-efficient, especially when dealing with process tracing over an extended period (van Thiel, 2014) as it provides accurate facts. Although the use of a single embedded case study puts the reliability and the validity of the research results at risk, conducting desk research using existing secondary data has limited this risk because the researcher was not directly involved in the data collection procedure (van Thiel, 2014).

3.2.2 Data collection, sample, and instruments

The data collected covers the scope of the research only, meaning that it focused only on the spatial and economic transformation of Kiruna, within the past 30 years (1990 to 2020). As mentioned, the data that was gathered for this research was of qualitative nature and was collected over 2 phases:

Phase 1: Gathering of existing secondary qualitative data about the urban transformation of Kiruna. The data was extracted from 24 sources including academic papers, book chapters, webpages from stakeholders' websites covering the "Urban Transformation of Kiruna", and reliable online articles. This method was used to save time on data collection. A list of the secondary data used is found in Annex 2.

Phase 2: Gathering of primary data using semi-structured interviews with key-informants and experts affiliated with and/or involved directly in the urban transformation of Kiruna.

The type of sampling used is purposive sampling, meaning that key informants were contacted based on desk-research. In addition to that, snowballing sampling was used to reach out to more involved experts until saturation of data was attained. According to van Thiel (2014), purposive, non-probability sampling can be chosen when studying governance processes in a certain context. The municipality of Kiruna (Kiruna Municipality, 2020) and Sjöholm (2016), mentions 17 actors who were said to be involved in the urban transformation process (annex 3). Although those 17 actors were contacted via email for scheduling appointments, only 7 of them responded, and I was able to reach out to 3 more by snowballing sampling.

Three interviews were prepared to include semi-structured questions to guide the conversation, fill in the missing data, and to verify the data collected in phase 1 during the desk research. An example of interview questions is listed in annex 4. Because of the corona pandemic, the interviews were conducted via Zoom online conferencing and ranged between 20 and 60 minutes. A detailed list of the 10 interviews with key informants and their affiliation is found in annex 1.

3.2.3 Data analysis methods:

For the explanatory part of the research, the data analysis method used is content analysis of both primary and secondary data collected from written documents and transcribed interviews. The content analysis resulted in a process tracing of each of the embedded case studies (Case 1: economic processes, Case 2: relocation). The process in each case study is explained through a narrative highlighting the milestones of the dependent variables. In this stage, control variables (CV1,CV2) as well as the corresponding dependent variables were described in each case study.

For the analysis part of the research, the independent variables (urban governance: actors, interaction, decisions) of each case study were analysed through qualitative co-variational analysis and compared through comparative analysis. In the testing part of the research, a congruence analysis was conducted to understand which theory of urban governance best explains these transitions, and testing the null hypothesis H_0 . It is important to note that process tracing and congruence analysis are often used when the number of units in a case study is small (Blatter, 2012), which is the case in this research.

Based on this, the data was processed in the following steps:

Step 1: Process tracing

The dependent and independent variables and their dimensions were assigned codes using qualitative data processing software. Open coding was used to control for control variables (barriers, triggers) in order to ensure scientific analysis. According to van Thiel (2014), coding data through data processing software ensures systematic analysis of qualitative data.

After coding, the data was arranged into a chronological order of decisions relating to the urban transformation in Kiruna in the past 30 years (1990 – 2020), resulting in two narratives:

- *Case 1: Economic Restructuring*
- *Case 2: Spatial Relocation*

In this part, triggers (CV1) of one transition could be the barrier (CV2) of another, and so on. In this step, relevant dimensions of the dependent variables and control variables were extracted and displayed.

Step 2: Qualitative co-variational analysis

After compiling the data and arranging it in a timeline narrative, an analysis of the independent variable (urban governance) is conducted for each case-study unit. In this step, the co-variation between urban governance (IV) and the urban transformation (DV) is analysed. This type of

analysis is typically used when the number of observations is small, and is often combined with other qualitative methods like process tracing (step 1). It is also used to infer causality between IV and DV. This is followed by a comparison of the two cases, which offers the possibility to systematically test hypotheses relating to the causal relationships between different variables, by simplifying the complexity in each case and allowing for better scientific explanation of patterns or drivers of change. This method is common in studying urban governance and will assist in analyzing the differences in urban governance (IV) that led to a different form of transformation (DV) (Pierre, 2005).

Step 3: Congruence analysis

Congruence analysis was used to test if the theory of transition management by Loorbach (2010) applies to each of the 2 case-study units of the urban transformation. This was done by constructing a truth table for transition management and comparing the findings from dependent and independent variables to that table. This type of analysis helps in testing if the findings of a crucial case study could be explained by one theory or more (Blatter, 2012).

3.3 Challenges and limitations

There are some challenges and limitations associated with the data-collection methods as well as the research in general. The challenges were mostly limited to the primary data collection, as some key-informants who were contacted did not respond to the interview request. This was because most of them were on their annual vacation. It was also challenging to obtain the contact details of some informants who were involved in the decision-making processes but are no longer involved in their organisation or institutions. However, this challenge was addressed by collecting data through desk research, as well as using snowball sampling to reach out to more individuals, until saturation of data was met.

Limitations of this research include the limited external validity of the embedded case study, the limited reliability of primary data due to the subjectivity of respondents, and limited reliability of secondary data. In a case-study in general, the internal validity of data is considered strong because the case is often studied in-depth, whereas external validity and reliability are often at risk. This is because often qualitative data obtained from interviews is subjective because it depends on the respondent's perception or understanding of the subject. Additionally, the data collected from secondary sources also depends on the reliability of those sources.

However, the issue of external validity was mitigated by using the triangulation of data by mixed-strategy approach (van Thiel, 2014). This means that the data is collected from more than one source (both the interviews and the secondary data sources) which helps in increasing both reliability and validity of the research (van Thiel, 2014). Another limitation was the limited time available for research as well as the limited time dedicated for data-collection and analysis. These limitations were considered by ensuring complete credibility, transparency, and accountability in the thesis research.

Chapter 4: Findings and analysis

This chapter starts showcasing the findings of the research as designed in chapter 3. It starts by giving a brief overview of Kiruna before its transformation and highlighting the role of the mining company LKAB in the context. Then it describes the process of transformation focusing on the two cases: restructuring the economy and relocating the town. This is followed by a qualitative covariance analysis focusing on urban governance in each transformation, then a comparison between the two governance modes. In the end of this chapter, the hypothesis H_0 is tested through a congruence analysis, to check whether TM theory explains the mode of governance in each case.

4.1 Kiruna before the transformation – Between space and mining

The history of Kiruna is deeply rooted in mining (Annex 5). In 1980, the mining company LKAB was established and with it, the town was formed. In fact, the first managing director of LKAB, geologist Hjalmar Lundbohm, is considered the official founder of Kiruna, and was assigned by the company to design a town where the workers could live. Lundbohm had visions for the mining-town and he strategically choose Mount Haukivarra for Kiruna for its location between two mining mountains, taking into consideration wind-protection, milder temperatures, and nice views. He *wanted to make Kiruna a good place to live*. The first seven houses constructed in Kiruna were to house the workers who extracted the iron-ore. At that time, Kiruna was barely suitable for mining due to the lack of economic actors, customers, suppliers, roads, houses and shops.

In 1900, the first city plan was adopted, and was considered to be the first “climate-responsive” city plan. In 1903, the Iron Railway Line was constructed between Kiruna and Narvik in Norway, making it possible to continue mining activities and to boost the economic viability of the industry. The railway also paved the way for the labor market to grow, attracting more workers, scientists, architects and businessmen. Consequently, the population grew to 7500 inhabitants in 1910. During the WWI, the Iron ore production drops, then it increases between the 20’s and the 30’s and drops back after the Great Depression.

In 1950’s the lake Luossajarvi at the Kirunavaara mining mountains started being emptied to allow for continuous mining and starting the 1960’s the mining started under-ground.

In the 1957 space activities, and specifically space research began in Kiruna when the “Swedish Institute of Space Physics” ((Institutet för rymdfysik, IRF) started conducting extensive space research in Kiruna. Shortly after the establishment of IRF, the “Esrang Space Center” was built in 1960, and a year later, the city hosted the first rocket launching in Sweden. Later in 1972, the space centre turned into a state-owned company and its name was changed to SSC (Swedish Space Corporation), becoming the national rocket base for space research.

Between the 1960’s and 1970s, Kiruna’s population reached 31,000 inhabitants, and it had a city hall and a municipal high school. The development of Kiruna as a town was highly affected by LKAB, being the main employer and key service provider, especially in the industrial period after the war, where the mining company was speculating increase of global demand on steel.

In 1970’s, the populated area closest to the mine had to be vacated due to the ground deformations.

Around 1975, LKAB notified the Kiruna municipality about an anticipated need of around 2000 apartments due to increase of global demand on Steel, however, shortly after that between 1976 and 1982, extreme losses were reported leading to the halving the number of employees.

This decrease in labor market led to an increased migration out of Kiruna, and its population decreased rapidly from 31200 (1977) to 27000 in 1983. Kiruna has not recovered its lost population until now, although mining regained its boom immediately in 1983.

Being a resource community, Kiruna has been heavily dependent on mining, with export-oriented economy. The mining industry's dependence on global markets makes the whole town vulnerable to against many external forces. This has pushed the municipality of Kiruna to come up with strategies to protect its existence. In the 1980s, discussions started in aim of diversifying the economy of Kiruna and strengthen emerging industries in order to become less dependent on global steel market driven by mining. Plans were developed envisioning Kiruna as a 'future town' with a diverse economy that includes mining, space activities, computer technologies, and tourism.

Meanwhile, the government was intervening to save LKAB from bankruptcy through a state-directed programme that aimed to restructure the production of iron. The programme introduced automated operations to the company, and helped it regain power, especially during de-industrialization period because the technology was ahead of its time.

On one hand, the government's intervention has made LKAB what it is today: *"a comparatively efficient producer of high-value iron products operated as a business rather than a state-owned enterprise"*. On another hand, LKAB has helped the government strengthen its economy and focus on building a welfare state.

After this, the population of, and stabilized. The automation, along with the increased demand on steel worldwide, has led to the economic growth in Kiruna and consequently a population growth, where numbers reached 20,000 in 1990.

4.2 The narrative of urban transformation

This section describes the process of transformation of Kiruna (process tracing), focusing on the two cases: restructuring the economy and relocating the town.

4.2.1 Case 1: Economic restructuring

Since the 1990's, strategies aiming for economic restructuring of Kiruna show the focus on two priority areas, 1) space activities, ranging between space research, education and industry, and b) tourism:

Space research, education, and industry

Since the 1960's students have been visiting the IRF in Kiruna to carry out PhD studies and research in the field of space engineering, however, it was not until the 1990's that it was made official. Shortly after the municipality began its efforts for economic diversification in Kiruna, the IRF managed to establish a new facility for space engineering education in 1993. That was one year after the second Swedish satellite, Freja was launched in 1992.

However, in 1995, stakeholders gathered in the town hall of Kiruna to discuss the future of space research as opposed to space industry and business. Although there were different opinions about the future of space in Kiruna, the gathered parties agreed that "the location of the research and education in Kiruna" was a very important matter. In 1997, the first space engineering programme started in LTU, with plans that the last year would take place in the town of Kiruna.

Consequently, the national government of Sweden gave directions to the LTU, UME and the IRF to work together to establish what is called the "Kiruna Space and Environment Campus. In 1999, the construction of the new space campus began, and it was inaugurated in September, 2000.

In 2000, there were discussions about the role of the involved parties, namely LTU, UMU, IRF and the space campus, in space education. Discussions concluded that collaboration is needed, rather than competition, for reaching a higher standard of space education.

In the same year, SSC started to grow, after it acquired the Universal Space Network in the US and established a global ground station network. This made SSC (Estrange space center) more attractive to universities, who started collaborating for educational reasons.

This created some tension between the SSC and universities on one side, and the IRF on the other side, due to competition students and space education.

“Of course, there are always problems when several parties are cooperating. And of course, for us, at IRF we ran into some difficulties when the universities up in the northern part of Sweden has stopped cooperating around space education. That caused some problems for us”. (I9)

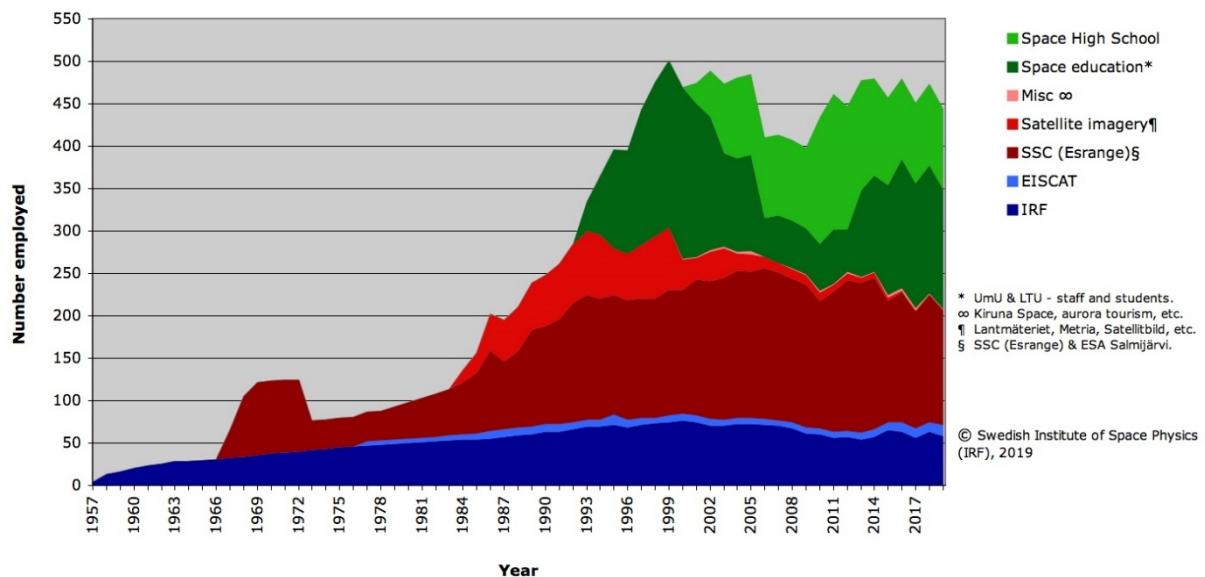
Additionally, the space high school (rymdgymnasiet) was established in year 2000, as one of the municipal highschool with an independent curriculum that aims to introduce highschool students to space. Its education does not only focus on space physics but also space biology and chemistry.

“The idea was to take advantage of the space industry in Kiruna, to attract more high school students into technology, using space as bate”. (I5)

In 2005, “Spaceport Sweden” was initiated to promote commercial flights to space and high-tech space-research in Kiruna. The town is expected to become Europe’s first hub for commercial spaceflight, as many space-related companies are locating in the town such as the British company “Virgin Galactic”, due to the space and tourism related skills in the town. In 2007, the Swedish Minister for Enterprise and Energy inaugurated the initiative, and talked about how space tourism could be combined with other cultural activities.

Today, the space activity in Kiruna is distributed across the IRF, SSC, the universities, as well as the space high school, as shown in graph 1, and annex 5.

Graph 1: : Space activity in Kiruna between 1957 and 2019



Source: Swedish Institute of Space Physics IRF, 2019

Year-round tourism

In the beginning the tourism not an economic activity, but rather a cultural activity. People came to Kiruna for space-related tourism such as the midnight sun and aurora gazing, as well as its natural activities such as rafting, reindeer herding, hiking, and others. Most of these activities took place in the Summer and were tied with the space research in the area.

Today it has become a year-round tourist destination due to its snowy weather that allows for winter sports. The first sign of winter tourism emerging as a form of economic activity was the establishment of the Ice Hotel 1990. With that, other owners of properties started to further develop their businesses around nature-based wellness activities.

In 1993, Kiruna Lappland was established, as an economic association that supports tourism companies and represents them in partnerships and collaborations (I2).

“It started as an Economic Association to support the tourism companies, to also work both in local, regional and national projects, EU projects also in terms of destination, development and different kinds of, we do really work for the destination as well as a workforce for sustainable growth for its members which are Today currently 105 member companies are represented in the tourism and in the hospitality of Kiruna” (I2).

The growing number of tourist companies shows the increase of tourism industries. Kiruna Lappland has been the organizer of the tourist companies and received support from the municipality by funding its tourist information centers, and from the government through destination marketing via VisitSweden platform.

In 1999, there was an agreement between stakeholders in Kiruna including the IRF, the space high school, the municipality, and others to grow the tourism sector in the city by the year 2020. This was achieved starting 2000, when large investments started going into the tourism industry, leading to tourism growth:

“And we’ve seen a lot of new hotels and hospitality companies coming in the last 10 years, it probably doubled” (I6)

Tourism has always been used as an attraction to support other industries like education, space and mining. It attracts students and workers to live in the town. Unfortunately, this was the case only until 2018, when the support by municipality to tourism stopped. The reason for withdrawing the financial support was said to be due to the necessity to redirect funding towards other issues like healthcare.

“They (the municipality) decided to instead put their entire focus on the healthcare, on the schooling and on the medical sector” (I2)

Although there are many tourist companies which employ a high number of people in Kiruna, tourism remains economically insignificant as compared to the space or mining industries.

“it’s very genuine and very local in that way so it’s not many big investors are coming and opening up, so it’s still small scale, and it’s still private owners.” (I6)

4.2.1.1 Relatedness among sectors

The sectors in Kiruna relate to each other through different forms, including training, knowledge-sharing, collaboration, and use of technology.

Mining and space industry: The high-tech skills used in the automation in LKAB complement the high-tech skills of space industry and research.

“Because Kiruna has one of the most highly technological underground mines, we have the LKAB high tech industry underground and, which is something you need in space”. (I5)

Mining also benefits from space equipment for remote geo-sensing under the ground. The Space and mining industry are independent from each other, yet they both attract similar type of labor market. They both work with universities for talent acquisition.

“Engineers working in our test range, sometimes quit and go to work in the mines, as engineers. So they can go back and forth. (...) if you look at IT, communication, remote sensing, mechatronics, they are needed in both in both branches”. (I3)

Mining and tourism. The mining company supports unemployed residents who work in tourism seasonally. Tourism companies also organize tours within the mines.

“I know quite a few people actually who were working within LKAB, the mining company and who are now working within the tourism sector, so and I think that's also because that living here you are surrounded by nature. (...) but we see many examples of those who have worked within the mining company who has then moved on to work within the tourism, hospitality service”. (I2)

Space education and tourism: Kiruna's unique tourism activities have always been used to attract students and advertise space programmes:

“And what we do is, as we are recruiting a lot of pupils from all over the world actually, sometimes we could collaborate and I think that there is a dialogue now going on between Kiruna Lapland and LTU to see if the material that they are producing to show what Kiruna is all about” (I3)

Additionally, tourists who come to Kiruna usually come for knowledge-based tourism related to space. There are always guided tours in the space centre. Many conferences attract tourists to Kiruna. However, in terms of skills, there is not much relatedness, it is limited to knowledge of space.

Space industry, Space education and Space research. Space research attracts students who are interested in space. Space education and research uses the facilities of the space industry for testing. Students undergoing space education initiate projects with the universities which drives innovation in space industry. Space industry benefits from space education as it prepares a specialized labour market. Space industry and research are related and complement each other, although one is driven by knowledge and the other is driven by profit.

4.2.1.2 Drivers for economic restructuring (CV1)

Locational assets: The location of Kiruna in the arctic, its beautiful nature, and closeness to the aurora phenomena has made it possible to establish activities in space and tourism.

Global shock: The decline in profits of the mining during the depression between 1976 and 1983, has pushed the Kiruna municipality to initiate strategies for diversification.

International cooperation: because the space stakeholders were involved in international networks of space, it was possible for the space activities to grow in Kiruna.

“It was very important that we had this European cooperation when we started the space activities, because that gave us networks, and it gave us possibilities, and it gave us also possibilities to show what we could do”. (19)

4.2.1.3 Barriers for economic restructuring process (CV2)

Shortage of housing. Ever since the late 90’s, the municipality of Kiruna was not able to provide the Space students with accommodation. Till this day, housing remains a challenge for students moving to study at the space high school in Kiruna:

“Our Achilles heel is housing. Most of our students come from outside Kiruna, which means they need housing”. (15)

Lack of local government’s support. In 2018 the support by the municipality to tourism has stopped due to changed priorities related to funding.

“it’s also a barrier in that way that they are taking in some of the funding that they give to the tourist office, which means that the tourist office has to close or reduce their opening hours” (16).

Lack of land for tourist development. There is a lack of hotels in the area, which the municipality is tackling by building more hotels in the center. However, due to the lack of land, the municipality cannot do much.

“Despite being such a big municipality, I think we could have had more tourism actors if the municipality had owned more land”. (17)

Difficult connectivity with the airport in Stockholm and the new railway E10. Although there is a dialogue to organize flight times towards Kiruna, the conversation with the national transport agency is difficult.

4.2.2 Case 2: Relocation process

Before diving into the details of the relocation process, it is important mention that Kiruna has undergone several transformations triggered by the mining activities. Being the main employer and key service provider in the town, LKAB has had impacts on the town’s development several times, but the Relocation Process that started taking place in 2004 is one of its kind.

The relocation decision

In 2004, LKAB takes the lead the municipality of Kiruna of the geological risk related to mining under the city. They recommend revising the city plan. At that year, the government begins to plan the new railway line, through the national Swedish Transport Administration.

Before the process of planning begins, in 2006 there were some infrastructural adjustments that aimed to mitigate the effect of mining on the ground.

Location 1 and the design process

The strategy adopted by the actors involved in the relocation plans was not to take any decisions before taking the people’s opinion through participation. The participation strategies involved discussions steered by the municipality, municipal companies, and LKAB along with the community members, including elderly people, students, business owners, who lived in the areas to be affected by mining activities.

The discussions first focused on where the city-center should be relocated, and the community’s vision of the new city-center. That was in addition to surveys, suggestion boxes,

and other offline and online participation methods. In 2007, the plan was to move the city centre to the North West and the city started implementing infrastructural rerouting plans.

In 2008 and 2009, infrastructural and electric works started being executed in the newly planned city centre. In 2011, the new railway station was built.

Change of plans: Location 2

Also in 2011, the mining company discovered the possibility of having iron-ore bodies in that planned area, which pushed the municipality to reconsider the location of the new town. They launched an international design competition in 2011, and eventually in 2013 two architectural firms (White arkitekter, which is based in Stockholm and Ghilardi + Hellsten Arkitekter which is based in Oslo) won, producing a new master plan suggesting the relocation of the city centre 3 kilometres to the east.

The design process took several years which meant that people eventually got bored and started disengaging with the process as mentioned by respondents (I7).

“It depends on which year you're talking about. There were many years before the last decision of where to put to the new centre, would it be in the north or would it be in the east, and that discussion was going on for some years, and people got bored” (I7)

Moreover, the residents whose houses were going to be demolished were asked about their housing preferences like size, number of rooms, features, etc. Younger people wanted smaller – and cheaper – apartments (I10).

The aim of this inclusion process was similar to the vision of Kiruna's first town plan (D5, D8) :

“The actual result of the operation is that the townspeople of Kiruna will be able to enjoy more efficient, climate-friendly, state-of-the-art public infrastructure.” (D5)

The move begins

In 2014, the new construction began with LKAB pledging an investment of 415.5 million euros. LKAB is responsible for compensating for people's houses, and paying for the new construction, while the municipality is responsible for getting the plans approved by the national and regional authorities, and implementing the plans in coordination with the architects, developers, and the two municipal companies (housing and technical companies). The municipality is also responsible for purchasing the new construction land from the central government.

In 2015, the destruction operations started and the construction of the new town hall began having LKAB as the client. One year later, in 2016 the compensation models were decided and new apartments were in place.

The mining company offers homeowners two choices: either to (a) move into a new house, without having the freedom to pick the exact location, or (b) 125% of the house market value. As far as the incentive for residents who are relocating, they will get new houses or apartments.

In 2018, the town hall in the new city centre was inaugurated and the municipal employees started working in the new office spaces.

The next immediate milestone of the transformation is expected to take place in September 2022, during the grand opening of the new city centre. The municipality is working

closely with the businesses and shop owners that were originally in the old city centre, to relocate them before that date. It is important to mention that the move of all the businesses is also financed by LKAB.

4.2.2.1 Willingness to relocate and approval

Because the community understands the importance of the relocation, most people, according to main stakeholders and to key-respondents, agree with the relocation plans. However, according to interviews, while there is a general consensus (willingness to relocate) regarding the relocation plans, the degree of approval on whether they will be relocated. According to respondents, despite the mixed feelings of the community, the reality remains positive due to the dependence of the town on the mine:

“Well, I think you have like 18,000 people living in Kiruna, so I think you would have 80,000 views. But I think overall, Kiruna is very dependent on the mine. So overall, whatever keeps the mine going is a good thing in some regards. But of course, it will be a huge impact on people's lives. I think some people are probably happy to move to new locations” (I1).

It is agreed that the following facts affect the degree of satisfaction of the community with the relocation plans:

Shortage and affordability of Housing: According to many interviewed key-informants, there has been an enormous shortage of housing in Kiruna in the last few decades (I1, I5, I6, I10). This shortage of housing leads to a higher demand on housing, which in turn leads to higher rents, creating a sense of fear for residents (I5, I1).

“It's really expensive to live in Kiruna, it's like Stockholm prices because of the housing market, so they can keep the prices high”. (I5)

“I know there's a huge concern about the new housing being more expensive compared to the old ones, so people are afraid and might not be able to afford the rent”. (I1)

Today, the workers of the relocation coming into Kiruna create an even higher pressure on the housing market. However, because they are *needed temporarily*, it is the responsibility of the employing company to provide them with accommodation, usually in the form of temporary buildings (I10).

Value for history: Although LKAB is responsible to compensate for certain historical buildings, the problem is that for some home-owners, the re-imbursement done by LKAB, which is 125% of the market value, is not enough. In certain cases, the historical value is not taken into account (I1).

“Residents, the Swedish Union of Tenants, and the Swedish Homeowners Association protested what they perceived as a forced removal that would not be duly compensated with equivalent housing”. (D24)

Since the municipality is not involved in the process, in case of a disagreement regarding the market value of a house, the mining company goes to the governmental body in Lulea, who in turn decides the value. (I10) In fact, LKAB could do this in all cases, but chooses not to, due to its desire to keep the residents happy.

Unsatisfied tenants: although the compensation scheme (mentioned in the previous section) is clear for home-owners, the situation is much more complicated for tenants who rent, or more precisely, new renters who are not eligible for any re-imbursement from LKAB. If

they are affected by the relocation, they will have to find new apartments to rent. Renters affected by the relocation face up to 7% of increased monthly payments if they want to stay in Kiruna and rent again. And if they do not, they will have to move away (D19, I6)

“Well the thing is, for myself because I have only moved back like three or four years ago, and I did not buy an apartment, I rented one. Then I don't really see how I can get reimbursed for something that I don't really own” (I6).

Although this might imply a de-incentive for tenants to stay in the town, according to the head of urban transformation in the municipality and LKAB reports (D20), the aim is to make Kiruna attractive:

“if they hadn't nowhere to live, they are leaving Kiruna, and we cannot afford that, we need people here” (I10).

In 2018, LKAB changed its compensation model, increasing it for removal expenses while lowering levels of rent of the new apartments. This was done through negotiations with the Swedish Union of Tenants and means that the rent increases gradually till its paid full in year nine (D20).

4.2.2.2 Drivers and Barriers for the relocation process (CV1 and CV2)

Based on the narrative, it is evident that the *driver for the relocation process* (CV1) is out of control, meaning that it was based on geological factors, related to the continuation of the mining industry. However, there were many *barriers* (CV2) that controlled the relocation process, beyond the framework of the independent variable. Those barriers are limited to land, weather, and time:

Land: According to a recent talk with Linus Niva of LKAB (D20), land is still a key-issue for the relocation process. To protect the communities from the mining activities, LKAB must construct new housing, and to do that it must buy new land, and buying land is not easy.

By law, LKAB can only buy land from either private landowners or from the municipality, who only owns 1% of the land. This means that for the relocation to take place, the municipality must obtain permission from the government. In the beginning it was hard for the municipality to obtain the land, so the inevitable demolishing created a pressure on the housing market. Now, according to the municipality of Kiruna, the government became well informed about the situation and this has made the processes less subject to barriers (I10). To overcome this barrier, LKAB is using land that either it owns or is owned by the municipality.

“But now LKAB are building in areas that they own or we (municipality) own. So for the moment, we don't need more land. But maybe in some few years, we will need more land”. (I10)

Time: The normal process of obtaining land and permissions for development, whether from LKAB, the municipality or the private developers is the same. The other stakeholder involved in this is the government. There are no loopholes in the law, meaning that the bureaucracy takes its share in complicating the process of relocation even further. It is not within the scope of LKAB or the municipality to overcome this barrier.

Another factor affecting the “time” is the harsh winter weather which also slows down the construction process. However, this is not related to the urban governance in any way.

4.2.2.3 Analysis of economic restructuring and relocation processes:

Although, it may seem that the strategic decision by the municipality of Kiruna in the early 90's to restructure the economy of the town is the main milestone for the process, the case study shows that several factors have led to this transition, including the natural assets and location of Kiruna, the global shock, as well as the international network of space actors. This contradicts the evolutionary economic theory of Grin et al. (2010) who suggested that transformation could be either be emergent or targeted.

In this case, the economic restructuring is driven by multiple causes, of different natures. This supports the older theory of Tykkyläinen et al. (1995), of multi causality, that implies that decisions made by a group of people is as important to the policy-driven restructuring schemes.

During the depression period of the mining industry, there were efforts to exit the lock-in of the “mining path” through diversification, however, based on the data and the “relatedness of the skills” dimension, at that time Kiruna has managed to “extend its path” towards high-tech innovation in mining and space technology. Although it might be argued that this economic restructuring has signs of “path renewal”, the fact that a) it happened through incremental actions over the course of around 30 years, and b) the expected continuation of mining, suggest that this transformation follows the “path extension” typology (Chaminade et al., 2019).

The dependency of the community and the economy on LKAB controls the willingness of the community and businesses to relocate. LKAB's embeddedness in the culture of the community has been key in leading the relocation process and places the company as a key stakeholder for both transformations. The willingness to relocate is dictated by mining, making the relocation induced; it is neither forced nor voluntary (Lasgorceix, and Kothari, 2009). Indicators like the degree of approval by the community is therefore characterized by a high degree of approval due to the consensus on the relocation plans and the financial and physical incentives.

The table 4 below summarizes the findings related to the dependent variable (urban transformation) as analysed from the process tracing of cases 1 and 2.

Table 4: Analysis of sub-variables and indicators of urban transformation (DV)

Dimensions	Indicators	Values
Economic Restructuring (Case 1)	Type of emerging Industry	Existing industries: mining and space research New industries: High-tech sectors (space industry, space education, space tourism and automated mining) and Low-tech sectors (winter and summer tourism, hospitality, knowledge-based tourism)
	Relatedness to existing industries	Tourism is unrelated to mining Space industry is related by knowledge to space research, and related by technology to the mining operations
	Emergence type	Targeted (planned) high-tech industries like space and mining Self-organized low-tech businesses of tourism and hospitality
	Reason of restructuring	Path extension of mining operations for profit-making on national level High-tech innovation (space and mining) aimed at regional competitiveness
Spatial Relocation (Case 2)	Willingness to relocate	Induced relocation, highly depends on the mining culture of the population
	Degree of approval by community	Generally high level of approval Exceptions depend on the relocated individual's approval, the value of the compensation versus the actual value of the property, and the selection of compensation methods (money versus house) Controlled by fear of expensive rentals in the future
	Type of Incentives	Financial incentives include compensation for property and businesses, and promises of cheaper housing Physical incentives include better quality of housing, better heating, and better public space.

Source: Author (2020) based on the process tracing analysis.

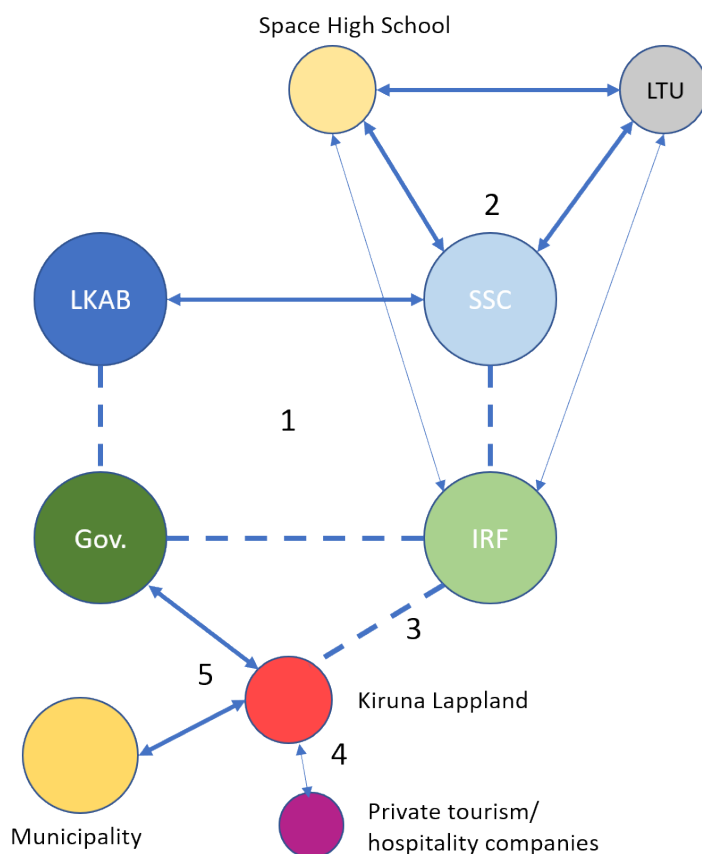
4.3 Covariational Analysis

This section provides a brief analysis of the independent variable (urban governance) in both cases 1 and 2. It is followed by a comparative analysis showing how the two governance processes have led to different forms of transformation.

4.3.1 Case 1: Governance Process

The graph 2 below simplifies the actors involved in the governance process (IV) of the economic restructuring of Kiruna. It shows the network of interactions across different domains and levels. From the graph it is clear that there have been many interrelated networks involved in the transformation over the past 30 years.

Graph 2: Actors involved in governing the economic restructuring process



Source: Author, 2020

There are at least 5 networks of interaction involved in the economic restructuring on Kiruna:

- *Network 1*: dominated by the mining company LKAB, supported by the government, who also owns the SSC (state-owned) and is represented by the IRF (national state authority). This network is driven by actors from the two main economic sectors in Kiruna, mining and space.
- *Network 2*: dominated by 3 main space sectors: space research, space education and space industry. It is important to mention that the SSC and IRF do not work together as they should as SSC is driven by profit through industry and IRF through research into space. SSC works more closely with the space high school and universities like LTU and Umu for project collaborations and student education as well as recruitment, as opposed to IRF whose role in education is minimal in the past 30 years.

- *Network 3*: represents an indirect mutual support between the low-tech tourism sector and the space sectors (education, research and industry). These two sectors use one another, one to attract labor and students (space), and the other to attract visitors (tourism).

- *Network 4*: represents the direct support of the Kiruna Lappland association to tourism companies. The companies lack any other direct support from the government; however, they indirectly receive support via the business association in the form of marketing and skill training.

- *Network 5*: The municipality supports Kiruna Lappland, by funding its tourist information center and promoting tourism in the town.

Actors Roles: the main actors in the process are the SSC (Esrange Space Center), the space educational cluster (space high school and LTU), as well as the mining company. However, the mining company remains the main employer and the major contributor to the national GDP. Tourism actors do not play any important roles in the transformation.

Decision-making levels and instruments: When looking at it, it seems that the restructuring is driven by private industry clusters (tourism, space, and mining), however the government owns the universities, the Swedish Space Corporation as well as the mining company LKAB. In this unique case, it seems that financial strength is important for decision-making.

Decision-making objectives: The main objective to diversify the economy was a reaction to the depression in the global steel market, the main objective was the long-term resilience against global shocks. However, by looking at the emergence of high-tech sectors, it seems that the objective is to make Kiruna competitiveness in high-tech labor and technology.

Interaction -leadership: The actors leading the decision making are LKAB, SSC and LTU. They control the decisions and collaborations because they control education and employment in the town. IRF's role is supportive and not leading.

Interaction – participation: The IRF has always been invited to participate in the strategic decision-making, yet it has been absent from active collaboration with the other main actors after the year 2000 as compared to before. It also seems that the municipality, who wanted to push for diversification in the late 80's, has disappeared from the process. It is important to mention that the ESA (European space agency) has a ground station in Kiruna, and has helped the space cluster grow in the beginning, but it remains unclear how it has contributed to restructuring in the past 30 years.

Interaction - rules: The rules of interaction are flexible and led by initiative, especially that the main actors are corporations and educational institutions that have their own agenda's and objectives of growth (SSC, LTU, LKAB).

4.3.2 Case 2: Governance Process

There are 4 networks of interaction involved in the relocation of Kiruna as shown in graph 3:

- *Network 1*: LKAB and the municipality of Kiruna, along with the community. Together they steer the relocation process.

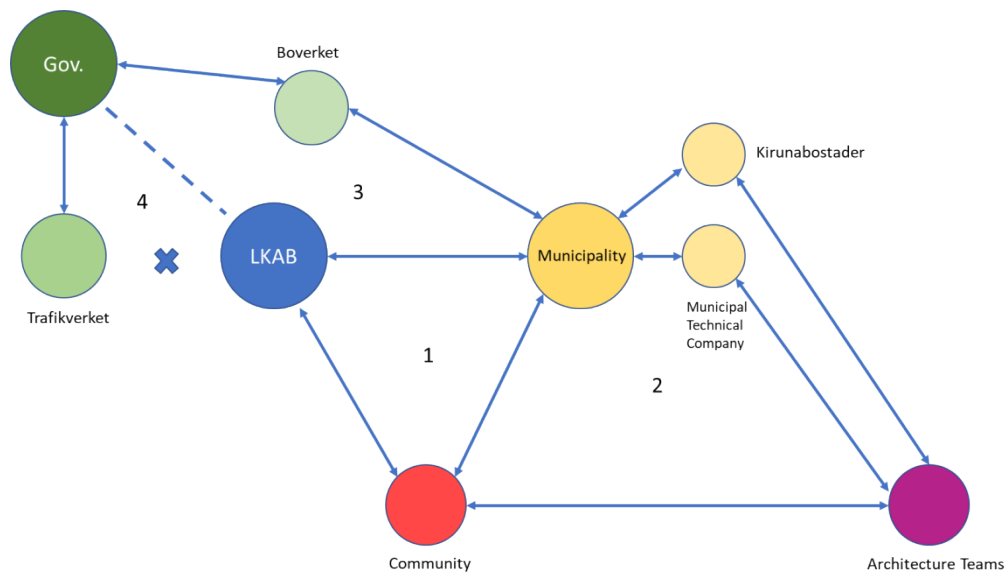
- *Network 2*: The municipality with the architecture, and the two municipal companies, and the community. They together work on implementing the relocation plans.

- *Network 3*: shows the actors involved in land purchasing, the municipality, the Boverket (public land authority) represented by the government, as well as LKAB who pays for the land.

- *Network 4*: includes the parties involved in planning the new transportation line E10, highly dominated by the transportation authority and the government, excluding any main actors involved in the relocation.

The graph 3 below simplifies the actors involved in the governance process (IV) of the economic restructuring of Kiruna. It shows the network of interactions across different domains and levels.

Graph 3: Actors involved in governing the relocation process



Source: Author, 2020

Main Actors: The main actors involved in the relocation process are the *municipality of Kiruna* and the *state-owned mining company LKAB*. They are the main decision-makers, and they both work closely with the community on the *local level*. However, the situation is more complex than that. Although some might argue that the government is represented by LKAB, being state-owned, the fact is that the government was not actively active in the process.

Actors Roles: By law, LKAB is responsible to finance the relocation of the town, and take care of the logistics in coordination with the municipality. The role of the municipality is to plan and coordinate with the technical companies, and with other public bodies on the regional and national level.

Decision-making levels and instruments: The first decision to relocate was dictated by LKAB's social responsibility towards the community, whose livelihood is threatened by the continuity of mining activities and the law. There was no alternative to the relocation decision, as it is in the interest of the government to continue mining. LKAB's decision-making instruments are financial compensation for houses and businesses. The municipality had no real power in decision-making in the beginning. However, after the main decision, the municipality's decision-making was evident on a local administrative and planning level, for instance, giving permission for private developers to build in blocks purchased from the government by the municipality (I10), so it acts as a mediator between developers, community, LKAB on the local level and the governmental bodies while purchasing land.

However, according to the law and to respondents, LKAB choose to include the municipality (local level) instead of the national level.

“LKAB could have gone to the government and demanded a moving and a closing of houses, but they didn't, they went the other way” (I10).

Decision-making objectives: Although the municipality does not have as much authority over the future of Kiruna as much as LKAB has, they both work towards the long-term sustainability of the town.

It is worth mentioning that after LKAB had informed the municipality of the necessity to relocate, politicians were under the following dilemma: either to stop the mining activities, and consequently lose most of the population as what happened before, or keep the mining. And because the municipality and the community are knowledgeable of these complicated implications on the economy and populations, they had no other choice but to support the relocation decision.

Interaction -leadership: After the decision of the relocation, LKAB took the lead to coordinate with the residents for their compensation, and to coordinate with the municipality for setting the town vision for the future.

Interaction – participation: What made the process of vision-sharing and communication easy for LKAB and the municipality is that the former represents the residents and workers in Kiruna, being the biggest employer in town, and the latter being a political representative of its community. Their level of participation in this relocation is evidently high. The government is slightly involved in the process through LKAB and through the Swedish Transport Administration and the national land register in Stockholm (boverket).

Interaction Rules: The rules of interaction are set by the municipality and LKAB. There is a steering group that holds monthly meetings according to sources from the municipality (I10). It seems that those meetings are regulated with a little room of flexibility in certain cases. There are different levels of interactions within these networks, regulated by the municipality.

“No politicians are in that (steering) group. (...) So we (municipality) have three and it's the same from LKAB (...). So we meet once a month and if there are anyt issues from the groups who work under us, then we can have a discussion about how to solve them”.(I10).

However, for other actors, such as the developers, the municipality has stricter rules. When land is available for development, the developers are given a period of 1 year to finalize their plans before passing them for approval (I10).

4.3.3 Comparison and implications

This section aims to explain how different forms of urban governance (IV) caused different forms of transformations (DV) in Kiruna.

Table 5: Comparison of IV with respect to DV

Urban Governance (IV)	Case 1: Economic Restructuring (DV 1)	Case 2: Spatial Relocation (DV 2)
Actors (types, levels, roles)	<p>More actors are involved, complex networks</p> <p>Dominated by state-owned companies and educational institutions</p> <p>Actors role is to support the local economy and create employment opportunities</p>	<p>Less actors are involved, simple networks</p> <p>Dominated by state-owned and municipal companies</p>

		Actors role is determined by law (financial compensation by LKAB, planning and implementing physical relocation by municipality)
Interaction	<p>Main decisions are led by LKAB and SSC (both state-owned corporations)</p> <p>Less collaboration across levels (mainly among local)</p> <p>Government is not actively involved</p> <p>Higher level of collaboration across sectors and within sector clusters (LKAB, SSC, IRF, LTU)</p> <p>High level of coordination and dialogue across actors for short term projects</p>	<p>Main decisions are taken by LKAB and municipality (representing the community)</p> <p>More collaboration across levels (community, municipality, county, national)</p> <p>Government is not actively involved</p> <p>High level of collaboration between main local actors (LKAB, municipality, community)</p> <p>High level of coordination and dialogue between local actors, and low level of dialogue with national actors.</p>
Decisions	<p>Decisions are driven by profit making</p> <p>Decisions are made locally, across sectors (space, tourism, mining)</p> <p>Funding and profit control decision making</p> <p>Objectives are towards regional specialization in high-tech for longer term</p>	<p>Decisions are driven by democracy, and by continuation of mining.</p> <p>Decisions are made locally</p> <p>Laws and culture control decision making</p> <p>Objectives are towards the sustainability of the town and satisfaction of community</p>
triggers of urban transformation (CV1)	<p>Locational assets (nature, aurora, cultural activities)</p> <p>Shock in global market demand</p> <p>International cooperation in space sectors</p>	Cracks caused by Mining continuation
barriers of urban transformation (CV2)	<p>Shortage of housing</p> <p>Lack of local government support</p> <p>Lack of land for tourism growth</p> <p>Bad transport connectivity</p>	<p>Time and bureaucracy dictated by law</p> <p>Lack of land for relocation</p> <p>Harsh winter weather</p>

Source: Author (2020), based on findings from sections 4.2 and 4.3

The relocation is highly dictated by the Mineral Law that obliges the main actors (LKAB and the Municipality) to assume their roles. By law, LKAB is obliged to pay for the transformation and the municipality must do the planning and coordination with the community and relevant stakeholders.

However, by law LKAB could have decided to support the relocation financially without having to participate in the planning. LKAB is a state-owned company, but it would rather deal with the local government than the central government.

The reason why LKAB chose to participate, is because LKAB knew from the beginning that it would have to buy the land from the municipality in purpose of the relocation, and that it needs their cooperation for obtaining more land. The company chose to push the municipality to deal with the complications of the “national interests” with the government, through land purchasing and planning. It is important to mention that according to the Municipality of Kiruna, there are several national interests in Kiruna, other than the mining, such as “national interest in the cultural environment, reindeer husbandry, tourism, communication and minerals” (D14).

It is clear the government distanced itself from the operations by leaving all the responsibility to LKAB, effectively using its charter and the Mineral Law to shield itself from responsibility, although the barriers to urban relocation were mostly rooted in the governments’ policies that pushed the mining company to purchase property and land from the municipality.

Because the relocation was not initiated by actors, but rather by law, it is difficult to prove that this is a form of network governance. Additionally, although there are indicators of network governance, having a very powerful actor (LKAB) proves that it not a form of network governance. Actors do not have their own agenda's, but they are rather reacting to the consequences. The form of governance in the case of relocation could be better explained through a *Public Private Partnership* between a strong public authority (municipality) and a strong state-owned corporation (LKAB). On another hand, the choices made by LKAB show an interesting case of social entrepreneurship and responsibility because it has involved the community, which adds an extra dimension of "participatory-approach governance" to the equation. It is perhaps a very "*atypical form of governance*" in this town.

The governance process of economic restructuring involved many networks of stakeholders interacting at different levels. The main trigger that led economic restructuring is the shock in the global steel market. The efforts of diversification that first began as a municipal decision, resulted in two cases of economic transformation: 1) *The low-tech tourism sector*, and 2) *the high-tech variety* (mining and space).

The governance of low-tech tourism sector is characterized by governance with less actor networks, mostly the business association and the individual companies. In this case of governance, there is a low level of interaction with other networks of higher level. This indicates that the low level of interaction, and the low level of planning among the actors, has resulted in a more *self-organized* transformation at a local level. The best way to describe this form of governance is *partially planned governance*.

The governance of high-tech diversified sectors (mining and space) is characterized by high levels of coordination between actors, at different levels, across different sectors. These actors have more funding and support from the government, and have different interests of profit-making and growth, yet they work together strategically to attract more skills and funding. One can infer that the form of governance used in this case is "*network governance*", and has led to a *diversified*, highly networked, and futuristic economy.

This leads us to conclude that different forms of urban governance do in fact explain the differences in transformation processes and outcomes. While there is a large overlap between the two transformations, for instance there are driven by similar central actors (LKAB, municipality, SSC, universities), there is a variation in the level of interaction and coordination among actors. The *high level of coordination had led to high-tech diversification* because it was driven by profit and different interest of stakeholders, while the *lower level of coordination had led to the emergence of low-tech local tourism*.

The low the main decision was the government's support to LKAB for automizing its which created demand for high-tech skills. Although the restructuring efforts to diversity towards tourism and space were initiated by the municipality in the beginning, the key to urban governance leading to economic restructuring was the collaboration between stakeholders within each sector and across different sectors.

Similar to the urban relocation, the central government has also been absent from the economic restructuring in the past 30 years. However, the fact that the government owns the two main stakeholders (LKAB and SSC) shows that the government was indeed, indirectly involved in the process, yet has chosen to leave responsibility to its local corporates.

4.4 Congruence analysis:

This section aims to test the null hypothesis H_0 : *Transition Management (TM) theory explains the model of governance that has led to urban transformation of Kiruna.*

The hypothesis is tested by constructing a truth-table (table 6) for Transition Management Theory based on its framework (Rotmans et al., 2001; Loorbach, 2010; van Dijk and Edelenbos, 2017). This section serves to test if the theory explains the urban governance process dominating the transition of Kiruna over the past 30 years.

Table 6: Truth-table for transition management theory

Transition Management Theory	Case 1: Economic Restructuring (DV 1)	Case 2: Spatial Relocation (DV 2)
Long term thinking to develop short term policies	Strengthening the economy through small diversification efforts, focusing on high-tech education driven by innovation so that the city attracts a labour-market that is interested in futuristic economies (complete automation in resource extraction/mining, commercial spaceflights, space industry, etc.).	Long term thinking considers climate change and continuation of mining, aims to attract people and skills. Short term policies include participation of community in the process and innovative sustainability measures in infrastructure and housing designs.
Multi-domain, multi-actor and multi-level	Involvement of different actors and domains (space, education, government, private companies, mining, and tourism), working through different networks and exchanging resources. Process takes into consideration national interest as well as community economic empowerment through diversification.	Involvement of municipality, mining company, official authorities, community and planners. Networks of actors work across different sectors (industries, housing, technology, infrastructure, businesses) and across multiple levels (local, provincial, national).
learning-by-doing and doing-by-learning	Learning-by-doing evident in evolution of mine (depression, automation), as well as the synergy between space education and space industry. Doing by learning evident by introducing space education from upper secondary level, to prepare for labour market and relevant skills.	Learning by doing evident from LKAB's experience in relocation, due to previous ground cracks. Doing by learning evident through the consideration of the residents' ideas into the relocation plans through discussions.
Combines system improvement with system innovation	The automation in the mining operations is an example of system innovation that attracts technological skills to Kiruna. Another example is the use of geo-sensing technology from the space industry to help in underground sensing of the mines. Path renewal vs high-tech innovation	Evident through the improvement of different infrastructural problems through innovative systems. For instance, due to previous demolishing of housing due to maintenance costs of heating, the solution was to convert the heat from the mining activities to use for the new houses.
Resilient, flexible, and open	Resilient: the outcome is a diverse economy, with high-tech competitive economy that suggests future resiliency Flexible: Does not follow a certain strategy, but rather follows innovation in collaboration and projects Open: Led by industries that support each other and welcome new ideas and new skills, through continuous collaboration and dialogues.	Resilient: climate responsive plans and systems, in aim of creating sustainable and liveable town Flexible: Different schemes had been changed based on feedback from the community. Also evident by flexibility of community to relocate, despite their approval or disapproval of plans. Open: Transparent plans that included the public in its planning process, and ongoing discussions through steering groups.

Based on Rotmans et al. (2001); Loorbach (2010); van Dijk and Edelenbos (2017)

By looking at the framework of transition management theory, we can say that the theory is applicable to the two cases of transformation. Therefore, the null hypothesis H_0 is not rejected.

However, the degree of significance of this applicability is in question. That is because TM is designed to explain radical transformation of systems and regimes, however, there is no evidence of radical system change in Kiruna because the same powerful players remain the

same before and after the transformation. For instance, the mining company LKAB has managed to remain the main employer in the town even after transitioning to high-tech operations. Additionally, the transformation in the case of Kiruna is a result of many decisions and actions by many actors over a considerable amount of time. While the transition management indicators do explain the outcome (relocation and restructuring), they fail to explain the co-existence of several urban governance approaches leading to path-renewal.

This analysis implies that transition management model is not ideal to explain the governance of Kiruna's urban transformation. Other theories of urban governance like public private partnerships, network governance, and self-organization better explain the different transition paths and lead to a better understanding of the complexity of the transformation.

Chapter 5: Conclusion and Recommendations

The main objective of this research was to explain how governance processes led to the spatial relocation and economic restructuring of Kiruna in the past 30 years. Chapter 5 provides a conclusion that starts by answering the research questions briefly while linking concepts to theory, and follows by the academic contribution of the research, as well as recommendations for policymakers and recommendations for further research.

5.1 Answering the research questions

It is important to mention that before analysing the governance leading to different urban transitions, I made the assumption that the economic restructuring process would be more bottom-up and self-organized than the relocation process due to the existence of more stakeholders in the process. However, the analysis had different results: Findings have shown that there were three paths of transitions in Kiruna, one for the location (public private partnership), and two different paths for the economic restructuring (self-organization resulting in low tech tourism growth versus network governance leading to high tech diversification)

Research Question 1: How did governance processes lead to the economic restructuring of Kiruna over the past 30 years?

The economic restructuring followed two transition paths: one resulted in a high-tech diversified economy of space and mining, and another one with a low-tech tourism sector, independent of the first one, and not economically significant to the economy.

The governance processes leading to the high-tech diversified economy is characterized by a large network of sector clusters, having different conflicting interests in aim of profit. They collaborate for profit-gains yet end up complementing each other by sharing technology, knowledge, and skilled-labour. It is a strategic collaboration with high coordination among multi-level networks and actors. This type of transition is best explained through the model of network governance.

The governance process leading to the low-tech tourism sector is characterized by a partially planned, self-organised governance with less networks and more actors, mainly under one network (Kiruna Lappland). Tourism is only culturally significant, and not economically significant. It is used to attract students and labour to the other important sectors (space and mining)

Although both restructuring processes were triggered by the economic shock and were planned by stakeholders in the 1990's, the difference is the lack of significant governmental support for the low-tech sector, primarily because the actors involved are small and medium enterprises that aim for "privatized profit", whereas the second type of restructuring creates "high-profits for the state-owned" companies that are significant on the national-level and makes Sweden's Norbotten region competitive in high-tech operations in mining and space.

Research Question 2: Which transition path best explains economic restructuring in Kiruna?

In the beginning of this research, it may seem that the economy diversified from mining (resource-economy) towards unrelated economies (tourism and space), it was later evident that the real restructuring was aimed towards high-tech economy that is related by technology, knowledge and education (space physics, spacecraft testing, mining automation, etc.).

This suggests that Kiruna is undergoing a path-renewal, keeping them path of mining industry operational while introducing other strong economies with related skills. This skills would be beneficial for both the existing and the new path. The economic restructuring in Kiruna seems

to be aimed at regional or global competitiveness in high-tech operations. The reason to suggest this is that efforts of relocation and the compensation model are driving the current residents of Kiruna away, therefore showing that there might be a strategy by the government or its state-owned companies that dominate the process (LKAB, SSC), an attractive city for high-skilled labor only. This might be why the housing market in Kiruna is becoming more and more expensive, reaching rents higher than those in Stockholm.

Research Question 3: *How did governance processes lead to the relocation of Kiruna?*

The governance model used to relocate Kiruna could be best explained through a Public Private Partnership between the LKAB and the municipality, that was enforced by law along with social responsibility. Although LKAB is state-owned, it performs like a private corporation. The two strong actors control the relocation process. Although there is a participatory approach in this model to enforce democracy, the community had a general acceptance of the relocation plan because it was a matter of existence. This made the participatory approach not very necessary for the relocation, but a sign of solidarity of LKAB with the people. This contradicts with the compensation plans of the housing and properties, and the acquisition of LKAB of land through the municipality. The relocation of Kiruna has made LKAB even more powerful than before, as now it owns the land on which the town is built on, and the housing.

A further implication of this is that LKAB will be in control of the businesses and the type of residents living in Kiruna after the year 2035. This supports the speculations that Kiruna will be a very attractive city for highly skilled labor, with a futuristic economy and climate-responsive infrastructure.

H0: Transition Management (TM) theory explains the model of governance that has led to economic restructuring and to spatial relocation of Kiruna.

As mentioned before, the framework of transition management was not ideal to explain how governance in Kiruna has led to its transformation. While the model could explain transformation in general (dependent variable), it has failed to explain the independent variable's relationship with the DV. This supports the critique of the transition management theories that explain how the framework is vague and far from practice (Kemp et al., 2007; Loorbach, 2010) because in most cases the context is very specific. Perhaps the framework is more useful for managing specific types of transition (ie. energy transitions) in northern European countries like the Netherlands, Belgium and UK. Or perhaps, the transformation in Kiruna is slower than the type of transitions that the TM model is based on.

5.2 Contribution to theory

This research contributes to a growing body of research on theories of urban governance (Campbell, Hollingsworth, and Lindberg, 1991; Healey et al., 1995; Rhodes, 1997; Pierre, 1999; Stoker, 2000; Castells, 2000; Klijn and Koppenjan, 2007; Edelenbos et al., 2008; Edelenbos and Teisman, 2013; van Dijk and Edelenbos, 2017). It suggests however that despite that governance theories focus on actors, they do not pay enough attention to the degree of power of each actor, whether financial or cultural power. It is important therefore to include these dimensions into the models of urban governance.

This research also adds to evidence that transition management theory is very context specific ((Kemp et al., 2007; Loorbach, 2010) and is very generic and far from practice. For instance, in this research, TM framework would have been applicable and valid if we only looked at the transformation outcome, and did not properly analyze the independent variable, that is urban governance (actors, interactions, and decisions).

Additionally, this case study supports evolutionary economist theories that propose that unrelated emerging industries are often technologically related to existing industries (Frenken et al., 2007). It also provides empirical evidence to new theories (Content and Frenken, 2017) that suggest that there is often a spill-over of knowledge across sectors leading to related and unrelated varieties.

Moreover, the research supports theories that propose that coordinated-markets tend to diversify to related economies by leveraging existing knowledge and collaborative relationships (Boschma and Capone, 2015). While this supports theories of “targeted” diversification, (Tykkyläinen et al., 1995; Berkhout et al., 2004; Grin et al., 2010), it is still unclear if one typology is dominant due to the self-organization of the low-tech economy.

5.3 Recommendations for policymakers:

This case study represents a unique case of incremental urban transition. Although the context might be very original, the findings provide policymakers and decision makers - especially those working in governance or governing urban transitions - with the following recommendations:

- a) It is important for decision-makers to keep different governance options open and accept different models of governance based on the actors and the concept. This case study has showed that urban transformation could be steered by difference governance models based on the available resources, actors and interest of stakeholders involved.
- b) Universities play a big role in transformations, and involving is necessary for mediation, especially when there are interconnected networks of economically powerful stakeholders with different interests.
- c) Networks of private (or state-owned) actors work faster than public private partnerships, due to the lack of bureaucracy, which explains why governments operate through-state owned corporations like LKAB and SSC.
- d) Governance networks should be designed in a way that keeps the governmental actors at one level of the network, because the government protects will act as a barrier when a conflict of interest with national interest appears.
- d) Culture plays a big role in governing spatial and economic transformation. For instance, it controls the willingness of communities to relocate and sets the degree of approval. Therefore, to properly govern relocation plans, it is required to set long-term visions that take culture into account. When the culture is highly embedded in the identity, it becomes difficult for policy-makers to create radical transitions that transform cultures. This case-study has proven that change happens incrementally and not radically.

5.4 Limitations and recommendations for further research:

This research combines two complex embedded case studies within one context. This makes the findings ideal for empirical testing of theories yet limits their replicability on other cases of urban transformation. The existence of the mining company, which is a nationally – and regionally – important, which questions the external validity of the results. Although it is unique, it speculates that the findings vary if LKAB was isolated in this transformation. Another limitation of the study is that it did not take into consideration more variables such as democracy, culture, and ownership, which were proven to be important in this case study.

For further research, it is recommended to combine this case study with another case of urban transformation and see whether the findings would change. Perhaps what would be very interesting for further research, is to continue tracing the urban transformation for another 15

or 20 years and see how the governance processes vary in the findings. Moreover, it is recommended to study the economic diversification of Kiruna on its own, using a quantitative approach, focusing on the relatedness and unrelatedness of skill across mining, space and tourism.

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Annex 1: List of interviewed key-informants

	Title	Affiliation	Focus	Date & Time	Duration
I1	Senior Lecturer in Urban Design & Conservation	Luleå University of Technology	Relocation	Jun 22, 2020 11:20 AM	26 minutes
I2	Managing Director and CEO	Kiruna Lapland Economic Association	Tourism	Jun 23, 2020 2:05 PM	30 minutes
I3	Project manager RIT2021	Luleå University of Technology - Business	Education	Jun 24, 2020 8:05 AM	30 minutes
I4	Personnel and Administration Manager	Swedish Institute of Space Physics IRF	Space	Jun 30, 2020 10:15 AM	23 minutes
I5	Teacher Chemistry, Biology, Astrobiology, Human Space Flight	Swedish High School of Space Science & Technology	Space	Jul 13, 2020 3:00 PM	50 minutes
I6	Sales & Booking Manager	Camp Ripan AB	Tourism	Jul 14, 2020 1:00 PM	30 minutes
I7	Project Manager - Development Department	Municipality of Kiruna	Relocation	Jul 16, 2020 3:00 PM	35 minutes
I8	Politician	Municipality of Kiruna	Relocation Tourism	Jul 16, 2020 6:00 PM	48 minutes
I9	Former Director	Swedish Institute of Space Physics IRF	Space	Jul 17, 2020 11:00 AM	62 minutes
I10	Head of Development Department	Municipality of Kiruna	Relocation	Jul 22, 2020 2:00 PM	43 minutes

Annex 2: List of secondary data used in the study

No.	Type	Source	URL
D1	Academic Paper	Sandahl, I. and Norberg, C., 2003. Space education at Kiruna Space and Environment Campus. ESASP, 530, pp.75-77.	http://adsabs.harvard.edu/full/2003ESASP.530...75S
D2	Academic Paper	Sandahl, I., Wikström, A., Crosby, N., Welch, C. and Chambers, L., 2005. Space education in Kiruna, Northern Sweden. Advances in Geosciences, 3.	https://www.diva-portal.org/smash/get/diva2:985327/FULLTEXT01.pdf
D3	Academic Paper	Nilsson, B., 2010. Ideology, environment and forced relocation: Kiruna-a town on the move. European Urban and Regional Studies, 17(4), pp.433-442.	https://journals.sagepub.com/doi/abs/10.1177/0969776410369045?casa_token=o_PVmc8CHRYAAAAA:WjNAk5iYgByWrNuzIp3IgiLniHSYti9baMk4n0xNC7IxJC_GLJ5yIBAN7eQrhDw7-dj4aDXR7AsQ
D4	Academic Paper	King, A.D., 2010. A good society based on economical and cultural growth: What is Kiruna?. In Dilemmas for Human Services: 10/09/2010-11/09/2010.	https://www.diva-portal.org/smash/get/diva2:1011034/FULLTEXT01.pdf
D5	Online Article	Elektor. 2020. Kiruna: A Case Study In Public Acceptance.	https://www.elektormagazine.com/news/Kiruna--a-case-study-in-public-acceptance
D6	Academic Paper	Granås, B., 2012. Ambiguous place meanings: living with the industrially marked town in Kiruna, Sweden. Geografiska Annaler: Series B, Human Geography, 94(2), pp.125-139.	https://www.jstor.org/stable/pdf/23254571.pdf?casa_token=iuZCWxSXjikAAAAA:0IRo5VjKMNQ9CnxJmrMvggwlw2lZdnwsyynEmOgcwe-PUAVchXoMWotgUhT4NYaHBStq5HJMvQnu2tBo-VikmEWyTi9_5Cjh8T2_k4iZUX1PWRgNjG8
D7	Online Article	Hult, M., 2013. Moving A City. KTH.	https://www.kth.se/en/abe/forskning/forskproj/att-flytta-en-stad-1.413784
D8	Report	Berlina, A., Hörnström, L., Diş, A.T. and Fors, N.B.S., Case Study Report: Kiruna-Narvik (KINA) region.	https://archive.nordregio.se/Global/Research/EUROBORDERREGIONS/KINA%20Nordregio.pdf
D9	Secondary Data	Stockholm Resilience Centre, 2016. Kiruna - Relocation For Mining Activities. Stockholm: Stockholm University.	https://stockholmuniversity.app.box.com/s/www7j612uysvkeswggurajawoduwa0i4
D10	Academic Paper	Backman, F., 2015. Making Place for Space: a History of Space Town Kiruna 1943-2000 (Doctoral dissertation, Umeå universitet).	https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A801604&dswid=7386
D11	Webpage	LKAB, 2019. Community And Mine Together.	https://samhallsomvandling.lkab.com/en/urban-transformation/community-and-mine-together/
D12	Academic Paper	Sjöholm, J., 2017. Authenticity and relocation of built heritage: the urban transformation of Kiruna, Sweden. Journal of Cultural Heritage Management and Sustainable Development.	https://www.emerald.com/insight/content/doi/10.1108/JCHMSD-11-2015-0041/full/pdf?casa_token=yhTbCELhFMkAAAAA:k81scpTagsZwpZFSwHzScBZTg-NHuaToleKul8sET32e6ZO29qzhJJps0vrXc7ZCy8lj1SMxeSzJ1x5VF_av1iK9NBbpAo2w0LcNXJSA-BuKQw7elQcgY
D13	Academic Paper	Suopajarvi, L., Ejdemo, T., Klyuchnikova, E., Korchak, E., Nygaard, V. and Poelzer, G.A., 2017. Social impacts of the “glocal” mining business: Case studies from Northern Europe. Mineral Economics, 30(1), pp.31-39.	https://link.springer.com/content/pdf/10.1007/s13563-016-0092-5.pdf

D14	Webpage	Kiruna Municipality, 2020. Urban Transformation	https://kiruna.se/stadsomvandling/
D15	Academic Paper	Huisman, C.J. and Bengtsson, A., Innovation opportunities from rebuilding a city: the case of moving the city of Kiruna.	https://www.impgroup.org/paper_view.php?viewPaper=9036
D16	Academic Paper	Gebremedhin, F., 2018. Urban planning from scratch: collaboration and participation of stakeholders in the urban transformation of Kiruna.	https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1221865&dswid=5197
D17	Online Article	Agents of Change in Old-industrial Regions in Europe. 2019. Sweden – Case Study 2: Kiruna.	https://acore-project.eu/case-studies/sweden-case-study-2-kiruna/
D18	Online Article	Casey, J., 2019. Moving A Town To Save A Mine: The Story Of Kiruna. [online] Mining Technology.	https://docs.google.com/document/d/1xn8FUzk12_AGdp8JMw0JrZTgsV6ICwUdM3r2S4cipQU/edit#heading=h.6nk22yza98zl
D19	Online Article	Casey, J., 2019. Moving A Town To Save A Mine: The Story Of Kiruna.	https://www.mining-technology.com/features/moving-a-town-to-save-a-mine-the-story-of-kiruna/
D20	Report	LKAB, 2019. Where Mine Meets Town. LKAB.	https://www.lkab.com/en/SysSiteAssets/documents/publikationer/broschyren/where-mine-meets-town.pdf
D21	Webpage	Kiruna Municipality, 2020. Timeline.	https://kiruna.se/globalassets/stadsomvandlingswebb/besokare/tidslinjen-folder-svenska2.pdf
D22	Webpage	SSC - Swedish Space Corporation, n.d. History.	https://www.sscspace.com/about-ssc/history/
D23	Online Article	LKAB, 2020. Serious Talk With Linus Niva.	https://samhallsomvandling.lkab.com/en/news/serious-talk-with-linus-niva/
D24	Academic Paper	Haikola, S. and Anshelm, J., 2020. Evolutionary governance in mining: Boom and bust in peripheral communities in Sweden. Land use policy, 93, p.104056.	https://doi.org/10.1016/j.landusepol.2019.104056

Annex 4: An example of semi-structured interview questions

- How would you describe the process of urban transformation of Kiruna in the past 25 years?
- Who were the stakeholders who were steering process?
- Who was responsible for what?
- What was the role of the government?
- Who else was involved in decision-making?
- How would you describe the interaction of actors?
- What were the milestones in this transformation? Their objectives?
- Were there any barriers to this process? Who/what created these barriers? How were they overcome?
- What were the incentives of the relocation?
- How would you describe the level of satisfaction or approval of the decisions and plans?
- How did the relocation affect the economy?
- Were there any strategies to boost the emerging industries? By whom?
- How are the new industries related to mining? To each other?
- How would you describe the learning curve across the past 25 years?

Annex 4: Description of actors involved in the transformation

Actors Names	Description
Kiruna Municipality (Kiruna Kommun)	A municipality in Norrbotten County in northernmost Sweden. It covers 20,715 square kilometres, making it the largest municipality in Sweden (4.604% of its total area).
Kirunabostäder	Kirunabostäder AB is a non-profit housing company owned by Kiruna municipality. It manages, develops and builds houses in Kiruna.
Tekniska Verken i Kiruna AB	Municipal company - responsible for long-term sustainable community service, technical infrastructure and development for the entire Kiruna municipality.
LKAB	State-owned - high-tech mining company that mines and processes iron ore for the global steel market.
Swedish Transport Administration, (Trafikverket)	National authority which is responsible for all intermodal long-term infrastructure planning for road, rail, sea and air transport, and for the planning, building, operation and maintenance of the state roads and railways.
County Administrative Board	Official authority - Represents and safeguards the state's interests in the various processes of the Planning and Building Act, by issuing preliminary decisions, permits, start decisions and completion decisions.
The National Board of Housing, Building and Planning (Boverket)	A national authority that has the task of guiding, investigating and analyzing issues that concern urban planning, building and housing. It has the possibility of issuing regulations in some cases.
Luleå University of Technology	State owned university for applied sciences. Lulea university has a campus in Kiruna where it offers its space engineering programme.
Umeå University	State owned university based in Umea, offering undergraduate and graduate courses in space physics.
The Kiruna Sustainability Center	An arena where municipalities, businesses, research actors and citizens work together to develop and test innovative ideas for a sustainable and smart new Kiruna.
Swedish Institute of Space Physics IRF	It is a governmental research institute. Its task is to carry out basic research, education and associated observatory activities in space physics, space technology and atmospheric physics. Its main office is located in Kiruna.
Rymdgymnasiet (Space high school)	Municipality owned high school based in Kiruna, that gives high-school courses in space science and operations.
The European Space Agency (ESA)	Europe's gateway to space, shapes the development of Europe's space capability and ensures that investment in space continues to deliver benefits. ESA has a launch station in Kiruna.
Esrang Space Center (Swedish Space Corporation - SSC)	State-owned and operational since 1966, Esrange accommodates one of the world's largest civilian satellite ground stations and acts as a hub for the SSC' satellite station network. SSC is a leading global provider of advanced space services.
Kiruna Lapland Economic Association	It is an organization that promotes the travel industry within Kiruna, has about 120 members of private tourism companies, and runs the authorized Tourist Center.
Architecture team	Architecture team that won the design competition for the new Kiruna town: White arkitekter AB (Stockholm), Ghilardi + Hellsten (Oslo), Spacescape (Stockholm), Vectura Consulting AB (Solna) and Evidens BLW AB (Stockholm)
Spaceport Sweden (Inactive)	It is a pioneering initiative to establish commercial human spaceflight in Kiruna and become Europe's gateway to space.

Annex 5: Development of space operations in Kiruna

	IRF	EISCAT	SSC (Esrang)	§	Satellitbilder†	∞	Diverse	Rymdutbildningar*	Rymdgymnasiet	TOTAL
1956	3	0	0	0	0	0	0	0	0	3
1957	4	0	0	0	0	0	0	0	0	4
1958	13	0	0	0	0	0	0	0	0	13
1959	16	0	0	0	0	0	0	0	0	16
1960	20	0	0	0	0	0	0	0	0	20
1961	23	0	0	0	0	0	0	0	0	23
1962	26	0	0	0	0	0	0	0	0	26
1963	29	0	0	0	0	0	0	0	0	29
1964	29	0	0	0	0	0	0	0	0	29
1965	30	0	0	0	0	0	0	0	0	30
1966	31	0	0	0	0	0	0	0	0	31
1967	33	0	32	0	0	0	0	0	0	65
1968	34	0	71	0	0	0	0	0	0	105
1969	36	0	85	0	0	0	0	0	0	121
1970	38	0	85	0	0	0	0	0	0	123
1971	39	0	85	0	0	0	0	0	0	124
1972	40	0	85	0	0	0	0	0	0	125
1973	42	0	35	0	0	0	0	0	0	77
1974	43	0	35	0	0	0	0	0	0	78
1975	45	0	35	0	0	0	0	0	0	80
1976	46	0	35	0	0	0	0	0	0	81
1977	47	5	35	0	0	0	0	0	0	87
1978	48	5	35	0	0	0	0	0	0	88
1979	49	5	39	0	0	0	0	0	0	93
1980	50	5	43	0	0	0	0	0	0	98
1981	51	5	47	0	0	0	0	0	0	103
1982	52	5	51	0	0	0	0	0	0	108
1983	53	6	54	0	0	0	0	0	0	113
1984	54	6	61	15	0	0	0	0	0	136
1985	54	7	72	23	0	0	0	0	0	156
1986	55	9	95	43	0	0	0	0	0	202
1987	57	9	80	49	0	0	0	0	0	195
1988	59	9	90	52	0	0	0	0	0	210
1989	60	9	115	55	0	0	0	0	0	239
1990	63	9	116	60	0	0	0	0	0	248
1991	63	9	124	65	0	0	0	0	0	261
1992	66	9	140	70	0	0	0	0	0	285
1993	69	9	146	76	0	35	0	0	0	335
1994	69	9	142	76	0	68	0	0	0	364
1995	71	13	140	56	0	116	0	0	0	396
1996	68	10	140	55	0	122	0	0	0	395
1997	71	9	140	64	0	159	0	0	0	443
1998	73	7	140	74	0	182	0	0	0	476
1999	75	8	148	73	0	197	0	0	0	501
2000	77	8	146	35	1	202	0	0	0	469
2001	75	8	160	25	1	181	25	0	0	475
2002	70	9	162	35	2	157	54	0	0	489
2003	70	8	167	35	2	110	81	0	0	473
2004	72	8	173	20	3	110	95	0	0	481
2005	72	8	172	20	5	113	95	0	0	485
2006	71	8	177	13	0	46	95	0	0	410
2007	70	7	174	11	0	56	95	0	0	413
2008	67	8	169	11	1	56	95	0	0	407
2009	61	7	169	11	1	54	95	0	0	398
2010	60	7	150	11	2	55	149	0	0	434
2011	56	7	166	8	1	64	159	0	0	461
2012	57	7	178	8	2	50	145	0	0	447
2013	54	8	177	6	1	102	130	0	0	478
2014	57	9	179	6	1	113	115	0	0	480
2015	65	10	142	4	3	130	103	0	0	457
2016	63	11	154	2	3	152	95	0	0	480
2017	56	11	138	1	3	147	95	0	0	451
2018	63	12	150	1	1	151	95	0	0	473
2019	58	13	135	1	1	141	95	0	0	444

* Rymdutbildningar (UmU och LTU - studenter och anställda)

∞ Diverse (Spaceport Sweden, Kiruna Space, LTU Business, forskningsturism mm)

† Satellitbilder (Lantmäteriet, Metria, Satellus, Satellitbild och Miljödatacentrum)

§ SSC Esrange och ESA Salmijärvi

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Source: Swedish Institute of Space Physics IRF, 2019

Annex 5: History of mining in Kiruna

IT STARTS WITH THE IRON

1696 The ore-rich mountains Luossavaara and Kiirunavaara, after which LKAB was named, are mentioned for the first time in a document by Samuel Mört, a bookkeeper at the Kengis works.

1888 The first ore train rolls along the Ore Railway from Malmberget to Luleå.

1890 The company Luossavaara-Kiirunavaara Aktiebolag – LKAB – is formed.

1898 Hjalmar Lundbohm is appointed as local manager in Kiruna. Later he becomes the company's first general manager, and right up until his retirement in 1920 he remains a strong driving force in the development of LKAB and the entire region.

1902 The railway is completed all the way to Narvik, ensuring that the iron ore can be transported to the ports of both Narvik and Luleå.

1903 Grängesberg'sbolaget takes control of LKAB.

1910 The first processing plant is taken into use. The same year, property company Kiruna-Gällivare Fastighetsaktiebolag is formed. The company still exists today, under the name LKAB Fastigheter.

1912 Kiruna Church is completed, a gift from the company to the parish. The church will be moved to the new centre of Kiruna as part of the urban transformation.

1940 Narvik is invaded by the Germans and the port is blown up. Ore traffic focuses on Luleå until the port of Narvik is rebuilt.

1955 LKAB's first pelletising plant – the first such plant in Europe – is taken into operation in Malmberget, increasing the degree to which the iron ore is upgraded and thus also the value added for customers.

1957 The Swedish state becomes the owner of 96 percent of the shares in LKAB.

1964 The Svappavaara mine is opened, along with the railway from Kiruna to Svappavaara. The same year the new port in Luleå is completed – at the time, the largest single investment ever made in a Swedish port.

1973 Driverless trains are introduced into regular use in the underground mines.

1976 LKAB becomes 100 percent owned by the Swedish state.

1982 LKAB takes the decision to introduce large-scale sub-level caving, increasing productivity noticeably. LKAB develops olivine pellets, which prove to be a highly competitive pellet product.

1989 The subsidiary Minelco, now LKAB Minerals, is established. Its task is to develop markets for the iron ore outside of the steel industry.

1997 Wireless communication is introduced into LKAB's underground mines using the Wireless Underground Communication System (WUCS) system.

2001 One of the world's strongest electric locomotives is called IORE. Both strong and incredibly energy-efficient, it saves LKAB around 6 percent of energy per tonne of ore transported.

2004 LKAB notifies the Municipality of Kiruna that the continued ore mining will impact the built-up area of the city.

2004 LKAB establishes the Hjalmar Lundbohm Research Centre and gives SEK 100 million in research grants to Luleå University of Technology.

2010 LKAB earmarks a budget of billions of kronor for future urban transformations in Kiruna and Malmberget.

2011 LKAB makes record profits. The same year the LKAB Academy foundation is established to secure future recruitment.

2015 LKAB celebrates 125 years and publishes a book about the company's history.

2018 The starting shot for the SUM (Sustainable Underground Mining) initiative to develop a new world standard for sustainable mining at great depths.

2023 Estimated start of production for the ReeMAP initiative to produce phosphorous and rare earth elements.

2035 The current main haulage levels are expected to be mined out and the whole of the centre of Kiruna is expected to have been moved.

2045 In partnership with SSAB and Vattenfall, LKAB is running the HYBRIT initiative for future fossil-free steelmaking. If the initiative succeeds it will make a decisive contribution to meeting Sweden's climate goals for 2045.

Source: LKAB.com, 2019

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