TO HOOK ON OR TO UNHOOK: A RESEARCH ON THE ADDED-VALUE OF BROADBAND ON SOCIO-ECONOMIC ACTIVITIES IN RURAL AREAS

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Illustration front page:	Ground crew deploying fiber optic cable network (RTL Nieuws, 2018).

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Abstract

Previous research has indicated that regions faced with limited physical accessibility, digital connections are useful regarding economic activities and regional development, but also that digital connectivity is more about usage patterns. Therefore, this research analyzes several usage patterns in the work and residential climate and puts the aforementioned issue in a regional perspective. The aim is to explore to what extent broadband has an added-value on socio-economic activities in rural areas. Qualitative data is collected among 11 participants from two broadband initiatives in the north of the Netherlands through semi-structured interviews, addressing several statements and motivations. Subsequently, the interviews have been transcribed, analyzed and coded using Atlas.ti. The results illustrate that broadband enables socio-economic activities for both companies and residents and that absence of such connection in particular would be problematic. Thus, it is more a requirement rather than a clear added-value for socio-economic activities in rural areas. Another relevant notion is that boundaries between the work and residential climate may get blurred due to broadband.

Keywords: broadband, rural areas, socio-economic activities

Preface

You are about to read my Master Thesis: 'To hook on or to unhook: a research on the added-value of broadband on socio-economic activities in rural areas'. It addresses the effect of broadband internet and to what extent it has an added-value on socio-economic activities in rural areas. There are several techniques involved in broadband internet. One example includes a fiber optic cable network. I have been employed in this industry for a while, by working at a company that carries out all types of excavations and groundwork regarding the deployment of such a network. This inspired me to do this research.

It represents the final step of the Master Program Economic Geography at the University of Groningen. In this thesis, all the knowledge, skills and tools that have been acquired are put together, resulting in all-encompassing research. The completion of this project also marks the end of my academic career, which will be continued by entering the labor market in the field of geography or spatial planning. I am looking forward to the exciting times that lie ahead.

Now that an intensive period of about a year has come to an end, I have definitely learned a lot on the concept of broadband and its (possible) effects on the socio-economic situation in rural areas, but also that due to unforeseen circumstances (covid-19), it is difficult to draw firm conclusions on the actual effect of broadband. I would like to thank my supervisor Arjen Edzes for his useful and constructive feedback during the process of conducting research and writing the thesis. Furthermore I would like to thank Koen Salemink for handing several articles which benefitted the theoretical framework. Finally, I would like to thank the respondents that wanted to be interviewed for their time, knowledge and expertise. I would not have been able to complete this research without their enthusiasm and input.

In the meantime, I hope you enjoy reading my thesis!

Sander Tjoelker
Kollumerzwaag, June 2021

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1. Introduction

Broadband has received significant societal attention in the public media as indicated in articles by NOS (2013), RTL Nieuws (2018) and, more recently, in NOS (2021) and Algemeen Dagblad (2021). The demand for fast internet connections in the Netherlands is still growing (Brennenraedts et al., 2016) and therefore, its relevance has also been acknowledged by governments and policymakers. This increasing demand is also visible for companies as a result of the increasing use of cloud services for instance. In addition, the demand will be defined by upcoming digital services and applications embedded in new business models. These new services are based on the exploitation of several types of data and depend on a combination of Big Data analysis, cloud computing and the Internet of Things. All in all, this development increases the dependence of organizations and firms on digital connectivity (Brennenraedts et al., 2016).

Also in the literature, broadband has received significant attention. Especially in regions with limited physical accessibility, digital accessibility – connectivity – through broadband may provide a useful alternative regarding economic activities and regional development (Salemink & Strijker, 2015a). They further argue that connectivity and accessibility are important for regional development, since areas and communities need to be connected to be part of the wider economy and people need to have access to (other) areas and communities and labor markets to participate in society. Nowadays, not only physical connectivity and accessibility but also digital connectivity plays an important role in the economic and social potential of regions. Next, according to Kim & Orazem (2017), access to broadband is widely presumed to boost economic growth, since it lowers production costs and widens the market for firm output. For example, broadband internet lower transaction costs, while easing coordination and streamlining face-to-face communication with upstream suppliers and downstream consumers. They also found that broadband availability has a positive and significant effect on location decisions of new firms in rural areas.

When looking at the development of the broadband network, it can be concluded that the situation has improved clearly over the years. As a result, 85% of European households had a broadband connection in 2017, on average. In the Netherlands, this number is 98% which is the highest in the European Union (CBS, 2018). Elaborating on this, it is not just technologies that are changing. There is also a social component that plays an important role. Thus, the adoption and use of the internet are becoming more and more diverse, which means that the debate about digital inclusion is no longer on ‘haves’ and ‘have nots’, but instead on the degree of usage and different usage patterns (Salemink et al., 2017). In particular, rural areas are of interest since authors have argued that broadband is beneficial for rural regional economic development, for example regarding employment and entrepreneurship (number of firms) (Whitacre et al., 2014), while others argue that this (positive) effect of broadband also depends on economic growth in (nearby) cities (Bulderberga, 2011) and agglomeration economies (Kim & Orazem, 2017).

This explorative research contributes to the existing literature by analyzing several usage patterns and by putting the aforementioned issue in a regional perspective. The central question being discussed is: To what extent does broadband have an added-value to socio-economic activities in rural areas? Furthermore, as indicated by Hasbi (2017), previous research on the economic impact of broadband has focused primarily on so-called ‘old generation’ techniques (DSL or coaxial cable networks for example), while the impact of ‘very high-speed broadband’ (fiber optic cable network for example) is rather underdeveloped. As such, this research explores whether these different techniques of broadband (VDSL, coax and fiber optic cables) could have a different effect regarding socio-economic activities. In addition, Salemink & Strijker (2016) researched the role of how citizens instigate and run initiatives to improve broadband connectivity, which indicates that local employers and employees more and more play a role in the rural broadband initiatives. Thus, this study

elaborates on this by analyzing what role these local employers and employees played in the deployment initiatives. Finally, the effects of broadband as discussed by Kim & Orazem (2017) are related to firms and the work climate, while broadband affecting housing values, as researched by Deller & Whitacre (2019), more plays a role in the residential climate. As such, this research theorizes on what specific effects and mechanisms play a role in both the work and the residential climate.

This thesis has been structured in the following way. It continues with chapter 2 that discusses the current state of literature on several themes, such as broadband and its influence on rural areas, rural areas defined by economic activities and the implications of covid-19. Also the conceptual model is explained here. Subsequently, chapter 3 explains the methodology and operationalization: qualitative data collection through semi-structured interviews, but also the ethical considerations. Chapter 4 addresses the main results derived from the interviews, from which several conclusions have been drawn in chapter 5. Also, recommendations for future research and reflections are discussed in this final chapter.

2. Theoretical framework

In the theoretical framework, I first discuss key notions such as (different types of) broadband and the role local citizens play in this and economic activities that define rural areas, as indicated by the literature. Furthermore, I analyze how broadband affects the rural work and residential environment. Based on this, the conceptual model is defined and discussed.

2.1 Broadband

As indicated by Amiri & Woodside (2017), broadband is a container notion of several telecommunication strategies with the combining element of a fast download capacity of at least 30 megabit per second (Mbps). Especially for the last 20 years, the importance of digital connectivity and ICT has been acknowledged according to Bojnec & Ferto (2012). They stress that digital connectivity has played a key role regarding world trade flows and economic growth. Broadband accelerates the removal of transnational trade barriers, resulting in a reduction of costs for companies. In developed countries the deployment and improvement of the broadband network is being considered more and more as a key comparative trade advantage regarding economic growth. As such, the demand for fast internet connections is growing (in the Netherlands) (Brennenraedts et al., 2016) and therefore, its relevance has also been acknowledged by governments and policymakers. Thus, the Dutch government set a target that by the end of 2023, every Dutch citizen should be able to access the internet through a connection of at least 100 Mbps.

As mentioned before, the deployment of broadband is not about the 'haves' and 'have nots' anymore (Salemink et al., 2017). Similarly, broadband can be deployed using a variety of techniques such as ADSL, VDSL, fiber optic cables, wireless and satellite connections (Amiri & Woodside, 2017). Also mobile connections such as 4G (and in the future 5G) enable for capacities above 30 Mbps (De Jong et al., 2018) and thus can be considered broadband. Elaborating on this, Hasbi (2017) distinguishes two groups of techniques 'old generation broadband technologies' (DSL and co-axial cable technologies) and 'very high-speed broadband technologies' (fiber optic cable technology). The difference between these technologies (or channels) primarily involves capacity or 'date rate' (differences in download speed) (Gul & Gutierrez, 2018). Table 1 illustrates the broadband technologies used to this date with their 'date rate'. Relevant for this research are the notions of 'DSL', 'FTTH-FTTX' (fiber optic cables) and 'LTE' (4G mobile network). Based on table 1, fiber optic cables provide the highest capacity, followed by the mobile network and DSL. In other words, every technique offers different speeds and capacities. Elaborating on that, Salemink & Strijker (2012) mentioned that technically speaking, fiber optic cables are superior compared to other techniques. According to Whitacre et al. (2014), broadband adoption and availability, but also download speeds influence rural economic growth. Furthermore, they found that high download speeds attract workers in the creative class, but also have benefits unemployment reduction. Mack (2014) analyzed the correlation between broadband speeds and agricultural and rural establishments and found a positive impact of broadband speeds on such establishments. In addition, she argues that high-speed connections are essential for economic vitality.

Year	Broadband technologies	Data rate (max)
Fixed line		
1990	Hybrid fibre coaxial (HFC)	400 Mbits/s
1990s	Broadband over power lines (BPL)	3 Mbits/s [11]
1998	ADSL	12.0–1.8 Mbits/s
2003	ADSL2+	24.0–3.3 Mbits/s
2008	FTTH-FTTX	2.5 Gbits/s–622 Mbits/s [12]
Wireless		
1947	Microwave	800 Mbits/s
1998	LMDS	64 kbits/s–155 Mbits/s [13]
1998	MMDS	27–38 Mbits/s
2000	W-CDMA, CDMA2000	153 kbits/s
2008	FSO	10 Gbits/s
2008	LTE (standard)	144 Mbits/s
2011	WiMAX	30 Mbits/s–1 Gbits/s
2011	LTE Advanced	200–300 Mbits/s
2015	LTE Advanced Pro	1 Gbits/s

Table 1: *Broadband techniques. Source: Gul & Gutierrez (2018).*

Another factor differing between techniques involves 'symmetry'. According to the European Commission (2020) wired DSL copper lines are rather asymmetric, meaning that upload capacities are much lower compared to download capacities. This has negative implications for services regarding cloud computing and videoconferencing. Similarly, Canzian et al. (2019) indicated that for the most advanced broadband applications (cloud computing applications), upload speeds are more important than download speeds. On the other hand, fiber optic cables provide both high rates of transmission and symmetry (Gbps or even Tbps) (European Commission, 2020). Moreover, given the increasing demand for data, but also working from home (due to covid-19), it is plausible that higher upload capacities – and thus the broadband technique used – become more and more important for socio-economic activities.

However, since the emergence of the internet in the 1990s, rural areas in advanced economies have been disadvantaged regarding the development of their digital accessibility and broadband deployment. The telecom market does not consider these areas to be sufficiently profitable, as the number of potential users is low and the costs are high. In most Western countries, national and regional governments are either unable, due to legislation and regulation, or unwilling, because of political and financial priorities, to provide rural citizens with high-speed internet. This is also the case in the Netherlands and has impacted a number of rural sectors and stakeholders (Salemink & Strijker, 2015b). Similarly, Townsend et al. (2013) argued that telecom providers rather invest in urban areas with higher densities and larger market potential. Therefore and in line with 'neo-endogenous rural development' and 'decentralization', local broadband initiatives, instigated by local employers and employees, are becoming more and more prominent (Salemink & Strijker, 2015b; Salemink & Strijker, 2016). Yet, Salemink & Strijker (2015b) also argue that 'endogenous powers' are not distributed evenly. Furthermore, market parties seem to aim at limiting the influence of local

initiatives for strategic financial reasons. Still, it has been acknowledged that local initiatives are a crucial factor in deploying broadband in rural areas (Salemink & Strijker, 2015b) and that local citizens and entrepreneurs need to be able to achieve their own objectives (Salemink & Strijker, 2016).

2.2 Economic activities defining urban and rural areas

The question then is how to characterize rural areas based on socio-economic activities. A rural area is generally used as an expression for non-urban or peripheral regions. Yet the differentiation between rural and urban areas as opposite types of spatial structure is not that clear. Commonly used criteria are mentioned by Dax (1996): size of population; population density; commuting intensity; and proportion of labor force involved in agriculture. Moreover, the thresholds for such criteria may vary substantially. For example, limits for population size of the units range from 1000 to 10.000 and share of agricultural employment ranges between 1.5 and 20%. According to Dax (1996), in most countries a rural area classification is related to regional development and such classifications have not been used as a generally accepted base for thematic research on rural issues. Agriculture used to be the key economic sector in rural areas. However, its relevance has decreased over time. Especially the service industry has become more and more important. Also, the urban-rural relationship used to be more hierarchical, with rural areas as the supplier of food for the city (Bulderberga, 2011). In a research by Strijker (1999) it is also argued that agriculture no longer is the largest economic sector in rural areas, while it still remains to have a significant impact.
Urban and rural areas are intertwined regarding other sectors as well. Examples include industry and services (Bulderberga, 2011), but also construction, logistics, government, recreation and tourism play an important role in rural areas (Strijker, 1999). This supports the notion that rural economic activities are strongly interlinked with urban areas (Gebre & Gebremedhin, 2019). For example, both rural and urban citizens have similar consumption needs and desires (Woods, 2005).

More recently, the OECD (2019) considers that rural areas (or lower density economies) differ from urban areas across three key dimensions: physical distance to major markets and related costs regarding transport and connectivity, importance of competitiveness in regions with small specialized domestic and locally oriented markets and how local economic opportunities are driven by specific geographical conditions. Furthermore it is argued that the interconnectedness goes beyond economic activities and also shows demographic, labor market public service and environmental linkages. These linkages often move beyond traditional administrative boundaries and moreover are not limited to city-centered flow patterns, but instead involve bi-directional relationships. Each interaction includes a different geography, resulting in a ‘functional region’. This is also illustrated in figure 1.

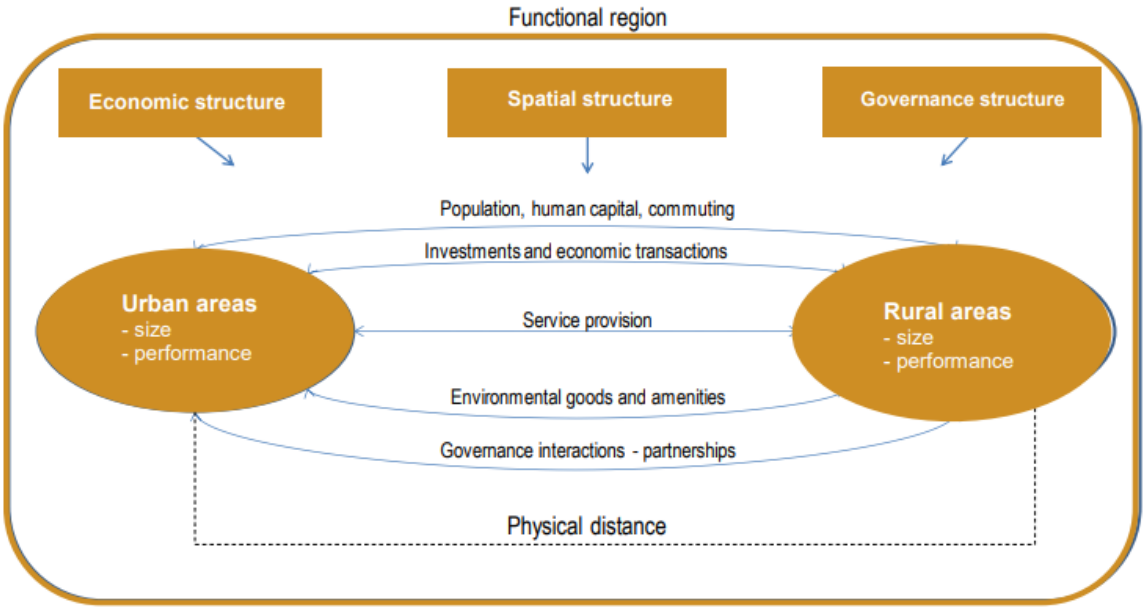

Figure 1: *Rural-urban functional linkages involve many types of interconnections. Source: OECD (2019).*

The OECD (2019) also identifies three types of rural areas with different characteristics. First are rural areas within a functional urban area (FUA) and thus are an integral part of the FUA. Here the urban center is surrounded by a commuting zone and the development of rural areas is embedded in that of the FUA. The second type involve rural areas with access to a FUA, which are areas that have strong linkages to a FUA regarding flows of goods, ecosystem services and other economic transactions. Despite rural areas not being part of its labor market and rural and urban economies not being integrated, most of the development of rural areas is linked to the FUA. About 80% of the population of rural areas in OECD countries is located in this type. Finally, there are remote rural areas distant from a FUA. The connections mostly come from exchange of goods and services. Interactions on a personal level outside the rural area are sparse. Yet, connections within the region are well-developed. Also, the local economy largely depends on exporting the output of primary activities (OECD, 2019).

Based on this and in line with Bulderberga (2011), it can be argued that economic development in rural areas depends significantly on the growth of the central urban core. Despite the interconnectedness, urban areas become more and more important as hubs of knowledge and innovation. Clustering of economic activities plays an important role in this. One side of the mechanisms behind the stimulation of clustering economic activities are described by Marshall (1890). He argues for knowledge spillovers, specialized suppliers and specialized labor markets. First, not every firm has the right knowledge in order to come up with a specific innovation, which is driven by combining knowledge. Each individual worker often possesses a specific type of high-skilled knowledge, which is more common in urban areas. Innovative firms will then locate more in urban areas in order to be in close proximity to the high-skilled knowledge pool. Thus when (similar types of) firms are located together, firms can understand each other, resulting in knowledge spillovers (Marshall, 1890). Second, regarding the specialized suppliers, many firms do not have the capacity to provide highly-specialized jobs for each individual employee. Nevertheless, in order to hire the employee, firms locate in urban areas to get access to the services provided by other firms. Finally, Marshall argues for a specialized labor market, which can be considered as a matching argument driven by the notion that it is cheaper for firms in urban areas, compared to their rural counterparts, to find appropriate employees for the job opportunities offered by them. The reverse also holds true that it is easier for employees in urban areas to find suitable employment than in rural areas.

Instead of specialization, increasing economic diversity has received more and more attention, especially in rural areas (Koster et al., 2020). For example, Cai et al. (2018) analyze innovation policies and development on both national and regional levels. Their findings reveal that there is also a movement towards increasingly diversified innovation strategies, despite differences in logics underpinning the policies. This diversification rests on the theories by Jacobs (1961), who was opposed to the specialization externalities. She argues that a wide variety of firms located together results in spreading the costs of infrastructure and that firms can learn new things from each other. What brings these approaches together, however, is that both underline the importance of clustering entrepreneurship, or the agglomeration of firms for economic performance. Yet, they disagree on the effect of business concentration (Beaudry & Schiffauerova, 2009). As such, rural areas should not be considered as less attractive for firms to locate (Cabus & Vanhaverbeke, 2003). The comparative advantages of firms located in urban areas may be negatively affected over time due to the agglomeration (Vassen & Wever, 1993). Examples include congestion due to traffic or higher competition levels. In order to avoid the negative urban agglomeration effects, firms could relocate to rural areas. According to Lafuente et al. (2010) rural areas have additional advantages due to lower prices of land for specific sectors and a pleasant physical environment.

To answer the question I started with that a rural area can be defined as a lower density economy that still relies for a significant part on agriculture, but at the same time is part of an interconnected rural-urban network. Also, rural economic development depends to a certain extent on urban areas. Therefore, a well-developed rural-urban relationship is crucial. In the Dutch context for example, rural areas are often in close proximity to urban cores, which benefits the economic development (Cabus & Vanhaverbeke, 2003). As such, in line with the characterization by the OECD (2019), it could be argued that all Dutch rural areas are integrated within one functional urban area (FUA). Broadband connections may reduce this distance even further.

2.3 Influence of broadband on the (rural) economy: work climate

The following issue zooms in on the effect of broadband on the rural firm level and work climate. On the firm level, digital innovation may create new opportunities related to increased efficiency in production, or product distribution, leading to higher revenues. According to Kim & Orazem (2017) access to broadband is presumed to boost economic growth, since it lowers production costs and widens the market for firm output. However, according to Bertschek et al. (2013) broadband internet appears to have no impact on firms' labor productivity, while on the other hand, it does seem to have a positive and significant impact on firm's innovation activity. However, findings in South Africa revealed that a significant number of entrepreneurs are not using digital technologies for business purposes, but instead for private communications and friendships (Lekhanya, 2018). Similar results have been found by Galloway et al. (2011), who studied the use of internet portals by small rural firms in Scotland. They found that firms use the portals to place greater importance on maintaining local interest to enable local trade rather than focusing on external markets.

As mentioned before, broadband also may have a positive impact on employment rates. However, the effect of employment growth may differ for different sectors. For example, Stockinger (2019) analyzed the effect of broadband availability on employment growth in German establishments. He found a negative – but not very robust – employment growth effect due to broadband availability in Western German manufacturing establishments. On the contrary, he found a robust and positive effect for Western German service establishments, which includes knowledge intensive industries. He concludes that broadband expansion especially benefits job creation in firms (and sectors) that use broadband intensively (and thus depend on it). Similar results for the service sector have been found by Fabritz (2013). On the other hand, she found no employment effects in the manufacturing sector.

Salemink & Strijker (2015a) argue that both agriculture and rural tourism (hospitality industry) are affected and thus depend more and more on good internet connections. For example, maintenance on agricultural equipment often is carried out online. The same holds true for communication with government and semi-public organizations. For the latter, the rural tourism sector also strongly depends on the provision of sufficient digital connectivity both on the supply and demand side. Regarding supply, tourist businesses rely on good internet connections to run their everyday business, which includes website maintenance or processing bookings and reservations. On the demand side, customers take into account both the availability and quality of internet connections when deciding where to stay or which activities to undertake. As such, staying at a hotel nowadays includes being able to check the news or social media and keep those staying at home updated (Salemink & Strijker, 2015b). Another sector to be expected with good broadband availability involves the creative industry, which includes businesses operating in music, advertising, crafts, performance, film, and video games for example (Townsend et al., 2017). They explored the extent to which broadband connectivity can reduce the penalty of distance for the rural creative sector and how a lack thereof affects the development of the rural creative economy. Their findings imply that access to broadband of at least 2 Mbps is critical for those working in the creative sector. A lack of adequate access may negatively affect rural communities through out-migration towards areas with better digital connectivity.

To sum up, broadband seems to positively affect firm's efficiency in production, employment rates (job-creation) and innovation capacity and widens firm output. However, firm's labor productivity does not seem to be affected significantly by broadband. Regarding using patterns, rural firms use broadband connections to enable and boost local trade, rather than exploring external markets. Nowadays, agriculture and rural tourism depend more and more on good internet connections. Also the creative industry is to be expected with good digital accessibility.

2.4 Influence of broadband on the (rural) economy: residential climate

Elaborating on the aforementioned, it is of importance to investigate how the rural residential economy is affected by broadband. There is growing consensus on the importance of broadband for the local economy (Deller & Whitacre, 2019). Czernich et al. (2011) investigated OECD countries to find an one percentage point increase in GDP per capita due to a ten percentage point increase in broadband penetration. In line with this, Whitacre et al. (2014) found, specifically in the rural context, that non-urban areas with high level of broadband deployment showed a faster income growth and slower unemployment growth during the 2000s. Furthermore, they also found a positive relationship between broadband adoption and the number of firms and employees non-urban areas. Furthermore, availability of broadband also seems to have a positive effect on in-migration patterns (Mahasuweerachai et al., 2010). This in turn can impact civic engagement, but also (rural) housing markets (Whitacre & Manlove, 2016). In the social domain and civic engagement, broadband has provided new communication tools, including email, social media, Skype and Facetime and instant messaging among other things. These tools may increase both the scope and intensity of social interactions which has implications for wellbeing (McDool et al., 2020). Deller & Whitacre (2019) found that higher access of broadband shows a positive relationship on rural housing values. Another important aspect is the potential influence of broadband to go beyond economic activities. According to Cowie et al. (2020), broadband and digitization play an important role in the 4th Industrial Revolution (4IR), which relates to a series of technological developments that will significantly change society. Connected and Autonomous Vehicles (CAV), Internet of Things (IoT) and smart grids are examples that are considered by Cowie et al. (2020). Due to the IoT, opportunities emerge for e-health services. Elaborating on that, broadband also provides enables access to home entertainment such as streaming services, downloading movies and video games (Atasoy, 2013). This are relevant

notions for rural areas, due to their lower degree of accessibility and presence of physical facilities compared to urban areas.

A logical step forward would be to provide broadband everywhere (also when considering the work climate), even in the most remote areas and thus to increase (digital) accessibility (and lower transportation costs). However, from Krugman's (1991) new economic geography perspective (NEG), this may be problematic. According to Krugman, small changes in economic parameters may have significant effects on behavior. If economies of scale, but also transportation costs reach a certain threshold, the population starts to concentrate and regions diverge. Once started, this process will feed on itself, but also initial conditions are important. For instance, if region A has a slightly higher population compared to region B when transportation costs are lowered, then the former ends up gaining population at region B's expense (Krugman, 1991). This already takes place in the core-periphery (urban-rural) distinction. Therefore, increasing accessibility through broadband – lowering transportation costs – would primarily benefit the urban area instead of rural areas.

Moreover, as mentioned before, it has been argued that economic development in rural areas depends on what happens in the city (Bulderberga, 2011). A similar pattern is observed by Kim & Orazem (2017) regarding start-up rates. Their findings do not support the notion that rural broadband deployment will lower the gap between urban and rural firm start-up rates, as the effect of broadband on new firm entry is boosted by the agglomeration of firms. The broadband availability effect is largest in areas with greater agglomerations or areas that are in close proximity to urban areas with agglomeration economies. Thus, the smallest and most remote rural towns with few local agglomeration economies will get the smallest economic benefits from broadband deployment projects compared to larger rural counties closer to metropolitan areas. Thus, it is obvious that ICT are not the only determining factors regarding economic development (Mack & Grubesic, 2008). Furthermore, policymakers need to be cautious not to focus solely on the developments and investments in digital connectivity as it may also have implications for the labor market, which will be explained in more detail later on. Moreover, it may increase the current 'digital divide', which in turn increases the difference between poor and rich areas. Instead, implementing several methods (of which ICT is one), helps to create a competitive business environment that enables entrepreneurs to operate on a larger, global scale (Clarke, 2003). Similarly, it also may generate an attractive residential climate and thus enables for competing with other (attractive) residential areas.

To conclude, broadband provides several opportunities for rural economies to compensate for their limited physical accessibility such as CAV and e-services, but also an increase in housing values. Furthermore, it enables civic engagement through new communication methods which benefit well-being. However, proximity still plays an important role in the effect of broadband on the rural economy, as indicated by Kim & Orazem (2017). Also, implementing broadband in broadband in rural areas may even negatively affect the local economy, for example, from a NEG point of view. Therefore, adequate policies to guide the implementation process are also crucial.

2.5 Implications of covid-19

At the end of 2019 and early 2020, the world faced the emergence of covid-19, which has evolved into a global pandemic. As such, there are approximately 93 million confirmed cases and a death toll of just over 2 million globally (WHO, 2020). To tackle this pandemic, governments all over the world took measures, affecting the global economy in several ways: trade declined by 15% during the first half of 2020, working hours were reduced in labor markets, loss of jobs and closure of businesses (OECD, 2020). It is also expected by the OECD (2020) that the economic output will remain below 2019 levels at the end of 2021, indicating possible long lasting negative effects.

To partially absorb the economic consequences, financial support policies were implemented, since without these policies, the effects on output and employment would have been substantially larger (OECD, 2020). Another key measure that has been implemented on a large scale involves social distancing (1,5 meters / 6 feet in most cases) and working from home that results from this. Groenewegen & Hardeman (2020) focused on the Netherlands and considered which portion of the total amount of jobs can be done either from home or by adhering to the 1,5 meter distance. Therefore, they illustrated the size of the so-called '1,5 meter economy'. According to them, 90% of the economic activities still can take place when adhering to the 1,5 meter distance, from which 43% point can be done from home. Especially work in sectors related to specialized business services, finance and ICT can be done from home rather well, while, on the other hand work, related to agriculture, construction and industry cannot be done from home. Still activities in these sectors can take place on-site while adhering to the 1,5 meters. Roughly 10% of the Dutch economic activities cannot take place, since the 1,5 meters cannot be adhered. This includes activities related to hospitality, healthcare and services such as hairdressers. Given the sector distribution in Dutch regions, especially the north wing of the Randstad translates rather well to a 'working from home economy'. In these cases, policy should be targeted at facilitating conditions that optimize working from home. A key example is digital facilities or in other words: good digital accessibility (Groenewegen & Hardeman, 2020). This is in line with a paper by Crowley & Doran (2020), in which they researched the social distancing potential and remote working potential (working from home). They concluded that more affluent, dense and highly populated, better educated and towns with better broadband accessibility have a greater social distancing and working from home potential.

While it is difficult to monitor how long covid-19 will be around and the lasting effects due to many different factors, it is plausible that working from home may be a long-term effect. For example, once businesses and individuals invest in working from home (technology but also necessary human capital and organizational processes), they may decide to stick with the new methods. Moreover, the pandemic has forced people to try out new approaches that have been proven effective. In both cases, long-term effects would be expected (Brynjolfsson et al., 2020). Still, a condition for cloud computing, videoconferencing and also working from home is a good internet and broadband connection (Canzian et al., 2019). Given the notion that rural areas are lacking behind regarding digital infrastructure, the effects of working from home may be less terminal. Thus, working from home can be an opportunity and have a long-term effect, also for rural areas, provided that the digital infrastructure is improved. In turn, the work-private distinction then becomes blurred more and more.

2.6 Conceptual model

In rural areas, local initiatives become more and more important for deploying broadband. Therefore, the role played by and influence of local stakeholders also increases accordingly. Next, the effects of broadband play a role in two key mechanisms: supply (production and work-related) and demand (consumption and residential-related) patterns. I define supply as the production of commodities or services by local (rural) firms. For example, the notion that broadband positively affects firm's innovative capacity is an effect on the supply side. On the other hand, demand involves the consumption of these commodities and services by the local population. Also migration patterns and where people live involve demand. An important aspect I consider is that consumption takes place where people live. Furthermore, it is important to note that the effects of broadband can be both positive and negative.

On the supply and production side, broadband enables job-creation, especially in knowledge intensive industries. Moreover, it appears to boost the firm's innovative capacity. Also, according to Atasoy (2013), internet increases worker's job opportunities, since information about jobs is distributed more quickly and as such, it can improve the worker-firm matching process (specialized

labor markets). Yet, broadband also negatively affects supply by maximizing the access to larger labor pools which results in outsourcing of labor services (Katz, 2012). This increases the competition on the labor market for employees, which may result in workers becoming crowded out from the labor market. Regarding demand and consumption patterns, broadband appears to positively influence housing values. Moreover, the influence of broadband goes beyond economic activities towards a series of technological developments that will significantly change society. Especially CAV and e-services enabled by IoT are important factors for rural areas given the lower degree of accessibility. However, competition for labor also becomes visible regarding consumption patterns as competition (and e-commerce) may negatively affect businesses relying on local market demand, in essence local retail ('brick and mortar') stores. This trend may lead to job-destruction and foreclosure of local retailers, leading to higher vacancy rates. In addition, broadband provides access to home entertainment, including streaming or downloading movies and interactive video games, which reduce the demand for local entertainment facilities (Atasoy, 2013).

Finally, the physical proximity of urban areas, or physical accessibility in general, also plays an important role due to agglomeration economies and thus can serve as an external influence. Therefore, the effects of broadband implementation can be different for rural areas with good physical accessibility compared to more remote ones. Similarly, the specific broadband technique used may also have an influence given the notions of 'old generation' and 'very high-speed broadband' techniques, but also that fiber optic cables are superior compared to other techniques (Salemink & Strijker, 2012).

Based on theories mentioned before, the following conceptual model (figure 2) was constructed in order to illustrate the mechanisms behind the influence of broadband on socio-economic activities in rural areas.

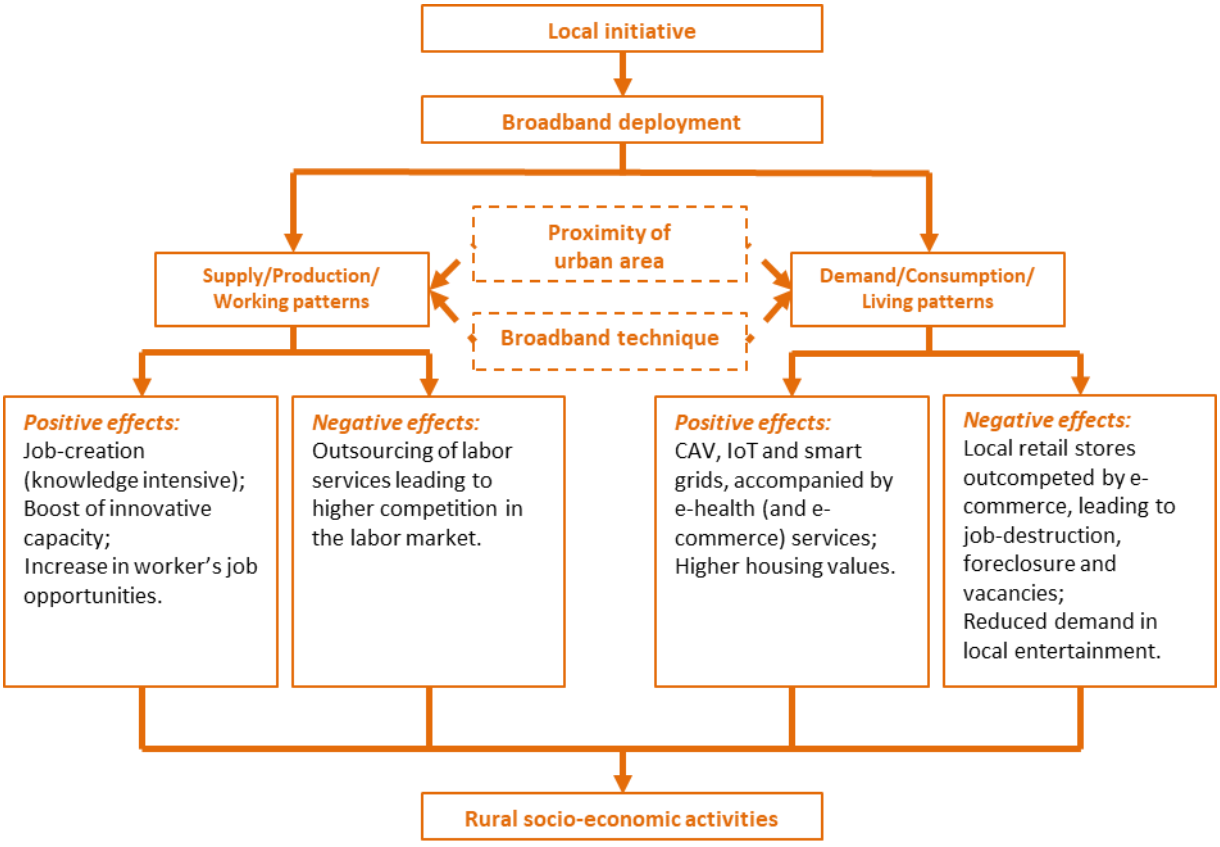

Figure 2: *Conceptual model.*

3. Methodology

In this chapter, the research design is explained. It addresses the methodology regarding data collection, with respect to qualitative data and the advantages and disadvantages it brings about. Furthermore, it also deals with the way the data is collected, in which the semi-structured interview is explained.

3.1 Motivation for chosen research methods

In the previous chapter, the key terms and concepts are defined using literature. According to Clifford et al. (2016) that is the first step when conducting research. The goal of this research is to explore to what extent broadband has an added-value to socio-economic activities in rural areas from different perspectives. It also aims at illustrating the mechanisms that play a role in these activities due to the deployment of (new) broadband networks. As such, qualitative research is a logical step forward, as it allows for a more in-depth focus on a specific case and its mechanisms (Clifford et al., 2016). An effective method in doing so is by conducting semi-structured interviews, since it allows interviewees to clarify certain aspects beyond the pre-determined questions. Underlying mechanisms thus become visible. Also, because of the way the research questions and the aim of this research are set up, it is best to look for descriptive, in-depth knowledge on how (and why) certain events take place. One of the better ways to gather such knowledge is through a case study. A case study is also referred to as a form of naturalistic research, that the case is studied in its natural environment and not in a laboratory or other artificial environment. A case study thus is ideal for focusing on in-depth understanding of one event or a set of events (Clifford et al., 2016). Yin (2013) state that a case study is useful in identifying how strategies are being put into practice. Yet, generalizations cannot always be made, which should be realized as well (Clifford et al., 2016). Therefore, it is important to pick a case represents the 'real world' as well as possible.

3.2 Case study and interviews

Currently, a key technique used in broadband deployment involves a fiber optic cable network. However, not in every location such a network is deployed and being used. Especially in some rural village cores fiber optic cables are not always possible, while others have been using it for quite some time now. As such, data collection focused on two similar village cores (and their municipalities) in the province of Friesland in the north of the Netherlands: Kollum and Buitenpost. Their location is illustrated in figure 3. Both village cores are located halfway in between the major cities of Leeuwarden and Groningen, which is also illustrated in the map on the next page. Both have roughly 5.500 inhabitants, according to CBS Statline. And both villages are among the key village/urban cores in their municipalities: Kollum in Noardeast-Fryslân (formerly known as Kollumerland c.a.) and Buitenpost in Achtkarspelen, with the latter also being the capital of the municipality. Kollum used to be the capital of the former municipality of Kollumerland c.a.. Elaborating on that, based on data from CBS (2020), with Noardeast-Fryslân having an average household wealth of 59.500 euros in 2019 and Achtkarspelen with 68.300 euros, they are slightly above- average regarding wealth in the Netherlands. The national average household wealth is 49.800 euros. Finally, both villages also have their own active business association.

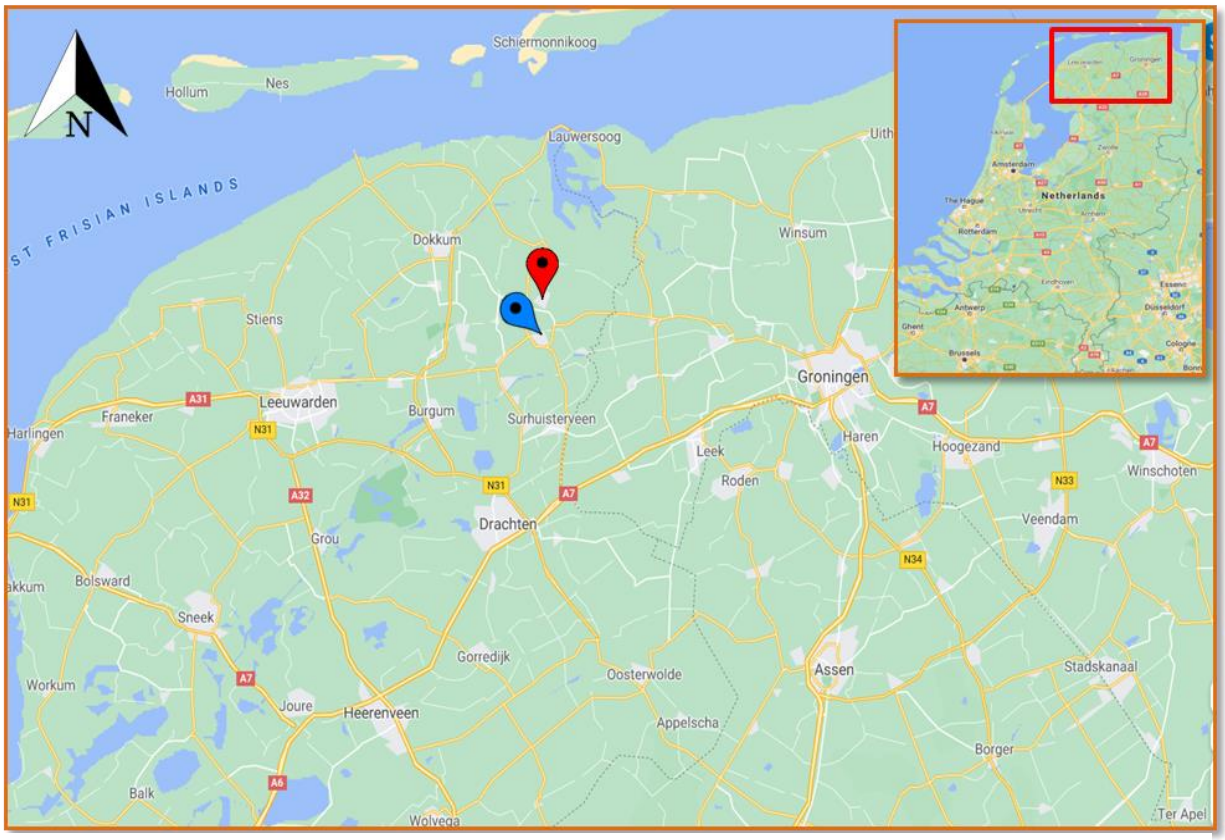

Figure 3: *Location of the villages of Kollum (red marker) and Buitenpost (blue marker). Source: Author using Google Maps (2021).*

There are, however, also some differences. While both villages cores are relatively well-accessible by public transport, Buitenpost has its own railway station on the railway line Groningen-Leeuwarden, while Kollum does not have one. Kollum is accessible by bus. Secondly, Buitenpost has been facing decreasing population and as such, increasing vacancy rates of commercial real estate in its town's center due to online-shopping (Waldnet, 2020). However, whereas Buitenpost faces decreasing attractiveness and amenity levels in its town center, Kollum has managed to maintain the same level of quality regarding services and amenities for some time now. Kollum has a regional position and Buitenpost used to have the same above-local position, but the turnover of shops in Buitenpost comes for a greater part from its own inhabitants (Beleef Kollum, 2014). The most important difference is that Kollum already has a fiber optic cable network since 2014, deployed by KabelNoord (Beleef Kollum, 2014). In Buitenpost on the other hand, such a network is currently being deployed. The goal is to provide over 2500 households with a fiber optic cable connection. This task will be executed by KPN NetwerkNL (Gemeente Achtkarspelen, 2020). This makes it a relevant case study for studying opinions, motivations and what the expectations were socio-economically before broadband deployment and what the actual effects are (the latter section is especially relevant for Kollum).

Making such a network (financially) possible involves a number of stakeholders and key organizations. In order to create a complete representation as possible, several stakeholders have been interviewed including municipal aldermen, municipal council members, municipal policy officers, business associations, local interest groups, housing corporations and telecom providers. Furthermore, the research is interested in both expectations and actual outcomes, indicating the need to control for the time variable. In total, 11 interviews have been conducted. The interviewees have been approached by contacting (the board of) the organization at stake. On the other hand, some interviewees have been reached using the 'snowball method', which means that new interviewees have been nominated by former interviewees (Myers & Newman, 2007). This may

result in interviewees having similar opinions due to information exchange between them. Also, the research aimed to interview the housing corporation in the municipality Achtkarspelen and an entrepreneur in Kollum. The former responded that they felt they were unable to make a useful contribution to this research, since they do not use the fiber optic cable network and they also do not offer it to their tenants. The research was not able to incorporate the latter organization due to time constraints.

Finally, prior to the interviews and as a method of preparation, an interview guide (appendix 2) was composed in which main questions and sub-questions are determined along several themes and stages. In line with the conceptual model, the first set of questions address the involvement of the interviewee, local employers and employees and other key organizations. Next, the different techniques and their implications are discussed, which are followed by statements on the expectations regarding effects of broadband (positive and negative) for the work and residential climate. Subsequently, there are several questions on the actual effects. To conclude, it is discussed to what extent the interviewee considers broadband an added-value regarding rural socio-economic activities. These questions enable for a better structure of the information which ensures to provide answers to the questions. The interview guide can vary between interviewees, since they do not all have the same role regarding the fiber optic cable network deployment. Therefore, some parts have been discussed in short, while others have been discussed more broadly and in-depth. The interviews have been audio-recorded and transcribed. Subsequently, they have been coded using the Atlas.ti software. The codebook is illustrated in appendix 3. Regarding data analysis, a more basic approach of transcribing is being used. This research is not interested in highlighting the interviewee's emotions for example, so there is no need in doing a full, elaborate transcription (Clifford et al., 2016). The data from the interviews will be coded, analyzed and supplemented with literature. Eventually, this is the foundation for the answering the main research question.

3.3 Ethical considerations

When conducting interviews, the interviewee needs to be able to speak in confidence and know what will happen to the data provided by them at all times. Prior to the interviews, this is mentioned and discussed by asking explicitly for the interviewee's permission via an informed consent form (appendix 1), which ensures that the interviewee knows his or her rights at all times (Clifford et al., 2016). Preferably, the interviews would be conducted face-to-face at the interviewee's office, which ensures the interviewees to express themselves freely and in anonymously. However, given the current covid-19 situation, most – 9 in total – of the interviews were conducted online either using Microsoft Teams of Google Meets. 2 out of 11 interviews were still conducted face-to-face at the interviewee's workplace, while adhering to the social distancing and covid-19 regulations. Moreover, 5 out of 11 interviews came from the village of Buitenpost (or the municipality of Achtkarspelen), while 6 out of 11 interviews are applicable to the village of Kollum (or the municipality of Noardeast-Fryslân). This information is also illustrated in table 2 below. In some interviews, there may have been some disturbing externalities that may have influenced the interview and the accompanying data. A number of transcripts have been sent to the interviewee for inspection in order to ensure accuracy.

Respondent no.	Which municipality/village?	Where?	When?
R1	Achtkarspelen, Buitenpost	Online (Microsoft Teams)	4 March, 2021
R2	Kollum	Blokker, Kollum	9 March, 2021
R3	Noardeast-Fryslân, Kollum	Online (Microsoft Teams)	10 March, 2021

R4	Buitenpost	Online (Google Meets)	10 March, 2021
R5	Noardeast-Fryslân, Kollum	Online (Microsoft Teams)	10 March, 2021
R6	Achtkarspelen, Buitenpost	Online (Google Meets)	11 March, 2021
R7	Kollum	Online (Microsoft Teams)	19 March, 2021
R8	Buitenpost	Online (Microsoft Teams)	26 March, 2021
R9	Noardeast-Fryslân, Kollum	Office KabelNoord, Dokkum	1 April, 2021
R10	Noardeast-Fryslân, Kollum	Online (Microsoft Teams)	7 April, 2021
R11	Achtkarspelen, Buitenpost	Online (Microsoft Teams)	13 April, 2021

Table 2: *Information on interviews and respondents. Source: Author (2021).*

However, regarding the accuracy of data, it should be considered that interviewees and stakeholders do not want to share everything with the interviewer and thus withhold information. This may then lead to bad blood between parties. In order to prevent this and in line with the informed consent, the research adheres to the disidentification concept, which means that the data is processed anonymously without mentioning names. Also important to mention is the awareness of correct interpretation of words and information during and after the interview. Moreover, there could be a one-sided, biased view due to (previous) knowledge exchange between interviewees, especially with the 'snowball method' (Clifford et al., 2016; Myers & Newman, 2007). Similarly, it should be noted that with R10, some questions were left unanswered during the interview due to the interviewee not having an answer at that time. As such, the answers to these questions were collected afterwards via email. Yet, due to the fact that the interviewees have a significant level of expertise on the (local) situation regarding broadband and/or socio-economic activities, it may be assumed to consider the collected data as reliable.

4. Results

This chapter discusses and explains the main results, analyzed from the interviews. The chapter is structured along the themes defined in the codebook, the conceptual model and the sub-questions from chapter 1.

4.1 Area description

Kollum

Kollum is located in a municipality with rural areas, but is not considered a rural area itself per se. Moreover, the region is considered a 'shrinking region', in which Kollum is indicated as a 'regional core'. Elaborating on that, Kollum has a significant hospitality, retail and hospitality sector. Especially the tourism sector is focused on, according to R2. Furthermore, R3 indicated that Kollum's residential climate has always been on a decent level. For example, R7 states that Kollum is a relatively large village with both a lot of amenities/facilities and companies. However, according to R3 there is a longer term trend playing a role in the larger village centres, such as Kollum, that there is a shift towards more hospitality oriented businesses at the expense of 'traditional shops'. Regarding the labor force, R10 characterized the region as 'MBO-region', which means that there are a substantial amount of jobs in construction, metal fabrication and manufacturing industry at the middle-educational and vocational level. Elaborating on this, R7 and R10 identify four key economic sectors for the local and regional economy: construction and metal fabrication, manufacturing, agriculture and tourism. Especially the rural areas surrounding Kollum are predominantly occupied by agricultural activities, according to R7. Yet, according to R10, the socio-economic situation of Kollum can be defined as a 'village with a sub-regional service function with a relatively low employment rate (number of jobs per 100 inhabitants) and thus a high rate of commuting towards urban cores such as Drachten, Leeuwarden and Groningen'. Moreover, R2 mentioned that due to the characteristic of limited physical accessibility – weak connection to highway A7 – several large companies with more 50 employees moved from Kollum to more central locations, close to the main highways. In return, a number of smaller firms emerged that still have the potential to grow.

Buitenpost

As stated by R8, Buitenpost originally started as an 'agricultural community', but nowadays is more considered as a 'civil servant village', due to the local government offices located there. The local government office contains almost 200 jobs. It is a service-oriented village with a relatively small industry sector. The largest employer with more than 200 jobs according to R8 is Enitor, which is a large extrusion manufacturing company. This is in line with R6, who mentioned a relatively large share of the labor force with low educational attainment. In other words, a 'one-sided' local economy with a significant amount of construction-related companies and car dealerships. In addition, R4 mentions that Buitenpost has a substantial amount of larger companies with Enitor and BadkamerXXL as examples, but that commercial activities do not play a large role regionally. Similar to Kollum, R8 states that Buitenpost is also a 'village with a high commuting rate towards Groningen and Leeuwarden'. The residential climate, although being pressurized regarding liveability, is on a sufficient level due to facilities and amenities regarding education. However, the actual cohesion and involvement of the inhabitants with the village is rather low. According to R8, this is a characteristic, but also a challenge for Buitenpost. How can the inhabitants become more involved with their village? However, according to R11, as a personal opinion, the orientation of villages in general, but also Buitenpost, is more locally-oriented. This means that due to limited size of said village, people and entrepreneurs know each other personally, which automatically causes more cohesion. Finally regarding attitude towards developments and innovations, R8 pointed out a 'conservative mindset' as a key characteristic for this area. As an example, R8 mentioned the voting patterns at the last elections, in which the conservative and right-wing parties gathered a majority of the votes.

Thus to compare this with the concept of rural areas as defined in chapter 2, agriculture in Kollum and, to a lesser extent, Buitenpost indeed plays an important role in the local economy. However, several respondents questioned whether these two villages can be considered rural. They are located in rural areas, but within those rural areas they play an important role. Comparing this to other regions, Kollum still plays a significant sub-regional role, whereas Buitenpost is much more locally-oriented. Comparing this to the OECD characterization, these areas can be considered as a type 2 with strong linkages to the FUA, especially regarding commuting patterns.

4.2 History of broadband: techniques

Kollum

Strictly speaking, there was already broadband in Kollum via coax prior to the fiber optic cable network, but also copper lines. Comparing this with other areas surrounding Kollum, this was not the case, which means that the situation regarding broadband internet connections was already on a decent level. This means, as defined by R3, that regarding internet connections, Kollum was also not 'running behind on other, bigger villages/urban cores'. What should also be noted here is that the main network, or the backbone to the 'main neighborhood station' already consisted of fiber optic cables, whereas the connection from the 'main neighborhood station' to the people's houses still consisted of a coax or copper line. The latter has also been changed to a fiber optic cable. As such, R2, R3, R5 and R7 stated that the broadband technique does not matter per se for the effects on the socio-economic situation. What is more important is that they feel that especially that internet speed, or capacity, and stability are of key importance and that fiber optic cables currently is the technique that provides the most capacity and stability. The latter is also underlined by R9. However, the technology develops rather fast, as R3 pointed out among others, indicating that fiber optic cables are not the end. Similarly, R10 among others mentioned that coax also provided a good and stable network, but especially due to increasing demands in the past couple of years, but also recently, became more and more a limiting factor due to limited capacity. Therefore, investing in fiber optic cables is considered as a more future-proof technique. There is however an important difference and that is the higher upload capacity with fiber optic cables, which makes it a more 'symmetrical' connection according to R9. Coax provides approximately 80 Mbps download capacity and 10 Mbps upload capacity, compared to 100 Mbps download and 100 Mbps upload with fiber optic cables. As such, the difference between 80 and 100 is not that important if noticeable, but the difference between 10 and 100 on the other hand is. Especially for companies, such as agriculture or companies located at-home, that rely on the transfer of large datasets to customers, this is crucial, but also for people working from home that need to transfer datasets to colleagues. Furthermore, R9 states that different broadband techniques can in fact lead to different effects, but that is more due to usage patterns and not the technique per se. 4G or 5G, the mobile network, give different usage patterns and are used differently compared to a cable connection. Therefore, R9 advocates for a complementary broadband infrastructure with both mobile and cable connections.

Buitenpost

The situation in Buitenpost regarding broadband prior to fiber optic cables is rather similar to Kollum: the backbone consisted of fiber optic cables, but the final 50 meters to the home consisted of a copper line, according to R6. As R11 mentioned, this is also known as a VDSL connection. As such, the chosen broadband technique is therefore less relevant according to R11. This is also in line with opinions from R1, R4 and R6, that primarily speed and capacity are key aspects. However, R1, R4 and R11 also mentioned a drawback of this VDSL system, namely the greater the distance between the 'neighborhood center' and the dwelling, or in other words the greater the distance over a copper line, the smaller the capacity. Therefore, according to R4 among others, a fiber optic cable network is faster and more stable compared to a VDSL line. In fact, according to R8, a fiber optic cable network currently is the most reliable technique that enables for a 'qualitative leap' that is not achievable with other techniques. More specifically, R4 and R11 indicated that fiber optic cables compared to

other techniques allow for a larger upload capacity, which has also been mentioned by R9, but also a lower 'latency' or 'ping', that is, a smaller delay on the line. Finally, R4 and R11 noted that in order to be able to use mobile networks optimally, a physical fiber optic cable is still required. This has implications for certain usage patterns, which will be discussed in section 4.5.

In short, comparing this with chapter 2, broadband, or a download capacity of at least 30 Mbps, was already available in both Kollum and Buitenpost via coax or VDSL/copper lines. For every day usage, this technique already provided decent internet capacity. However, considering the increasing demand for data, but also the increasing importance of upload capacity, a fiber optic cable network is considered as a future-proof investment.

4.3 History of broadband: organizations

Kollum

From the respondents in Kollum, R7 and R9 have been directly involved in the process, although R7 was linked to a different organization then. Regarding organizations involved, two key organizations, KabelNoord and the municipality(ies), played a role based on R2, R3, R5, R7, R9 and R10. As mentioned before, there was already a broadband network in Kollum which was operated by KabelNoord. As such, in the words of R9, the investment in a fiber optic cable network was an idea from within KabelNoord 'in light of the company's future'. The municipality then was able to agree with this investment, which they did rather fast, according to R7. This was also partly due to the construction regarding KabelNoord, as it is a privatized company with several municipalities in the northeastern part of Friesland, among which the former municipality of Kollumerland c.a., as shareholders. According to R10, an important motivation for the municipality was to maintain the position of 'their own cable company'. Elaborating on that, as mentioned by R9, KabelNoord ensured to be the first to deploy fiber optic cables in the region, because if a network by another company was deployed first, then it would be 'hardly profitable to deploy a second network'. Also, larger cores such as Dokkum and Kollum are important for the business case, in order to enable KabelNoord to also deploy such a network outside the village cores. However, that does not mean that the societal component does not play a role at all for KabelNoord. As R9 indicated, 'KabelNoord has indeed considered the societal aspect by exploring the possibilities on ehealth through video connections for example'. However, this was only to a small extent.

Furthermore in the decision-making process, according to R2, also the local interests played an important role, which is opposed by R7. On the other hand, local employers and employees hardly played a role according to R2 and R7. However, R3 indicated that local employers and employees in fact did play a role by being able to sign-up for a subscription. Elaborating on that, R5 stated that local employers and employees rather had a desire than actual influence, or in the words of R10, 'a lobby', although it is uncertain how strong that lobby was.

Buitenpost

In Buitenpost, R1, R6 and R11 have been directly involved in the process. R4 was only actively involved in aiming for a fiber optic cable connection to the football club. Yet, R8 did contact KPN as a means of lobbying, but this had little to no effect. R8 was only 'indirectly involved' with the deployment of a network outside the village core 'by giving publicity to this topic'. Regarding organizations involved, R1 mentioned that only the municipality and KPN played a role. As such, the role of local employers and local employees was relatively small or, as R1 indicated: 'every company in the Netherlands, regardless where they are located, wants a fast internet connection. That goes without saying and the municipality aims at facilitating that'. Furthermore, R1 mentioned that it is still primarily 'supply driven', as KPN wants to ensure 'future cash flows'. R4 elaborated on this by mentioning that 'KPN chose for this deployment for commercial purposes, and not due to lobbying from our side per se'. According to R6, also the province played a significant role 'as they provided

financial support'. This is supported by R8, who also stated that 'at the local level, there has hardly been any influence. Rather, the provincial level is of greater importance'. R11 indicated that 'KPN coordinated and communicated with both the province and municipality in order to facilitate an effective deployment as possible, but also in order to synchronize the different parties' needs and desires'. As such, whether this deployment was primarily based on commercial and financial motivations can be questioned, since according to R11, KPN has also been actively involved in the societal component, by experimenting with several pilots regarding start-ups and innovation and eservices, which will also be elaborated in sections 4.4 and 4.5.

To conclude, it appears that in both villages the deployment was primarily an initiative between the telecom provider on the one hand and the government, municipality/province, on the other. There has indeed been some lobbying, but that was more related to the increasing demand for data, rather than local stakeholders actively organizing initiatives. Finally, both networks were primarily based on strategic commercial motivations, but the network in Buitenpost was tailored to also more societal needs, desires and usage patterns.

4.4 Expectations and effects: supply/work climate

Kollum

R3 and R7 agreed with the statement that the fiber optic cable network in Kollum may lead to job creation. Both mentioned Fotocadeau.nl as an example, which according to them, 'was able to grow significantly due to good internet connections'. R5 and R10 showed a slightly positive attitude towards this statement, especially expectations on hoping this will cause more investments in the region. Moreover, R10 mentioned that it could lead to job creation, 'since it facilitates working from home and companies anticipate on the possibilities due to a larger market area' or labor pool. On the other hand, R2, R9 and R10 stressed that, more importantly, these fast internet connections will benefit the region's employment by 'preventing companies from leaving the region' and 'keeping jobs' instead of thinking about more.

As such, when asking about the possible effects on innovation of business models or processes by companies already located in the region, R2, R5 and R10 agreed with this statement, while R3 and R9 disagreed or felt that this aspect played a less important role. Important to note is the close relationship between job creation and innovation, which became clear from R10. R10 stressed broadband as a facilitator for 'increased productivity' and 'innovation' for 'driving local economic sectors', such as construction, agriculture and metal fabrication. Since this region is characterized by demographical decline, productivity needs to be increased, as 'the same amount of work needs to be done with less people'. Increased productivity is connected to growth by companies and growth by companies may, in turn, also lead to job creation. Fotocadeau.nl can be an example of this, as the company was able to grow due to fast internet connections (increased productivity/innovation), which in turn led to more jobs. This is similar to R5, in which it is mentioned that due to the characteristic of the smaller firms, fiber optic cables may indeed generate innovation due to facilitation of a web shop among other things, which generates more work, but not more employment per se.

Regarding actual effects, R3 mentioned the emergence of smaller firms or solo self-employed as an example in the financial consultancy sector. However according to R2 and R9, this is because of other, demographic for example, factors and not due to the deployment of fiber optic cables.

Buitenpost

R1, R4, R6 and R8 agreed with the statement that fiber optic cables could lead to job creation in Buitenpost. R1 elaborated on that by mentioning a 'potential larger labor pool. It will generate increased possibilities on the labor market for both employers and employees'. However, R1 also

stressed that 'covid-19 could have a larger impact in this, especially on the short-term'. Similar to this, R4 also indicated that there is no 'bottleneck regarding firm-location based on fast internet connections anymore'. However, again, whether this can be ascribed to fiber optic cables is 'challenging to determine'. R8 stressed that for 'solely service-oriented companies it may become easier to locate in Buitenpost now'. R11 mentioned it is difficult to determine the impact of fiber optic cables on firm behavior. However, R11 also indicated that for 'people it does indeed become easier to relocate to areas such as Buitenpost, since they are able to do their things online there as well, instead of being located in urban areas'.

For innovation, R1 mentioned that 'fast internet is the highway for many work-related processes'. As such, 'software becomes more user-friendly, which benefits the quality of work'. R6 elaborated on that by indicating that 'fiber optic cables enables innovative techniques that are not place-bound anymore'. R4 acknowledged that 'there will be a shift due to automation, however, whether this is caused by fiber optic cables can be questioned'. R8 also stressed the importance of innovation, 'especially as end-users'. However, R8 considers it unlikely that Buitenpost will become a 'frontrunner in innovation'. Similar to Kollum, the close relationship between job creation and innovation is mentioned here as well, since R4 and R11 mentioned the emergence of start-ups. Due to increased internet connections, start-ups may be more inclined to locate their businesses in Buitenpost, for example, according to R4 and R11. R11 furthermore stressed that 'regarding innovation, start-ups are an important factor in getting people acquainted with the possibilities of digitalization'.

In short, while some people in Kollum anticipated job creation due to faster internet connections, others, which may be more important, noted that it can help by preventing both people and jobs from leaving the region. In Buitenpost, there seems more focus on job creation, but also innovation. Crucial here is the notion of start-ups, which can be considered as an example of both job creation and innovation. In both villages, there seems to be a positive attitude towards this. However, whether this will be caused by fiber optic cables is difficult to determine, as there may also be other factors playing a role.

4.5 Expectations and effects: demand/residential climate

Kollum

Fiber optic cables will not stimulate the use of eservices, according to R2. Or in other words, 'there are little to no signals on that matter'. R3, R5, R7, and R10 also agreed to this regarding connected and automated vehicles. According to R7 and R9, the mobile network will be more important here. However, especially on ehealth and the exchange of medical data, according to R3, the opposite is true. 'That was something we saw coming'. Similarly, R5, R7 and R10 also mentioned fiber optic cables as a key characteristic for the development of ehealth. Furthermore, on ecommerce, R3 mentioned that 'ecommerce is not something the local population wanted to happen per se, but that it rather is something for the local retailers to embrace the possibilities'. Finally, R5 stressed the importance of socializing and social media, which may be stimulated by fiber optic cables, while R7 mentioned the emergence of television on-demand and interactive television as an important driver for the deployment. More generally, R9 mentioned the importance and expectations of such eservices 'for the livability of rural areas'. However, as mentioned before, it can be argued whether Kollum is indeed a rural area.

Secondly, regarding the statement on the expectations of fiber optic cables influencing local housing prices, R2, R5, R7, R9 disagreed to that. R2 and R7 indicated that 'local housing prices were already at an all-time high', but that is due to other factors. Furthermore R5 and R7 mentioned that 'when a dwelling is not equipped with fiber optic cable, then it could indeed have an influence'. On the other hand, R10 agreed with this statement by mentioning: 'I think that there were some implicit

expectations. Location is key in the development of housing prices. That location becomes more attractive with increased physical and digital accessibility. It will definitely not have a negative impact.' Similar to this, R3 feels that it may indeed have an indirect positive effect.

Similar to the expectations, according to R2, there has not been any effect or increase in the use of eservices due to fiber optic cables. Yet, R7 in fact did notice an increase in these services and ehealth in particular, although 'not as much of an increase as initially anticipated'. Connected and automated vehicles does not play a role to this date, which has also been mentioned by R9. Ecommerce does play a role, but that 'cannot be ascribed to fiber optic cables, rather the circumstances due to covid-19'. Finally, R10 is slightly positive on the actual developments in eservices by mentioning that 'it may have played a role'. Moreover, R10 stressed that for the optimal utilization of such eservices, there is also a need for 'service related infrastructure that assists companies and institutes'. The implementation of such eservices is not something that can be done alone.

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On eservices, R1, R6, R8 and R11 agreed with the statement on the impact of fiber optic cables on eservices and that 'it will definitely play a role in the future'. Similar to innovation, R8 stressed that it will become 'generally accepted', but that 'Buitenpost will not be a frontrunner in those developments'. Furthermore, R6 indicated that it will be 'national trend', but regarding connected and automated vehicles, 'it is too early'. Based on R4, connected and automated vehicles, especially will be driven by the mobile network, which relies on fiber optic cables as its backbone. Yet, R11 indicated that there have been some pilots in other areas with 'connected and automated vehicles driven by 5G', but also 'agricultural pesticide usage with drones' and 'sensors which enable the elderly to stay at home longer'. This can also be promising for Buitenpost. Elaborating on R8, R4 mentioned a local initiative called 'Innovatiehuis'. The idea was that 'the Innovatiehuis would generate innovative ideas, also on eservices, but also 200 FTE jobs in 3 years'. Instead there were primarily 'subsidy-guzzling' organizations located there, rather than 'people with actual knowledge and know-how' and, eventually, it ceased to exist.

Next, regarding the influence on housing prices, R4 indicated that 'housing prices will increase slightly due to fiber optic cables', while R6 'does not expect any influence, as housing prices are already rather high'. Elaborating on that, R1 stressed that 'without fiber optic cables and fast internet, there is less demand' and, as such, 'the housing prices become lower'.

Thus, in the residential climate, especially eservices on healthcare are of great importance in both villages, while connected and automated vehicles play a smaller role, although there have been some promising pilots. Ecommerce is something that was already happening, rather than something that was anticipated. Furthermore, streaming services and services regarding TV on-demand are important factors to consider with increased internet connections.

4.7 Negative effects: demand/residential climate

Kollum
Similar to the statement on possible increased competition on the labor market, regarding possible increased competition for retailers which may lead to increased vacancy rates, R2 stressed again that 'it should be reversed. Without it, increased vacancy rates are created, as the incentive to leave the region becomes stronger'. Elaborating on this, R3 indicated that 'competition for local retailers will indeed happen, but it is up to the retailers how to cope with this'. This is in line with R7, R9 and R10. Competition from ecommerce was already happening, also in other areas, and will become greater in the future. R10 indicated, as mentioned before, that this competition forces local retailers to 'go with the flow', in order to keep their customers. However, R7 stressed that this can for the most part also be ascribed to covid-19, as people in general also prefer to 'physically feel or test a certain product'.

As such, vacancy plays a more important role for retailers, except for when they 'both have a physical shop and a digital showroom'. For 'hard commercial units, vacancy does not play a role'. However, whether this can be ascribed to fiber optic cables can be questioned according to R7.

On the other hand, R5 mentioned that this negative effect will 'turn out better than expected'. Moreover, R5 mentioned large vacancy rates in the 1980s as an example. This vacancy was especially the case in social housing due to people leaving the region. If this vacancy were to happen nowadays, then 'fiber optic cables might have a positive impact in preventing those people from leaving the region'.

In line with the expectations, R2 indicated that vacancy rates have not increased over the years. In fact, there has been a decrease in vacancy rates. However, it is difficult to determine the main cause, but according to R2, the fiber optic cable network 'must have played a role in this'. Elaborating on this, R7 also sensed a decrease in vacancy rates, but 'this cannot be ascribed to fiber optic cables'. This contradicts with R3, who indicated that 'some commercial units have become vacant. In particular units that used to be occupied by what R3 called traditional companies, whose products can be ordered faster and are better accessible online. However, this was only on a limited scale'. Similarly, R5 also sensed some increased vacancy rates in both residential and commercial units. But, 'it is very unlikely that vacancy rates have increased due to fiber optic cables'. However, R5 did mention, similar to R10, that several branches of a large bank, among which one in Kollum, have been closed due to 'digital possibilities'. R9 on the other hand mentioned that there is 'always a certain dynamic visible vacancy rates in both residential and commercial units. As such, this rate has remained rather stable over the years, but the fiber optic cable network again 'plays a minor role in this'. R10 indicated that 'there is a variety of reasons why a shop faces foreclosure and thus a commercial becomes vacant. The role fiber optic cables has played in this is difficult to examine'.

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In the residential climate, R1 agreed that due to ecommerce local retailers will be outcompeted, leading to increased vacancy rates. 'The traditional shopping center, except for the supermarkets, will change more towards fun shopping and that is something already visible today'. Furthermore, R1 mentioned that this is due to 'the developments of fast internet and the emergence of large internet companies'. R4 and R11 elaborated on that by indicating that 'it will be more a general, national trend', but also applicable to Buitenpost according to R4. R4 indicated that 'as a local retailer, you need to have a unique selling point. Otherwise, you will lose the competition to online companies'. Thus, R6's 'adapt or die' is also applicable here. R6 also stressed the changing way of shopping, towards a more story-oriented approach. R6 mentioned that 'it is not about the product itself, but rather the story about that product'. As such, 'the need for a physical store will remain', especially for larger expenses such as a car. On the other hand, R8 and R11 feel that these effects will be smaller for Buitenpost. As mentioned before in section 4.1, R11 indicated on a personal note that villages such as Buitenpost are more 'locally-oriented'. Although it will have an effect, this effect will be less prominent in such villages, as people continue to do their things locally, that they also used to do locally. R8 made a comparison between Buitenpost and Surhuisterveen, in which the latter 'has a much more prominent middle class with more variety such as accessory stores'. R8 continued by indicating that these are much less prominent in Buitenpost. 'Buitenpost primarily has a hard core of supermarkets, a pharmacist, greengrocer, butchers and bakeries, which are less sensitive from outside competition'. On the contrary, 'they may even benefit from it by being able to set up a grocery delivery service for example'. That does not mean that there is no vacancy. 'Most of those extra shops, such as the hobby shop, are already gone, since they were unable to continue their businesses. And what remained is the hard core'. Interesting to note here is that R8 also mentioned that the 'prices per square meter are not that low', which you would expect in such an area.

Similar to the negative effects on the work climate, there is also awareness on the negative effects of completion from ecommerce for local retailers. That is something that was already happening, but due to fiber optic cables, this effect may be accelerated. On the other hand, it was also noted that the effect of fiber optic cables is difficult to determine and that other factors play a role here as well. Eventually, there may indeed be negative effects, also on the residential climate, if 'you are not willing to adapt'.

4.6 Negative effects: supply/work climate

Kollum

Moving on to the negative effects related to the work climate, R2, R3, R5, R7, R9 disagreed with the expectation that fiber optic cables will lead to outsourcing due to an increased competition on the labor market. In fact, R2, R7 and R9 stated that 'it should be reversed. By investing in this, as a region you are then able to compete with other areas'. On the other hand, R10 agreed to this statement, by mentioning the construction of the Centrale As, an important regional motorway. R10 mentioned: 'That plays a role (competition on the labor market). With the construction of the Centrale As, everybody said Dokkum is better accessible now, while others said that other places are better accessible now too. What is important here, which is also applicable to fiber optic cables, is that as long as you are unable to maintain a certain level of quality, then such a connection will have a negative effect. Other parties are then able to offer both products and services more efficiently in your region. As such, it obliges you as a region for improving and maintaining that certain level of quality, due to increased competition'.

Regarding actual effects, R2 stated that there has not been a destruction of both jobs and firms due to deployment of fiber optic cables. As mentioned before, 'some firms and jobs have moved from the region to other areas, but that needs to be detached from the influence of fiber optic cables', which has also been mentioned by R5. R5 mentioned the transportation sector as an example, but that sector has moved out of the region for the sake of physical accessibility and, again, not due to fast internet. Similarly, R3 indicated that 'to me there is not an association between the availability of fast internet connections and firm destruction'. Furthermore, R7 and R9 also do not see a relationship between the two. R10 on the other hand mentioned that the service desk-related jobs at a large bank are facing increased competition due to innovation, but also fast internet developments. However, R10 also stressed that it can be questioned 'whether that is a negative development'.

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R6 was 'worried' on the effect whether fiber optic cables will lead to outsourcing of jobs. R6 elaborated on that by mentioning a 'possible emerging skills-mismatch'. However, that will primarily be the case 'if you are not willing to adapt. But in general, it will lead to positive effects. It is adapt or die'. Furthermore, R6 stressed that 'it may also have a positive impact on the construction-oriented economy since mechanics and builders are able to fill in receipts much faster using iPads, which are connected through broadband, to their employer'. This is also in line with R1 and R8. R1 stated emphasized that 'you need to embrace the future and look at how it will benefit you as a person or as a firm'. R8 indicated that 'this is difficult to determine, but overall we will break even'. More firmly, R4 stated that 'this will not play a role at all and that it will only have positive effects'. Similarly, R8 mentioned that 'a left-behind area like ours can benefit much more from these developments, compared to an area that already has a well-developed digital infrastructure'.

In both villages, there is awareness of possible negative effects. These effects can become problematic, if 'you are not willing to adapt' and if 'you do not embrace the future and its possibilities'. As such, these areas can benefit much more from such developments, as they have nothing to lose. That does not mean that no firms and jobs in Kollum were lost in the past years. Yet, this is primarily due to other factors such as demographics and physical accessibility.

5. Concluding remarks and discussion

In this final chapter, the findings of this research are presented. By answering three sub-questions, it aimed at finding an answer to the main question: 'To what extent does broadband have an added-value to socio-economic activities in rural areas?' Regarding socio-economic activities, a distinction has been made between the work climate and residential climate. Furthermore, these findings are put in a broader perspective by comparing them to the literature and some recommendations for future research are given.

5.1 Conclusion

From the analysis it becomes clear that the type of broadband that is being used, does not matter for the socio-economic activities. Rather, it is considered as part of the infrastructure. Fiber optic cables is considered as the standard for now, but if a new and better technique will become available in the future, then it is likely that said technique will become the standard. In fact, strictly speaking, there was already broadband available in the study area and therefore, people and firms already had access to good internet connections, regarding download capacity. Regarding upload, then fiber optic cable provides a much higher capacity. Or in other words, a more symmetrical connection. This is especially important when transferring large datasets by companies to their customers.

Regarding the deployment initiative, two organizations played a role primarily: the municipality and the telecom/cable company. The role of the municipality is rather similar as it contains granting permissions. The role of the telecom/cable company, however, differs. In Kollum, it was primarily based on strategic economic reasons, while in Buitenpost this was less prominent. Here, there was also a need to have a solid business case, but the telecom company is also actively involved in exploring the possibilities and benefits, such as innovation and eservices. The role of local employers and employees is also less important, but it does not imply they have not played a role at all. They had a role in letting their needs and desires be known to the municipality or the telecom/cable company. Also, they were able to make a decision whether they wanted to have a subscription and thus be 'hooked up' to the network or not.

Next, although there is awareness of the negative aspects, broadband deployment is considered relevant for innovation, and job creation. Also important is the notion of preventing jobs and companies from leaving the region by and the notion of start-ups. The latter should be provided with good connections, which enables them to grow and innovate, which eventually can also be considered as job creation. Similarly, the importance of broadband deployment for ehealth and TV-on demand services in particular has been mentioned. CAV are less important, although there have been some promising pilots in other regions. Regarding housing prices, primarily there is little to no influence. Moreover, it should be reversed, and this is also applicable to the work climate. Without broadband and faster internet connections, then it could have a substantial, primarily negative impact. By improving and investing in such a network, rural areas are able to compete with other, also more urban, areas. However, also the aspect of physical accessibility does play a role in this.

In short, while broadband internet enables people and companies in rural areas to do their things and while absence of said broadband internet would be problematic, it can be concluded that it is more a requirement (voorwaarde) for socio-economic activities instead of a clear added-value (meerwaarde). Rather, it can be considered as a self-evident part of the utility infrastructure, similar to the sewerage and drinking water system for example.

5.2 Discussion and recommendations

Several findings presented in this research can be considered in line with the literature. First, regarding the work climate, innovation and job creation (and start-ups) have also been important factors discussed in this research. Stockinger (2019) and Fabritz (2013) researched the influence of broadband on employment growth and found a positive effect in service related industries that rely heavily on intensive knowledge and extensive broadband use. On the other hand, they did not find such a clear relationship for the manufacturing industry. Bertschek et al. (2013) found a positive impact of broadband on the firm's innovation activity. The emergence and growth of a company such as Fotocadeau (Kollum) can be seen as such an example. Also, the emergence of several start-ups has been addressed. The investments in the broadband network may also have a positive impact on the growth of the latter category, although the future will have to tell us. For the residential climate, especially the importance of eservices regarding ehealth and TV on-demand has been stressed, which corresponds with Cowie et al. (2020), who considered the role of in the 4th Industrial Revolution (4IR), which relates to a series of technological developments that will significantly change society. Broadband can have a substantial contribution to these developments.

However, in their analysis on rural broadband initiatives in the Dutch context, Salemink & Strijker (2016) stress the importance of local citizens and entrepreneurs 'to be able to achieve their own objectives'. There is a thorough desire for livable rural areas with citizens taking an active role, behind this pursuit of broadband. The initiatives studied in this research, however, did not find similar notions. Rather, the two initiatives were primarily organized top-down, as a cooperation between the telecom/cable company and the local government. Some respondents have mentioned some lobbying from citizens and entrepreneurs, but this has not been a crucial and determining factor. Next, the region analyzed depends on construction and manufacturing related industries for its local and regional economy. An objective for the region is for these sectors to innovate and grow, due to investment in the broadband infrastructure for example. This conflicts with Stockinger's (2019) and Fabritz' (2013) findings, as there appears to be no clear effect of broadband on employment growth for the manufacturing industry. Furthermore, there also appears to be no clear relationship between housing prices and broadband. However, absence of broadband could affect housing values negatively. On the other hand, Deller & Whitacre (2019) who also explored the influence of broadband on rural housing values found that higher access of broadband shows a positive relationship on the housing values.

Moreover, Katz (2012) And Atasoy (2013) emphasized the possible negative effects of broadband such as outsourcing of labor services and competition from ecommerce on local retail and entertainment with accompanied job destruction and vacancy. In line with this argumentation, there is awareness of these possible negative effects and competition from ecommerce for example also plays a role. In addition, some companies have indeed left the region (Kollum), but the broadband network has not played a role in this. This was due to other factors, such as physical accessibility and demographic factors. In general, it is primarily considered as an opportunity and as a necessity for the region to be able to compete with other areas. As mentioned before by R8 for Buitenpost: 'A left-behind area like ours can benefit much more from these developments, compared to an area that already has a well-developed digital infrastructure'. This conflicts with the NEG point of view in the core-periphery discussion, as increasing accessibility through broadband would primarily benefit the urban area instead of rural areas. As such, the distinction between urban-rural/core-periphery becomes less relevant. Similarly, the distinction between work-residential climate also becomes more vague. Therefore, future research could focus on rethinking the core-periphery/urban-rural distinction, similar to OECD's (2019) FUA, and the role broadband plays in this. Secondly, there could be more focus on the extent to which the effects of broadband and covid-19 can be seen in isolation. Broadband facilitated working from home, but without covid-19, this effect would have probably been less obvious.

5.3 Reflection

Despite the ethical behavior and considering the confidentiality of the data, come improvements could be made. Prior to the data collection, by using literature, broadband is defined as a container notion with a download capacity of at least 30 Mbps. As mentioned before, this means that in both villages studied, there was also already broadband available. This made it difficult to compare the situation before fiber optic cable deployment and afterwards. Similarly, due to covid-19, the actual effects of broadband are also difficult to determine. Many respondents considered the effects in line with the contemporary covid-19 situation, despite this not being the scope of this research. Moreover, measuring the actual effects can also be difficult due to the time variable. Certain (demographic) changes take time to have a measurable effect. Therefore, the actual effects and conclusions need to be interpreted with caution.

Also addressed before has been the 'snowball method' that has been used to approach several respondents. This may result in respondents having similar opinions and thus distort the representativeness, due knowledge exchange between them. Similarly, some respondents also expressed and stressed their own opinion rather than the general thought of their organization or village.

On a more practical note, on Wednesday, 10 March three interviews were scheduled. This could have been organized better, as this gives no time to transcribe an interview, as the next one is already scheduled. Clifford et al. (2016) indicated that it is always better to transcribe an interview immediately, as the information and striking notions are still fresh. This condition could not be adhered to. Secondly, two interviews were interrupted due to a phone ringing, which may have influenced the atmosphere of the interview. Finally, despite the time limit of 45 minutes maximum, there were quite a number of interviews that exceeded the time limit. One interview exceeded the time limit by about one hour. As a researcher and moderator, I should have interrupted more in order to prevent this from happening, but also to prevent the amount of redundant and irrelevant data. On the other hand, from the respondent's point of view, this takes up extra of their time than necessary as they also probably have meetings afterwards they need to attend. As such, this could also result in (crucial) information being hold back, since there is not enough time left.

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7. Appendices

Appendix 1: Informed consent form

Toestemmingsformulier interview

Doel
Door middel van verschillende interviews zal dit onderzoek een verkenning uitvoeren naar de invloed en meerwaarde van breedbandinternet op sociaaleconomische activiteiten in landelijke gebieden. Tijdens het interview heeft u het recht om vragen niet te beantwoorden of het interview af te breken. Aangezien het interview vrijwillig is, kunt u altijd besluiten om zich terug te trekken als deelnemer. Van het interview zal een geluidsopname gemaakt worden. Deze geluidsopname wordt in een afgesloten en beveiligde ruimte bewaard en na afloop van het onderzoek vernietigd.

Data
De data uit de interviews zal worden geanalyseerd en gebruikt in het onderzoek voor bovenstaand doel. Het onderzoek zal openbaar toegankelijk zijn via de Rijksuniversiteit Groningen. Er zal vertrouwelijk met de data omgegaan worden. Deze zal dan ook anoniem verwerkt worden in het uiteindelijke onderzoeksrapport. U zal in het onderzoek aangeduid worden als (beleidsmaker/bestuurder/bewoner) in/van het gebied.

Ik heb bovenstaande voorwaarden gelezen en ga hiermee akkoord:

Datum: Handtekening deelnemer:

Appendix 2: Interview guide

Interview guide	
Deel 1. Algemene informatie	- Introductie - Doel van het onderzoek - Ethiek
	1. Bent u (of uw organisatie) betrokken geweest bij de totstandkoming van het glasvezelnetwerk? 1.1. Zo ja, wat was uw rol/verantwoordelijkheid/takenpakket (van uw organisatie) hierbij? 1.2. Zo nee, bent u op een andere manier betrokken of verbonden met het dorp?
	2. Glasvezel is maar een voorbeeld van breedbandtechnieken. Andere technieken zijn bijvoorbeeld VDSL, coax, 4G en in de nabije toekomst 5G. Wat deze technieken gemeen hebben is de downloadcapaciteit van tenminste 30 Mbps. Denkt u dat het type breedbandtechniek uitmaakt voor de effecten met betrekking tot sociaaleconomische activiteiten? 2.1. Zo ja, welk voordeel biedt glasvezel ten opzichte van andere breedbandtechnieken? 2.2. Zo nee, waarom is besloten om glasvezel aan te leggen?
Deel 2. Totstandkoming en sleutelorganisaties	1. Hoe is het netwerk tot stand gekomen volgens u? 1.1. Welke organisaties hebben een rol gespeeld bij de besluitvorming rondom de aanleg van het glasvezelnetwerk? 1.2. Hoe belangrijk was de rol van lokale werkgevers en werknemers hierin?
Deel 3. pre-glasvezel situatie	In dit onderzoek worden de sociaaleconomische effecten van breedband onderverdeeld in werk gerelateerde (aanbod) patronen zoals meer banen, meer innovatie (veranderde/verbeterde bedrijfsprocessen/structuren) en een breder werkaanbod voor werknemers, maar ook negatieve effecten zoals vergrote concurrentie op de arbeidsmarkt die het uitbesteden van werk tot gevolg heeft. Ten tweede worden patronen onderscheiden die betrekking hebben op het woon en consumptieklimaat zoals de mogelijkheid tot zelfrijdende auto's en e-gezondheid en e-commercie, maar ook een kans op het wegconcurreren van lokale ondernemers en winkels door een toename in e-commercie, wat kan leiden tot het verdwijnen van banen, bedrijven en leegstand. De volgende vragen hebben betrekking op de situatie voor de komst van glasvezel.
	1. Hebt u kennis van de sociaaleconomische situatie in het dorp met betrekking tot het woon-werkklimaat vóór de komst van glasvezel? 1.1. Zo ja, hoe zou u deze omschrijven? 1.2. Zo nee, kunt u een inschatting maken hoe de situatie toen was?
	2. Vervolgens wil ik u een aantal stellingen voorleggen met betrekking tot de verwachtte en beoogde effecten van glasvezel in het dorp. Kunt u aangeven in hoeverre u het eens of oneens bent dat glasvezel zou leiden tot … 2.1. meer banen? 2.2. meer innovatie? 2.3. diensten op het gebied van digitale gezondheid, digitale

	commercie en zelfrijdende auto's? 2.4. het uitbesteden van werk door een toenemende concurrentie op de arbeidsmarkt? 2.5. het wegconcurreren van lokale ondernemers en winkels, wat kan leiden tot het verdwijnen van banen en bedrijven en leegstand?
	3. Had u daarnaast ook verwachtingen over de invloed van glasvezel op … 3.1. het (lokale) onderwijs? 3.2. huizenprijzen? 3.3. patronen in het woon-werkverkeer? Zo ja, hoe zou u deze verwachtingen omschrijven?
Deel 4. Begin van aanleg –en exploitatiefase	1. Waren er volgens u al effecten merkbaar in het dorp toen het glasvezelnetwerk er nog maar net lag/ men net begonnen was met de aanleg? 1.1. Zo ja, was er al sprake van meer banen of juist innovatie? 1.2. In hoeverre was er al een zichtbare toename in (de voorbereidingen op) het gebruik van diensten op het gebied van digitale gezondheid of digitale commercie? 1.3. Waren er ook al banen of bedrijven verdwenen? Zo ja, in welke sectoren was dit met name het geval? 1.4. In hoeverre was er een zichtbare toename van de leegstand?
Deel 5. Huidige situatie (alleen toepasbaar op Kollum)	1. Nu het glasvezelnetwerk een aantal jaren in gebruik is, is er volgens u sprake geweest van meer baancreatie of juist innovatie? 1.1. In welke sectoren was dit vooral het geval?
	2. Zijn er ook banen of bedrijven verdwenen door glasvezel? 2.1. Zo ja, in welke sectoren was dit het geval?
	3. Is er een duidelijke toename geweest in (de voorbereidingen op) het gebruik van online diensten als digitale gezondheidszorg en digitale commercie en zelfrijdende auto's?
	4. In hoeverre is door glasvezel de leegstand de afgelopen jaren toegenomen?
	5. Heeft glasvezel de afgelopen jaren ook invloed gehad op de bevolkingsomvang? 5.1. Zo ja, is deze toegenomen of afgenomen?
	6. In hoeverre heeft glasvezel invloed gehad op … 6.1. het (lokale) onderwijs? 6.2. huizenprijzen? 6.3. woon-werkverkeer?
Deel 6. Conclusie en feedback	1. Waar zit volgens u de precieze meerwaarde van breedband in relatie met sociaaleconomische activiteiten?
	2. Wilt u verder nog iets toevoegen aan dit interview met betrekking tot feedback en/of aanbevelingen?
Deel 7. Afronding	1. Bent u geïnteresseerd in de eindversie en heeft u nog suggesties voor andere kandidaten voor een interview? - Ethiek herhalen - Contactgegevens delen - Bedanken

Appendix 3: Codebook

Theme	Code
Area description	Area description
	BadkamerXXL
	Centrumvisie
	High demand
	Increasing demand for data
	Innovatiehuis / area description
	Trends in residential climate
History of broadband: techniques	Coax prior to fiber optic cables
	Comparing different broadband techniques
	Fiber optic cable on main network
	Fiber optic cable versus coax
	Fiber optic cable: most stable, fast network with higer capacity compared to others
	Higher upload capacity
	History of broadband network
	Situation before optic fiber cable
	Why fiber optic cable
History of broadband: organization	Involvement of BCB
	Key organizations
	Lobbying from province
	Motivation for KabelNoord
	Motivation for KPN
	Organization outside the village core
	Role of interviewee
	Role of local employers and employees
	Role of municipality
	Market share KPN
	Supply driven
Added-value: supply/work climate	Added value: work climate
	Both innovation and job creation
	Creation of jobs
	For employees: location of employer is less important
	Goal: job creation
	Goal: keeping jobs
	Growth potential
	Influence on local sectors
	Innovation
	Keeping people
	Larger labour pool for employers
	Sector specific innovation
	Sector specific job creation
	Start-ups
	Start-ups: innovation + job creation
	Tourism
Added-value: demand/residential climate	Added value for residential climate

	Automated vehicles abd Ecommerce
	Autonomous vehicles
	Broadband supports local education
	Changing way of shopping
	Ecommerce
	Ecommerce and Ehealth
	Effect: more cohesion
	Ehealth
	Eservices
	Expectations on Ehealth
	Expectations on eservices
	Fiber optic cable stimulates residential climate
	Goal: TV on-demand
	Housing prices
	Innovatiehuis: Eservices
	Local education
	Local education, housing prices, commuting
	Outcomes on Ehealth
	Population size
	Population structure
	Residential climate
	Social activities
	Socializing, TV on-demand
Negative effects: supply/work climate	Awareness of negative aspects
	Competition on local labour market
	Negative effect: outsourcing
Negative effects: demand/residential climate	Competition
	Destruction of shops
	Job destruction
	Negative effect: competition for local retail
	Negative effect: vacancy
	Sector specific job destruction
	Vacancy
	Vacancy in commercial units
Other important data	Both digital and physical accessibility
	Both residential and work climate
	Cable structure is backbone for mobile network (autonomous vehicles)
	Culture change facilitated by broadband
	Fiber optic cable as the standard
	Fiber optic cables Is not the end
	Implications of covid
	Importance of broadband
	Influence of fiber optic cable
	Less dependence on physical location
	Less place-bound
	Less segregation of working and private due to working from home

	No effects in deployment phase
	Physical accessibility
	Physical accessibility versus increasing digital accessibility
	Side note: accuracy of data
	Side note: covid stronger influence on short-term compared to broadband
	Side note: other demographic forces
	Without internet and broadband: lower housing price
	Without stable internet connections: less interesting for both residents and commercial activities

Appendix 4: Transcripts
Per request!