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Government involvement and learning in business model experimentation: NGA deployment in rural areas in the Netherlands

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Government involvement and learning in business model experimentation: NGA deployment in rural areas in the Netherlands

Search terms: rural broadband, rural connectivity, rural digital divide, rural FTTH, MLP, multi-level perspective, business models, access networks, access network operator

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Abstract

The paper analyses the effects of governmental policy in the Netherlands on the formation and development of rural broadband projects. Rural internet access speeds are increasingly falling behind. As a result, the vast majority of Dutch urban households use internet connections faster than those available to their counterparts in remote areas. As demand increases rapidly over time, the experienced deficit will grow rapidly without improvements to rural networks. This issue has received attention at different levels of government in the Netherlands, where regional and municipal actors have stimulated new broadband network deployment. In this context, the article explores the role of the governmental policy in the rise of these projects and in stimulating new business model development. The paper studies 191 projects in the Netherlands and uses publicly available reports on government spending. The study then focuses on 28 projects in greater detail by using quantitative information gathered via a survey. The analysis shows that a large number of small projects use differing network construction methods and a variety of business models, allowing for some experimentation. In addition, a combination of financial support and actor network building is found to provide advantages to these projects.

Introduction

Compared to the rest of Europe, lack of Internet access as defined by the European Commission for Next Generation Access (NGA) networks (i.e. based on a download speed of 30Mbit/s (EU, 2009)) is rather limited in the Netherlands. Even in sparsely populated areas, broadband availability in the Netherlands is around 93%, compared to an EU average of 77% (Eurostat, 2017). In order to address the poorly developed rural areas, the European Commission eased regulation for government support in so called ‘white areas’, first defined within the Broadband Guidelines (2009) as those without next generation access networks (EU, 2012). Currently white areas in the Netherlands are served predominantly by incumbent company KPN using twisted-copper pair connections. Most of these connections have been upgraded using DSL technologies. These DSL upgrades have brought vast improvements to network speeds of copper lines, but their effectiveness is dependent on the distance between the first point of presence (POP) and the subscriber. These POPs are commonly located in urban areas, and as a consequence internet speed in rural areas lags behind urban areas. Furthermore, due to the relatively quick drop in speeds, the distribution of download speeds within white areas, which are exclusively rural, is skewed to low speeds, as illustrated in Figure 1. This figure demonstrates that the download speed of the majority of white area premises is limited much more than if this distribution had been more even. Half of the premises have access to just 7 Mbit/s. Due to the technological nature of this issue, the distribution will be similar in all remote regions relying on DSL connections, although the specific distribution depends on the geographical spread of premises and specific type of DSL implementation used (Hincapie et al., 2015).

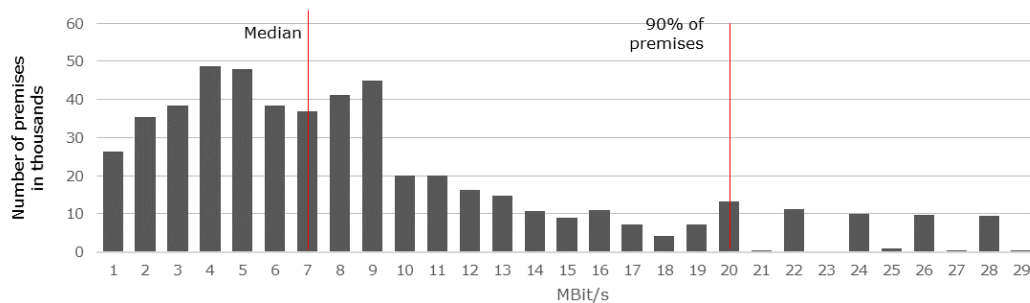


Figure 1 Maximum download speeds in white areas in the Netherlands, based on speeds reported by the incumbent operator (KPN), data courtesy of Dialogic

The effect of this speed divide between rural and urban areas is growing over time as demand for download speeds has increases in the future (Harstead and Sharpe, 2015). The rise in future demand can be operationalized by using the indicator 'advertised download speed equivalent', and relate it to the actual usage patterns required to meet this demand. The indicator is required because advertised speeds are maximum speeds that will not be available at peak capacity of the network due to network bottlenecks (for DSL networks). In the Netherlands, the increase of this advertised download speed equivalent is estimated to be 30-40% per year (Dialogic et al., 2016). Figure 2 shows an extrapolation of the advertised speed required by mainstream users, based on this growth figure. The median speed advertised in white areas is shown to have be less than the usage patterns of mainstream users in the Netherlands since 2013. Other technologies like cable modem techniques using DOCSIS standards are not used in rural areas. Some user groups consume much more bandwidth than mainstream users, the top 1%, so-called power users, will use close to 500 Mbit advertised download speed equivalent in 2017, innovators (4% of users) would use around a 150 Mbit/s according to this estimate. This illustrates the extent to which there is a 'rural digital divide' in the Netherlands. As a result, the vast majority of subscribers in rural areas would use at least double their bandwidth connection when they live in urban areas, whilst power users would use a speed up to 50 times of current offerings. This demonstrates that the available network speed plays an important role in the creating and maintaining a digital

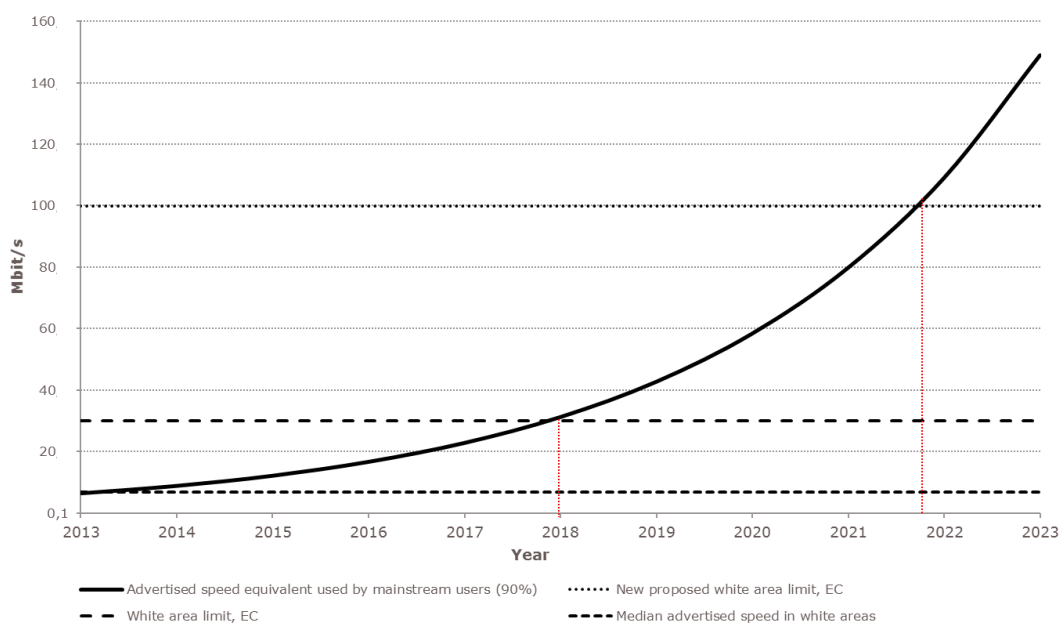


Figure 2 Used 'advertised download speed' equivalent for main stream users, (comprising 90% of the of population) compared to available speeds in rural areas, data source: Dialogic et al., 2016

divide between rural and urban areas in the Netherlands.

As the offered download speed in urban areas increases, users in rural areas, i.e. household, farmers and companies, will increasingly be left behind. Higher broadband speeds enable new services, to which residents in white areas will have reduced access (Zhaung et al., 2013). The consequences of this divide are further amplified by the benefits broadband network access holds for rural areas. These areas will gain more from remote healthcare services, as well as online governmental and educational and services (Townsend et al., 2013). Furthermore, a low download speed is associated with low upload speeds, which complicates remote-working, video-conferencing, and off-site backups, services with high economic value.

New network construction aimed at decreasing the rural digital divide requires vast fixed-capital investments. The investment costs for rural connections are on average 80% higher compared to these costs in urban areas (Schneir and Xiong, 2016). Some far-off premises are extremely more expensive to cover using fixed broadband networks, as digging costs are very high (Casier et al., 2008). Fixed wireless deployment, which supplies broadband through dedicated mobile cells, is less expensive, reaches far-off premises and is faster to deploy, but improvements in speed are limited to 20-100 Mbit/s, to keep up with urban speeds, these networks require regular upgrades. Another deficit of these networks is the inability to reach premises obstructed by dense vegetation (Muhammad et al., 2013). In the

Netherlands, 191 projects are currently active in targeting the installation of either fixed or fixed-wireless broadband networks, although many have yet to deploy these networks.

This paper focuses on the question how are these projects affected by governmental interventions at national, regional and municipal levels. The central research question is the following; *to what extent did national and regional government policy facilitate the emergence of alternative business models for rural high-speed broadband network in the Netherlands?*

Nurturing the business model

As rural broadband projects develop a variety of business model configurations, successful business models overtake incumbent's technologies within their area. Scaling of such projects may change the entire market for rural access. As such, concepts of stimulating and scaling projects, as used within niche theories, will give insight into ongoing market dynamics. In this context, Pant and Odame (2016) successfully apply learning concepts taken from the multi-level perspective (MLP), a socio-technical lens designed to study transitions in socio-economic systems, to generate insights into the learning processes in rural broadband development in public-private partnership projects in Canada. This study aims to further expand the application of multi-level perspective to broadband niches by including a quantitative analysis of rural project development and learning within in the Netherlands.

The multi-level perspective traditionally studies socio-technical transitions of technologies that have a major impact on society as a whole. But recently, several scholars have noted that this approach can be applied to transitions driven by new business model development (Huijben and Verbong, 2013, Bidman and Knab, 2014, Wainstein and Bumpus, 2016). As a result, the insights from MLP will be used to study the evolution of broadband projects within rural areas in the Netherlands. In this context, we consider the rural market as a socio-economic niche where new business model configurations are tested, and in which a successful new configuration may eventually overtake the existing paradigm. Viewing rural broadband deployment from this perspective, allows us to study the effects of many, loosely related broadband projects in rural areas. Because a number of studies have shown that the deployment of broadband technologies is well established, this study will view rural broadband as a business model niche rather than a technological niche, as suggested by Bidmon and Knab (2014).

As such, the rural broadband projects currently active in the Netherlands are effectively socio-economic innovation experiments. New socio-economic arrangements are tested within these project as experiments of actors with different types of financing, use of technology, and partnerships. These arrangements can be studied using the concept of business models, which can be conceptualized as a holistic description of 'the way firms do business' (Zott et al., 2011).

The MLP approach describes large systemic social changes as the interplay between three levels of organization, landscape, regime and niche (Geels, 2002). In which the regime represents the current 'ways of working' within society. A niche is conceptualized as a shielded space in which alternative ways of working to the regime are developed. Niche development allows 'hopeful monstrosities' to develop in an environment shielded from competitive pressure. These 'monstrosities' are usually underdeveloped technologies, but may equally be applied to untested business models (Bidmon and Knab, 2014). This line of research argues that if development of such a niche is of public interest, public investment may be justified to stimulate niche formation and growth. In the Broadband Guidelines (2009, 2013) , the public interest is clearly defined with respect to territorial cohesion and economic development objectives as criteria to assess the complementarity of public investment and to avoid distortions of competition.

MLP identifies two broad methods for public agents to stimulate niches: niche shielding, and niche building. The former creates barriers to protect niche agents from competitive pressure whilst the latter stimulates the niche agents to learn from each other and cooperate, creating a functional alternative to the current regime (Schot and Geels, 2008).

Within the rural broadband niche in the Netherlands, the policy interventions used are twofold. First, financial and in-kind support to projects and, secondly, stimulating learning and actor-network formation. The former operates as a form of niche shielding whilst the latter stimulates niche building. Therefore, this study will focus on these two mechanisms.

Learning takes on an important role in both niche formation in MLP approaches and in the business model literature, but both promote different concepts of learning. The MLP framework provides a structured overview of sources of learning, whilst information on learning within business model theory is distributed and more implicit. MLP outlines

four learning mechanisms: learning by searching, by doing, by using and by interacting. In order to align the two fields, concepts from business model literature are aligned to these categories in the sections below.

Because a business model is tightly interwoven with its context and dependent on the business models of others in its product chain (Chesbrough, 2010), *learning by interacting* is likely to play an important role in business model development. In support of this, general business model literature agrees that business models success is based on a network of partners rather than individual firms (Burkhart et al., 2011; Klang et al., 2010; Zott et al., 2011) and inter-organizational learning can be found in several examples of business model development (Jones and Macpherson, 2006).

Business model literature finds that business model experiments are a major way of developing new business model opportunities (Mullins and Komisar, 2009; Chesbrough, 2010; McGrath, 2010), they find initial business model designs are often build on wrong assumptions. This indicates that *learning by doing* plays an important role in developing to business model niches.

Learning by searching plays a less important role in general in the business model theories. Real world complexity limits opportunities for *learning by searching* in business model explorations as compared to technological learning. Even so, knowledge may be acquired by studying the market and other players (Sosna et al., 2010). Other forms of business model learning by searching include the use of financial models and the use of business model tools developed from theoretical frameworks, like Osterwalder's 9-point decomposition model (Chesbrough, 2010, Osterwalder and Pigneur, 2010).

These similarities indicate studying learning mechanisms may assist in further integrating business model theory within the multi-level perspective. This paper applies these learning mechanisms to rural broadband projects to identify their main learning mechanisms in business model development, in the hope insight will improve methods to stimulate these processes. Learning by using is not included in this analysis, as the majority of projects are yet to deploy networks, and are therefore unable to learn through using.

Methodology

To answer the research question, a mixed methodology is applied, aggregating online sources on projects and government spending. This data generates an overview of the current situation, whilst a survey and interviews are conducted to gain a deeper understanding of the underlying processes.

An online analysis identified 173 projects currently active in realizing broadband in 'white' areas, these include projects using FTTH as well as several fixed-wireless projects. Active projects are defined as projects in which non-incumbent are actors currently pursuing network construction and include completed projects. Note that each network deployment is regarded as a separate project, because actors regularly adapt business models when expanding into a new area. As a result, several projects may be run by a single agent. In total, there are 98 of these active agents, of which community driven organizations constitute 83. Information about these projects was gathered on its phase of development, network structure, any received governmental support, and several business model choices.

Public reports on governmental spending were used to create a dataset including governmental initiatives to improve rural connectivity, separating between projected and actual spending. This allowed for a structured study of the type of interventions used, their prominence and a comparison across different regions. This data is limited to provincial sources, as the national government did not stimulate projects directly and sources on municipal spending are scarce.

Five semi-structured interviews were conducted with industry experts and project owners to gain in-depth insight into processes within the industry.

The total amount of rural broadband projects identified is 191, but when reduced by the projects in very early phases, those stopped, taken over by others and multiple projects done by a single actor the number of projects drops to 78. A survey was distributed among 68 of these projects, which generated 41 responses, 28 of which could be used for analysis.

The survey was designed to answer questions regarding the effect of government assistance during different stages of the project and the learning methods used by project agents in designing the business model. In separating project phases an 8-stage model suggested by Saleminck et al. (2015) is used, which is based on interviews and triangulation with several rural projects.

The survey used multiple-choice questions to facilitate survey completion and allow statistical evaluation of the results. The interviews conducted were used to generate the options available to projects within the survey. All question enabled open answers so shortcomings of these selections could be identified. The resulting questionnaire was triangulated with experts and tested by a project before being spread through a mailing list.

The survey was completed by project members with a variety of roles, although most participants have been involved in their projects from the beginning. All participants were involved in the project during the phase in which the business model formed. Participants were spread throughout the country, distribution throughout provinces is roughly aligned to projects in the entire dataset. The tables with descriptive statistics below show no significant bias in the survey sample. In addition to these indicators, biases were checked using technology employed (FTTH: 96% in survey versus 93% in dataset) and type or organization (community driven organizations: 79% versus 71%).

Projects, entire dataset	Mean	SD	Min	Max	No.
Starting year	2015	1,66	2006	2016	114
Size (number of premises to be covered)	1800	8604,89	9	40000	93
Coverage required before roll-out (%)	55	13,44	0	100	92
Phase (1-8, 7 = deployment)	5	2,29	1	8	173
Projects, in survey analysis	Mean	SD	Min	Max	No.
Starting year	2015	2,50	2006	2016	20
Size (number of premises to be covered)	1400	10345,05	21	39000	17
Coverage required before roll-out (%)	55	8,52	40	70	15
Phase (1-8, 7 = deployment)	5	2,17	2	8	29

Results

Combining the diverse sets of methodologies yields a diverse set of results, ranging from general observations on the development of the rural broadband niche in the Netherlands to detailed analysis of learning methods applied by project participants.

The full dataset of projects reveals there is a large variance in business model components: in number of premises to be connected (9-40.000), coverage to be gathered in demand aggregation before roll-out (0-100%), monthly extra 'rural' cost for users (0-20 euros per month, ranging from 10 years to indefinite payments), required lump sum payment (45-4000 euros), type of technology used (i.e. wired or fixed-wireless), funding methods (i.e. user-owned, local businesses or long-term investors, governmental loans) and network structure (i.e. connecting every premise or limited to those who sign on or not connecting a percentage of premises hardest to reach). The differences in network structures supports the finding by Saleminck et al. (2016) that rural broadband projects may create 'patchwork' type of deployment. As a result cost will be incurred when attempting to combine these networks at a later date. This is especially problematic in fixed line deployments, because of the long-term investments required in passive infrastructure.

The majority of projects are community driven (79%). At least half of all projects use some form of governmental funding (59). The vast majority of FttH project which deployed networks have received some form of governmental funding, in the form of subsidies, loans or guarantees (20 out of 28), this indicates the effect of governmental funding has had a positive effect on project development at a 95% confidence interval. There are too few fixed-wireless projects in the dataset (12) to draw conclusions on the effects of financial support on these networks.

Governmental support for these projects differed by level of government involvement. The national government explicitly decided to leave deployment stimulation to regional and local governments (Dutch Ministry of Foreign Affairs, 2010). The national government did launch an online platform which includes guidelines detailing how to start a broadband project and links to existing projects, which may be considered as a form of niche building.

At a regional level, support was provided in a variety of ways: along with regional knowledge platforms, subsidies, guarantees and loans were supplied to projects. In addition, three Dutch provinces attempted to deploy own networks, but these attempts were withdrawn due to competition concerns. Several smaller network companies are partly owned by municipalities, these existing PPP's and government owned networks deployed rural broadband in several cases.

Governmental sources provide some insights into the extent of spending of Dutch provinces. These provinces have spent at least fifteen million Euro on subsidies and subsidy-equivalent of loans. In addition, around 83 million Euro

has at some point been promised, but was not been made available or has been revoked. Interviewees noted that in some cases the reason for revoking subsidies was a lack of viable projects. In others, successful roll-out is conducted by agents who prefer not to use subsidies. In addition to these observations, Salemink, Strijker and Bosworth (2016), found that rural broadband projects experience difficulties with regard to unclear and changing subsidy requirements, and project-owners will sometimes completely abandon the subsidy process for this reason.

Studying the relation between provincial spending and the number of FTTH (fiber to the home) projects in a province shows these are correlated at a 99% confidence interval as illustrated in Figure 3. Non-FTTH projects are excluded from this analysis, because regional spending is usually focused on FTTH projects, but including them does not change the validity of the results. Based on interviews there is a two-way causal relationship between these variables, with investment spurring project creation and growth whilst an existing project notes the discourse created by projects stimulates government intervention.

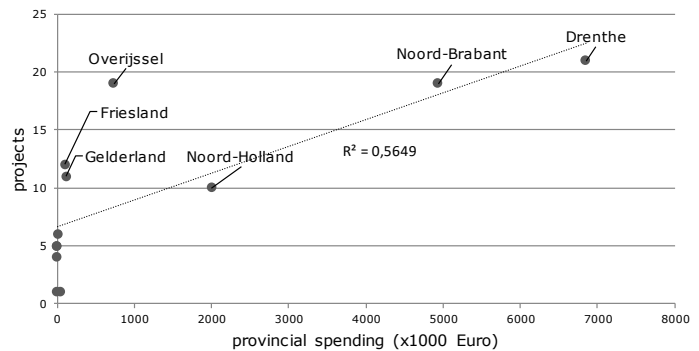


Figure 3 Provincial spending (subsidies and subsidy-equivalent of loans) compared to the number of active rural FTTH projects

Projects are an imperfect proxy for success as they differ to large extent in terms of network size. The province Friesland, for instance, has many very small projects, with 12 projects covering a few municipalities. This explains the large number of projects in Friesland, compared to their budget. Drenthe has invested in niche shielding on one hand, providing subsidized loans and niche building and on the other, by creating a cooperation platform. As a result large parts of the province are now covered by (yet to deploy) community driven projects. As such, the combination of niche shielding and niche building as employed by Drenthe seems to be more effective.

Gelderland and Overijssel perform above average because Glasvezel Buitenaf, a joint venture between a semi-public network operator and a long term investment company, is active in those regions. Glasvezel Buitenaf found that geographical qualities of the provinces, which have relatively densely populated rural areas, were favorable to fiber optic roll-out. As a result, they were able to deploy a large number of projects without government spending, although interviews indicate profitability is below on their expectations, which may affect future deployments.

Detailed analysis of the active projects in provinces with low or no recorded provincial spending shows these projects have either been giving support from municipal governments or are smaller and in earlier stages than projects in other provinces.

On a local level several municipalities provided support in the form of loans and subsidies, but governmental data on subsidies is sparse on this level. Data analysis of online communications from projects shows that at least 35 of these projects received some form of financial support from their municipalities, whilst at least 42 received financial backing from provinces. No project received any type of direct support from the national government, which was expected based on its decision not to intervene in this market.

Figure 4 shows governmental support received by projects within the survey. It illustrates support in kind, area mapping and support for demand aggregation, is more common for local governments. Local organizations may be better equipped at certain tasks. For instance, in the demand aggregation phase local governments may assist by building a relationship between the project inhabitants. The national government is never indicated as a source of direct support for projects.

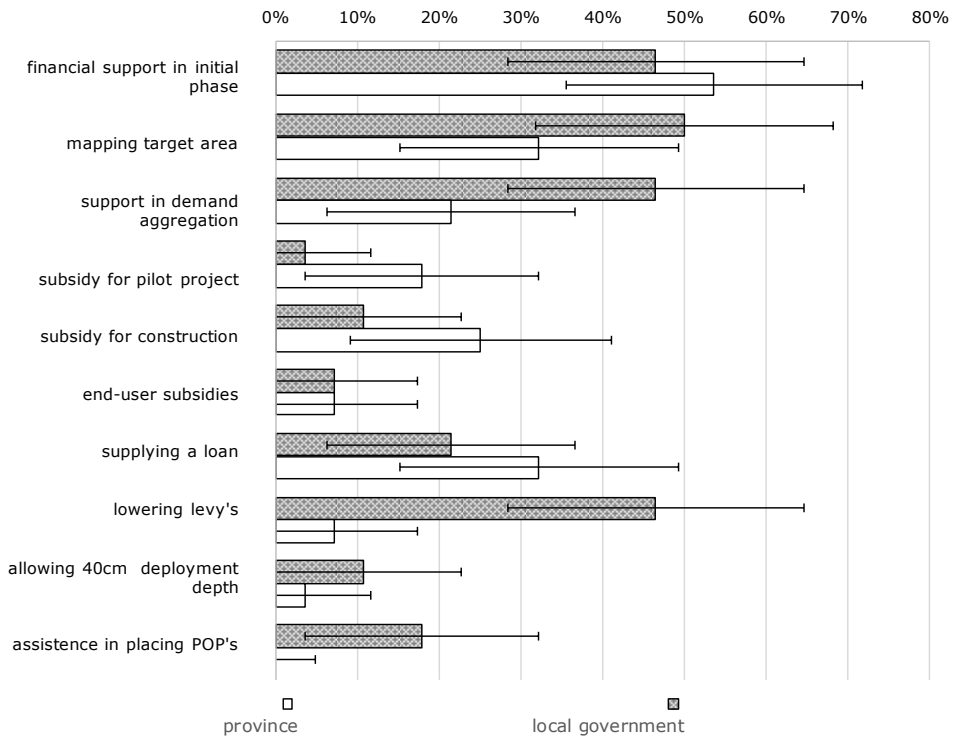


Figure 4 Type of support received from governmental organizations including 95% confidence intervals

Regional and government support has been an important driver for the vast majority of projects as shown in Figure 5. As expected, government support is often used in financing network deployment. More surprisingly, support is also found to be important in the exploratory phase, in which actors acquire general knowledge on the project.

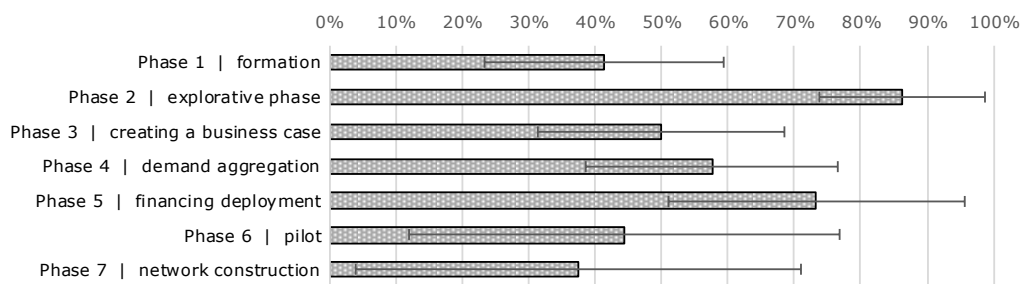


Figure 5 Importance of governmental support by project phase including 95% confidence intervals

Figure 6 shows the type of learning sources project agents used to build a business model. Learning from others external actors is the dominant form of learning employed. Which outside actors were of importance was also analyzed, resulting in a large variety of answers. Many external agents may provide pivotal information including: external advisors, agents from other projects, network constructors, regional and local governments, incumbents and service providers.

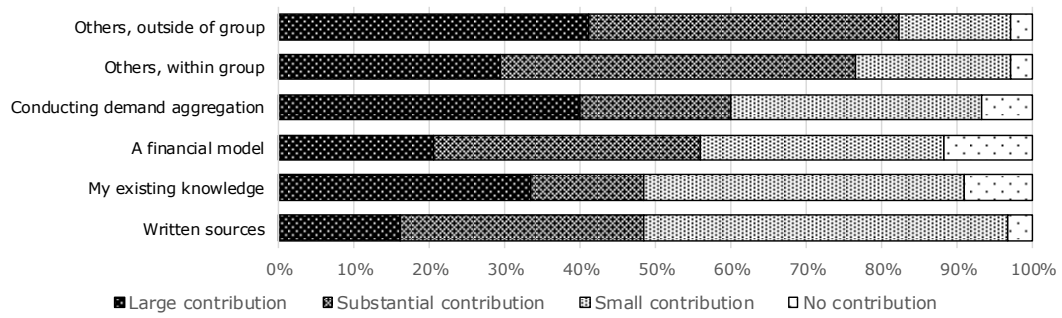


Figure 6 Contribution of different sources of learning to business model formation

Written sources are found to be the least popular learning method. Specifying which written sources were used, sources from regional knowledge platforms and other projects were deemed most useful, whilst the national platform scored lowest among these resources.

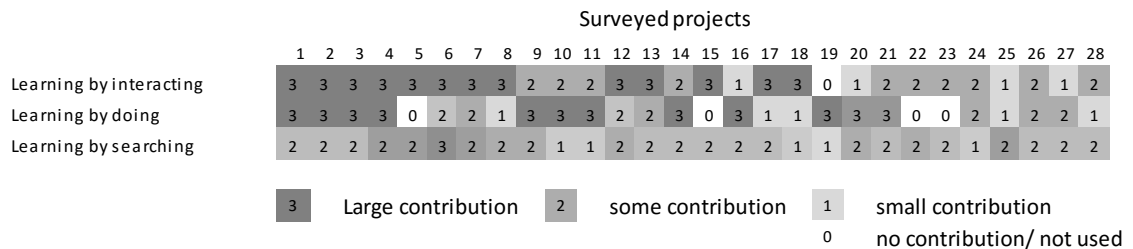


Figure 7 Heatmap of business model learning methods used by survey participants

Figure 7 shows the results of aggregating the data on learning into the theoretical framework within MLP; into learning by searching, doing and interacting. The figure illustrates the learning pattern of all surveyed individuals, which shows some individuals have a strong preference for one or two learning methods over the other, but many indicate they use all three forms of learning. This means methods of business model learning differ on an individual level, which can be taken into account when attempting to stimulate learning processes.

Conclusions

Drawing from the results presented in this study several conclusions are reached on the application of MLP theory to business models in addition some practical recommendations to governmental and (future) niche actors.

On the subject of MLP and business model theory integration, results indicate that rural broadband deployment by small local projects lead to the development of a variety of business models. As such, these projects form a business model niche. This adds empirical support to Bidmon and Knab, who theorize MLP and business model theory may enrich each other through the study of business model niches. Several similarities between business model and technological niches were found, mostly in the importance of niche building and diverse learning mechanisms. This indicates theory generated in classic MLP studies may be widely applicable to business model niches. Identified similarities will help MLP to contribute to a growing body of literature on business model formation and experimentation. Further research is required to investigate additional similarities and differences between business model and technological niches. This line of study will link business model theory to socio-economic theory, which will facilitate the study of business model generation in the context of societal processes. Community driven projects are prevalent in both the niche and performed survey. These projects may require more business model learning than existing operations (Salemink et al., 2016). As a result the needs and methods of business model learning may differ in niches were other actors have a different organizational type. Further study into business model niches of different compositions is required to investigate the extent of this difference.

Based on the results put forward in this study several recommendations can be made to governmental actors, both for the purpose of rural broadband deployment and business model niche stimulation in general. Governments interested in using community driven projects or other small-scale network deployment should take into account the need to coordinate network structure between niche agents. In addition, the extra costs of learning and limited learning

between projects, should be considered when pursuing this route (Salemink et al., 2016). These learning costs may be partly negated by supplying access to actor-networks including experts, other projects and process shareholder like service providers. Smaller projects will lack the benefits of scale of larger projects, but increase business model experimentation. As a result, when investing in business model niches, the benefits of variety and scale should be weighted. In the case of network deployment scaling is more important than other industries due to legacy effects created by small network deployments. Financial governmental support increases the development of FttH projects, the effect on fixed-wireless projects remains unclear.

A crucial finding is the difference in interventions at different levels of government. Whilst some forms of rural niche building and shielding may be conducted by multiple governmental actors, some methods are typical of different forms of governmental involvement. Local governments are able to mobilize their communities, which can be vital in insuring sufficient demand in the case of rural broadband deployment. Regional actors are effective in creating networks between projects and facilitating information dispersion. National and supranational governments have a role in ensuring full coverage. Understanding and leveraging these differences will provide support to the rural broadband niche.

Revoked governmental subsidies identified in this study extends the findings of Salemink et al. (2016) that complex and shifting requirements of subsidies are a barrier for projects. Considering the extend of these revoked subsidies, this is effect is likely affected a large amount of projects. Revoking subsidies and other inconsistent policies may be harmful in a promoting niche foundation as it erodes trust between niche actors and governmental agents.

The produced result may help inform rural broadband projects as well. To optimize learning experiences, projects should consult a variety of external sources. Relevant information may be sourced from a multitude of stakeholders, including experts, other projects, regional governments and other stakeholders within the production chain. When designing a network structure, coordination is required between projects. Projects should confer with neighboring projects and governments to align deployment plans and wherever possible and cooperate to create matching network infrastructure in areas proximate to one another.

For optimal support an open line of communication should be kept between project and governmental actors whenever possible, making sure governmental sources remain aware of project needs. This will help supply important forms of governmental support, including non-financial support, like permitting more shallow deployment or facilitating locations for network equipment. Financial support from governments may be vital to a rural broadband project but projects should regard promised subsidies with some skepticism, as these may not always materialize, or may come with detrimental constrains. Keeping an open dialogic on these issues is advisable to both projects and governments. As rural deployment remains a complex issue, coordination between governments and projects is vital in its success, both in the Netherlands and the rest of Europe.

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