Nexia Management Consulting AS

NBCI 2016

Nordic Broadband City Index 2016

How Cities Facilitate a Digital Future

November 2016

Title	*Nordic Broadband City Index*
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About this Report

The Nordic Broadband City Index has been prepared by Nexia Management Consulting AS on behalf of Telenor ASA in the period from August to October 2016.

A Special Thanks

Nexia would not have been able to obtain information if it was not for the very helpful people at Eltel Networks, Intego, Technogarden, Netel, GlobalConnect and Relacom. They provided valuable information needed in order to develop the NBCI, and Nexia is very grateful that they all took time out of their busy schedules.

Nexia would also like to thank the people in Telenor Denmark and Telenor Norway for their support and expert knowledge.

About Nexia Management Consulting AS

Nexia Management Consulting AS is a management consultancy with expertise in the telecommunications, ICT infrastructure and technology sector. Nexia Management Consulting AS provides expertise in business analysis, strategy development, business development and management to the aforementioned sectors.

Content

1 Executive summary

Introduction

The Nordic Broadband City Index (*NBCI*) is dedicated to gaining insight into how Nordic cities facilitate mobile and fixed network deployments and to what extent they offer digital services to their inhabitants. The digital services from the municipalities are a critical element in the digitalization of today's society, and citizens are continuously becoming aware of the benefits.

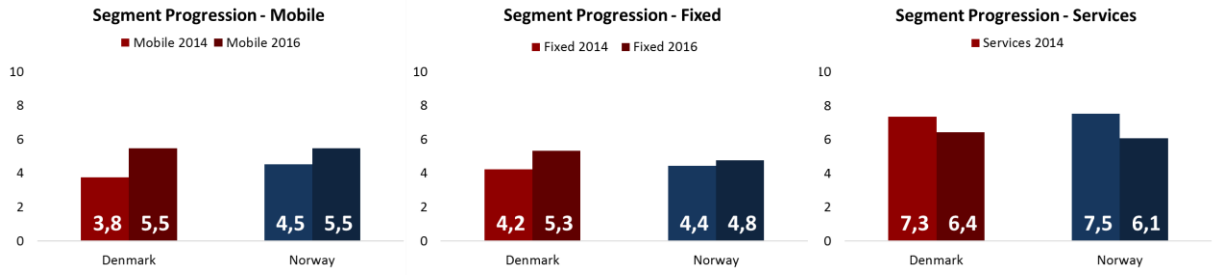
The digitalization of the society contributes to a steady data growth. In order to cater for the exponential increase in data, effective deployments of both mobile and fixed networks are necessary. However, in spite of the fact that European telecom operators are subject to a number of Europe-wide and national regulations, telecom is primarily a local business. Few national regulators issue trenching permits, and access to buildings for mobile antennas is usually granted by the owner of the building. Some of the most important drivers for network deployment cost are the infrastructure elements, e.g. digging activities and construction of mobile masts. Consequently, local rules and regulations have an important impact on the network operators' ability to roll out networks and services in a timely and cost-effective manner. In spite of the fact that national and EU-wide regulations are normally well defined, well known and consistently applied, municipal regulations and conditions can vary widely.

Furthermore, municipalities have become an important driver in the digitalization of the society. By providing digital services, they drive productivity gains and network usage. As a consequence, it is important to understand to what extent municipalities offer such services to their inhabitants. This report aims to identify good practice, innovative solutions, and local facilitation of digital services that meet societal needs and interests. Good broadband cities facilitate digitalization with an open and holistic strategy that takes full account of the citizens' needs. This is done by not only modernizing municipal websites and services, but updating and maintaining rules and regulations regarding fixed and mobile network deployments.

The first NBCI study in 2012 was designed and planned by experienced service developers and network managers at Telenor in Norway, Sweden and Denmark. The agenda was straightforward: If a municipality wants to facilitate network deployments and offer high-quality online services, what should that municipality do? The most important variables were identified and weights were assigned accordingly in order to build the framework for The Nordic Broadband City Index. Since then, the study framework has been upgraded accordingly to reflect technological advancements and the different situations the municipalities find themselves in today's society. In total, NBCI 2016 consists of 24 variables across three categories, analyzing 30 municipalities evenly split between Denmark and Norway[1]. In addition, a fourth dimension named *Digital Inclusion* was added in order to understand how the digitalization has been affecting the municipalities' citizens.

Main Findings

Norway and Denmark have some of the world's best broadband networks and public digital services. In spite of this, there exists an improvement potential in how Norwegian and Danish municipalities provide online services to inhabitants and facilitate mobile and fixed network deployments. The average score across all 30 municipalities and categories was 5.6 out of 10, which is a slight improvement from 2012 (5.2) and 2014 (5.3). Denmark stands out with its national policies, which consequently create homogeneous network deployment effects in the municipalities.



[1] The 2016 study includes cities from Denmark and Norway whereas the 2012 and 2014 study also included cities from Sweden. In order to make comparisons, the municipalities from Denmark and Norway in the NBCI 2016 study are the same as both countries' municipalities chosen in 2014.

Mobile Network Deployment: A Steady Step in the Right Direction

The mobile network deployment score were improved for both Denmark and Norway in the 2016 study. There are three main reasons for the improvement. Firstly, there is an increased acceptance of mobile network equipment on municipal grounds, mainly due to the municipalities having a better understanding of mobile coverage and how it affects the daily lives of its citizens (an understanding sparked by the citizens communicating directly with the municipalities about coverage issues). Secondly, the case-handling processes are more efficient, mainly due to mobile network rollouts currently focusing on swaps and not new constructions. Finally, there has been an improvement in planning. While most municipalities in both countries still have no comprehensive plans regarding mobile coverage, there is a better understanding of the importance of coverage for the citizens. As a consequence, operators are sometimes involved in an early stage of new constructions (e.g. schools). In Denmark, a few municipalities have initiated collaboration projects with operators where the municipalities agree to share part of the installation cost in order to cater for the need of citizens in certain areas.

The municipalities have a better understanding of the importance of mobile coverage, mainly due to citizens communicating directly with the municipalities about the coverage issues

Fixed Infrastructure: Information Gap to be Bridged

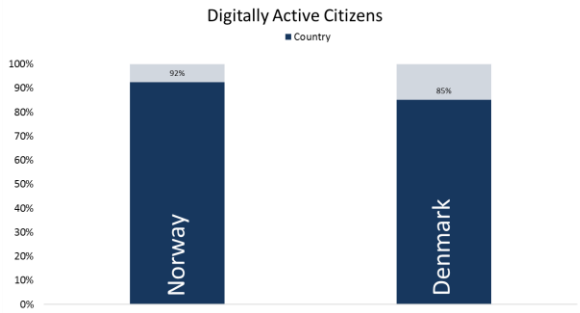
Denmark and Norway improved their score from the previous analysis in 2014. The Danish municipalities display almost no variations between the municipalities, a consequence of a higher degree of national regulations compared to Norway. Norway displays more variation among the municipalities, and holds the position for both the best municipality and the municipality with most improvement. Furthermore, there exists significant room for improvement for fixed network deployment for all of the surveyed municipalities. Although there has been an improvement since 2014, it seems that many cities do not see the importance of fixed network deployment and fail to see the connection between (e.g.) strict digging regulations and poor network quality. However, there has been a noteworthy improvement in the municipalities' understanding of the importance of digital services and mobile coverage. Sustaining and strengthening the dialogue between the operators and municipalities could bridge the remaining information gap that exists in the fixed deployment area.

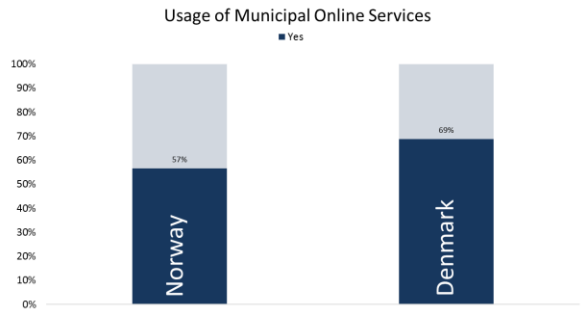
Digital Services: Learn from Best Practice Municipalities

The score for digital services was heavily revised for 2016: four new variables (mainly focusing on Smart City initiatives) were added and weights of the variables were adjusted accordingly. Of the 30 Norwegian and Danish municipalities in this study, Bærum, København, Trondheim, Stavanger and Aarhus came out as top five for digital services, all with scores between 7.9 and 8.9. These municipalities displayed high scores in almost all of the different variables of digital services and showed a solid understanding of the importance of digitalizing services. The main difference between the best practice municipalities and the other municipalities in this study is how comprehensive and holistic their strategy documents and planning processes regarding ICT, Smart City, digitalization and welfare technology are developed.

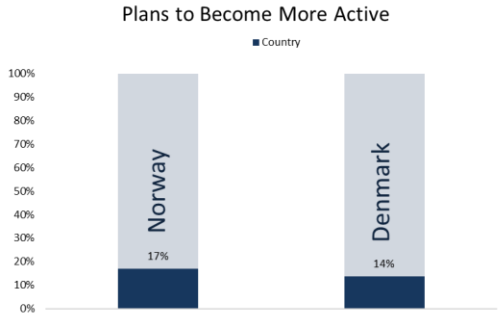
Digital Inclusion

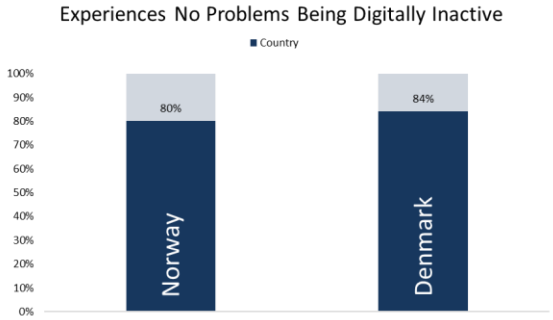
Norwegian municipalities are, on a general level, more digitally active than Danish municipalities. However, Denmark uses more municipal online services than Norway, but the Danish citizens do not necessarily know that they are provided by the municipality, potentially because many of the services are perceived as national services in Denmark.





Furthermore, digitally active citizens' experience with digital online municipal services are very similar in both Denmark and Norway and people are generally satisfied with the experience. The behavior and experience among Denmark's and Norway's digitally inactive citizens are very similar. In both countries, the digitally inactive citizens have few plans to become digitally more active, a consequence of them experiencing very few problems of being digitally inactive in today's society.





The Winners of NBCI 2016

The digital revolution is gradually transforming our society and the life of its inhabitants. A wide range of digital services require telecommunication networks to offer coverage wherever the citizens might choose to go. In addition, the digitalization of important value chains (e.g. logistics and health care) demands more robust telecommunication networks capable of carrying traffic growing at exponential rates. Consequently, municipalities need to cater for the digital backbone if people and businesses shall thrive. By playing a constructive role in network deployments and rollout of digital services, municipalities can effectively facilitate the digital backbone, and secure the foundation of future growth.

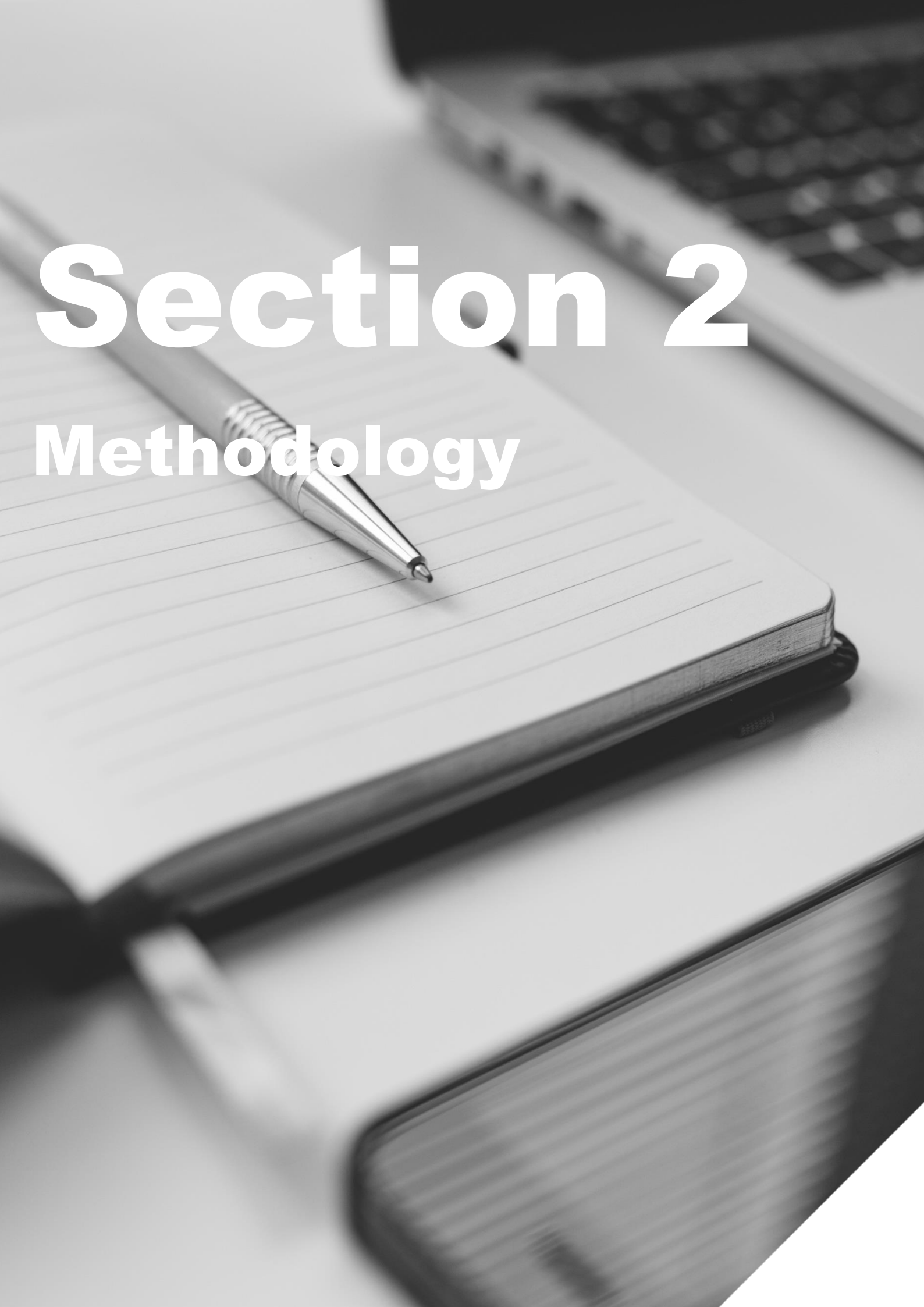
There still exists major room for improvement for all cities that have been investigated. Policies and guidelines constantly need to be maintained due to a fast-pace climate that is ever-changing. This is not solely dependent on the municipalities, but more so on the collaboration and general dialogue between telecom/utility operators and departments of the public sector. Both parties must bear responsibility and encourage a direction toward common solutions to improve effectiveness and, thus, ensure the digital backbone needed for the digitalization of value chains in the society.

There are some municipalities that are on the right path and reveal a holistic understanding of digital needs and policy requirements. In 2014, Norway managed to take nine out of the top ten positions[2] and Denmark's best-performing municipality (København) only reached a 10th place. This Norwegian dominance has changed in 2016 and the top ten list is evenly split between Danish and Norwegian municipalities. The winner of the NBCI 2016 survey is København with a final score of 6.9, followed by Odense with a final score of 6.2. The strongest performing Norwegian municipality is Bodø which claims the final place in the top three list.

NBCI 2016 - Top Ten Municipalities

Rank	Country	Municipali	Services	Mobile	Fixed	Final Score
1	Denmark	København	8,6	6,7	5,3	6,9
2	Denmark	Odense	7,5	5,9	5,3	6,2
3	Norway	Bodø	5,8	7,2	5,6	6,2
4	Norway	Skien	5,3	6,3	6,7	6,1
5	Norway	Trondheim	8,1	6,0	4,2	6,1
6	Denmark	Frederiksberg	7,3	5,5	5,3	6,0
7	Denmark	Aarhus	7,9	4,8	5,3	6,0
8	Denmark	Viborg	6,6	6,0	5,3	5,9
9	Norway	Bærum	8,9	5,2	3,8	5,9
10	Norway	Bergen	7,2	5,4	5,0	5,8

[2] 2014 ranking used for comparison excludes Swedish municipalities



Section 2

Methodology

2 Methodology

2.1 General Overview

When planning the original study in 2012, Nexia sat down with experienced service developers and network managers at Telenor in Norway, Sweden and Denmark. The agenda was straightforward: If a municipality wants to facilitate network deployments and offer high-quality online services, what should that municipality do? The overall project plan is shown in Figure 1.

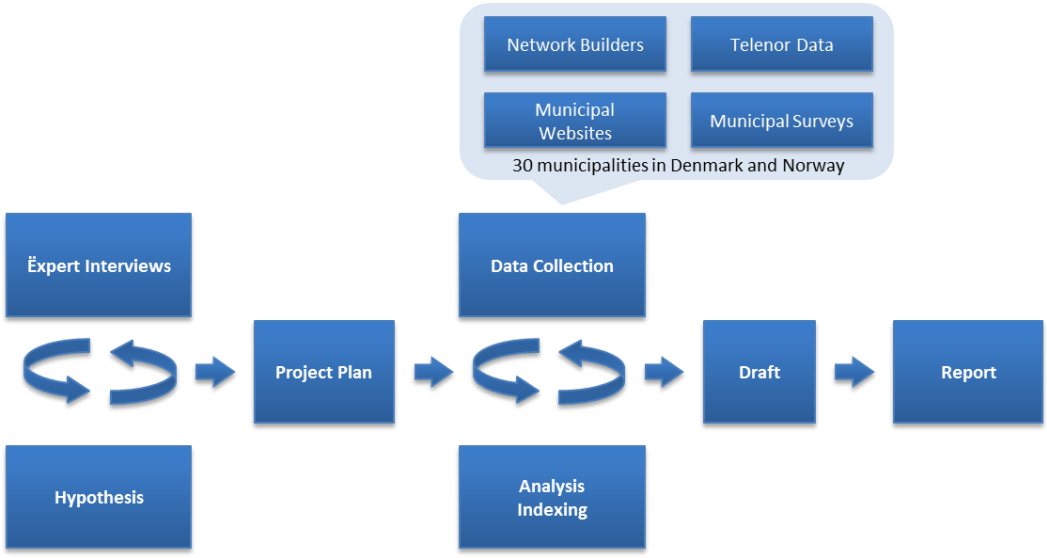


Figure 1 - Project Plan

The Nordic Broadband City Index (NBCI) 2016 has three parts which are familiar from the 2012 and 2014 study: *Municipal Online Services*, *Mobile Network Deployment* and *Fixed Network Deployment*. Each category accounts for a third of the total NBCI score. The difference between fixed and mobile infrastructure is diminishing as all networks are becoming more fiber-based. Still, there are important differences between fixed and mobile networks, and it was therefore decided to differentiate between the two as shown in Figure 2. In addition, the 2016 study introduces a fourth category called *Digital Inclusion*. The category chooses to look more closely at the citizens and their perception of municipal online services (see 2.1.2 for more information).

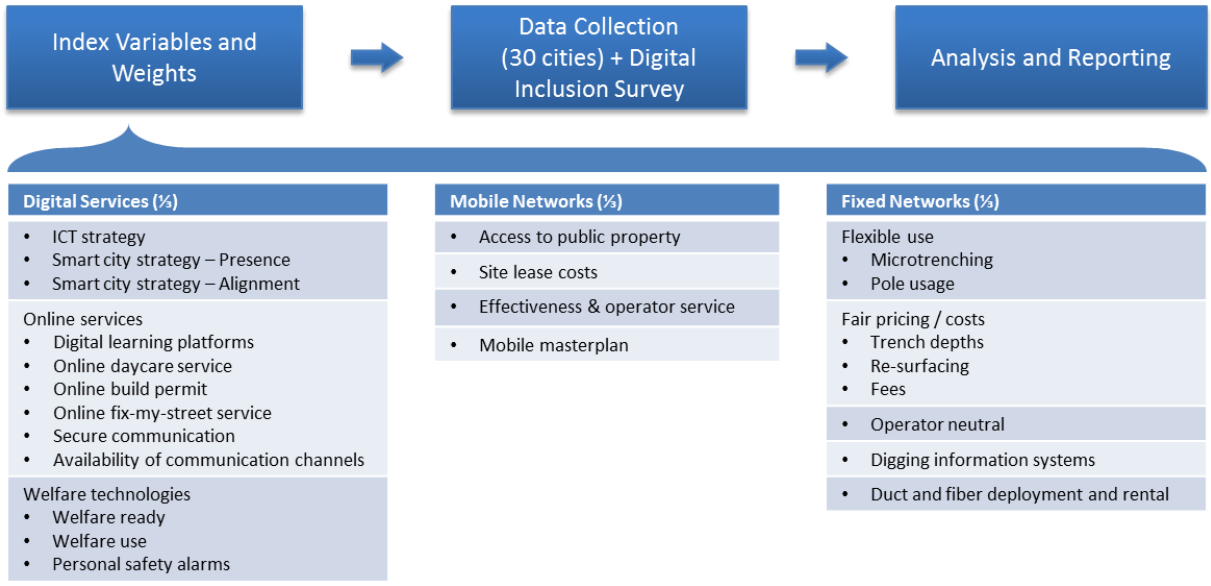


Figure 2 - Methodology

The methodology was similar to the one used in the 2014 study with one exception: the digital services area was expanded to include additional online services and municipal planning of online services. When the original study was planned in 2012, experts at Telenor and Kommunenes Sentralforbund (KS) in Norway assisted in identifying the best variables in each category. The same criteria have been in mind when selecting new variables:

- Valid: Meaningfully represent the area that the study wants to understand
- Objective and measurable
    - Reliable
    - Preferably quantifiable
- Granular enough to identify real differences

Once the different variables were decided, definitions of a low and high score for each variable were established. All municipalities were then measured against these definitions and graded accordingly. The weights and variables for each category will be described in more detail later in the report.

2.1.1 Cities

The 2016 study includes cities from Denmark and Norway whereas the 2014 study also included cities from Sweden. In order to make comparisons from two years ago, the municipalities (from Denmark and Norway) in this study were the same as in 2014 and they were initially chosen based on size. Consequently, this year's NBCI is based on a complete data set of 30 municipalities (15 in Denmark and 15 in Norway[3]). The municipalities and their scores are outlined in *Appendix A: NBCI 2016 Score* and changes for the municipalities from 2014 to 2016 are outlined in *Appendix B: Score Progression 2014 – 2016.*

2.1.2 Changes in the 2016 Edition

The following section will discuss the two main changes in the 2016 version of the study.

Change 1 – Revision of the Existing Digital Services Section

In the 2014 study, the variable *The presence of an ICT strategy* was interesting due to the fast-changing ICT landscape. There are, however, new areas of interest with intertwining goals. One of these areas is the Smart City concept. Under different initiatives, several cities have launched Smart City programs where they are investigating how to increase availability of services to its citizens, maximize the use of the cities' resources, etc. In order to investigate how far cities have come regarding their Smart City initiatives, the following variables were added:

- *The presence of a Smart City strategy*
- *Alignment of a Smart City strategy with the ICT strategy*

The section Digital Services has previously addressed welfare services and focused on its readiness (*Welfare Ready*) and implementation status (*Welfare Use*). The 2016 edition has added another dimension to the *Welfare Use* factor by investigating a concrete example of welfare technology services:

- *Implementation status of static and mobile (2G/3G/4G connectivity) personal safety alarms.* I.e.: Has the municipality implemented personal safety alarms that can be used by the citizens in (e.g.) only their homes or without any perimeter constraints?

Furthermore, the 2016 study has looked more closely at the municipalities' portfolio of electronic communication channels (including the presence on social media) as well as the municipalities' efforts regarding digital learning platforms. Consequently, the following variables were added:

- *Availability of electronic communications channels*
- *The availability and quality of Digital Learning platforms in primary schools*

[3] Some of the mobile information for Frederiksberg is from 2014.

Finally, the variable *Electronic Invoicing* was resigned in the 2016 survey since all municipalities reached full score in the 2014 survey. The final variables are illustrated in Figure 2.

Change 2 - Digital Inclusion

In order to address the results of the municipalities' digital efforts, a new section named *Digital Inclusion* was introduced in this year's NBCI. The section investigates how the municipalities have engaged its citizens in the digitalization of the society by interviewing the different municipalities' citizens about their online habits.

2.2 Data Collection

The data was collected from a number of sources, the most important being municipal web sites (for the Digital Services section) and local contractors (for the network facilitation parts). In addition, site information from Telenor Denmark (TT Networks) and Telenor Norway was analyzed. The data was collected over a period of two months and from several sources, as can be seen from Figure 3 - Data Sources.

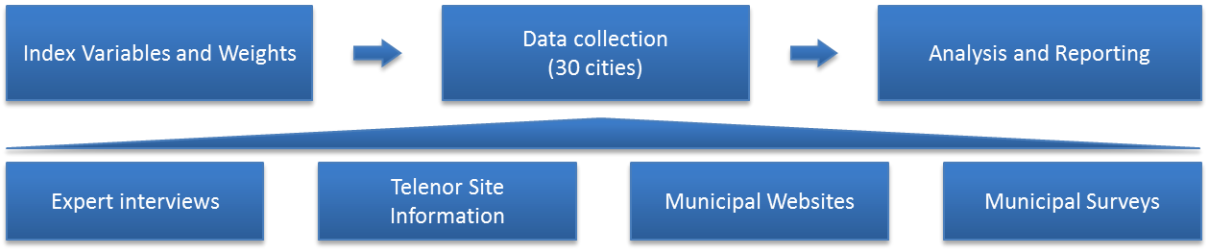


Figure 3 - Data Sources

2.2.1 Municipal Websites and General Web Searches

The municipal web sites and general web searches were used extensively to collect data on the digital services offered by the municipalities. The web search was performed from the middle of August until the middle of October 2016.

2.2.2 Network-Building Contractors and Consultancies

In-depth interviews were performed with the telecom contractors and consultants to find out how it is to work with the respective municipalities. These contractors and consultants let Nexia interview their employees who worked with the specific municipalities on a day-to-day basis.

2.2.3 Expert Interviews

Firstly, interviews with local contractors and experts who work directly with the municipalities were conducted. Secondly, several interviews with experts at Telenor Norway and Telenor Denmark were performed. In addition, interviews were conducted with experts in both countries who wished to remain anonymous for various reasons.

2.2.4 Telenor Site Analysis

The following site information were obtained for all the relevant municipalities from Telenor's Danish and Norwegian operations:

- Site ownership (municipal or private)
- Yearly site lease costs

2.2.5 Digital Inclusion Analysis

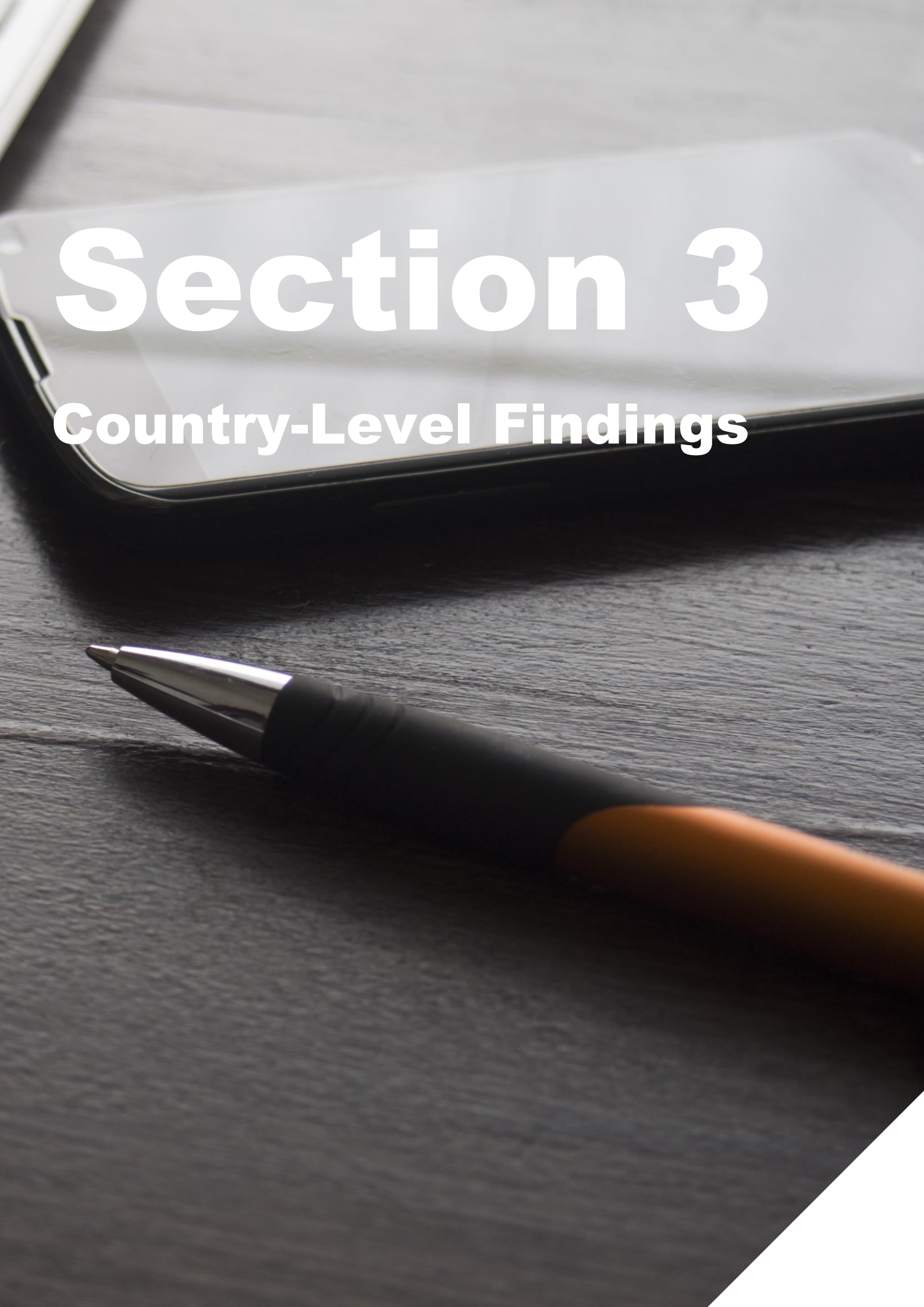
The digital inclusion analysis was performed with the help of a third-party market research company (Norstat). The analysis was performed in three phases as illustrated in Figure 4.

Figure 4 - Digital Inclusion Process

The first phase's goal was to construct a questionnaire survey with demographic- and digital inclusion-related questions. This work was performed by Nexia, Norstat and Telenor in collaboration.

The second phase involved data collection from 30 municipalities, evenly split between Denmark and Norway. A total of 3 300 people was interviewed (1 500 in Denmark and 1 800 in Norway). The questionnaire is attached in *Appendix E: Digital Inclusion Questionnaire*.

Once the data was collected by the research company, the data was processed and analyzed by Norstat, Nexia and Telenor.



Section 3

Country-Level Findings

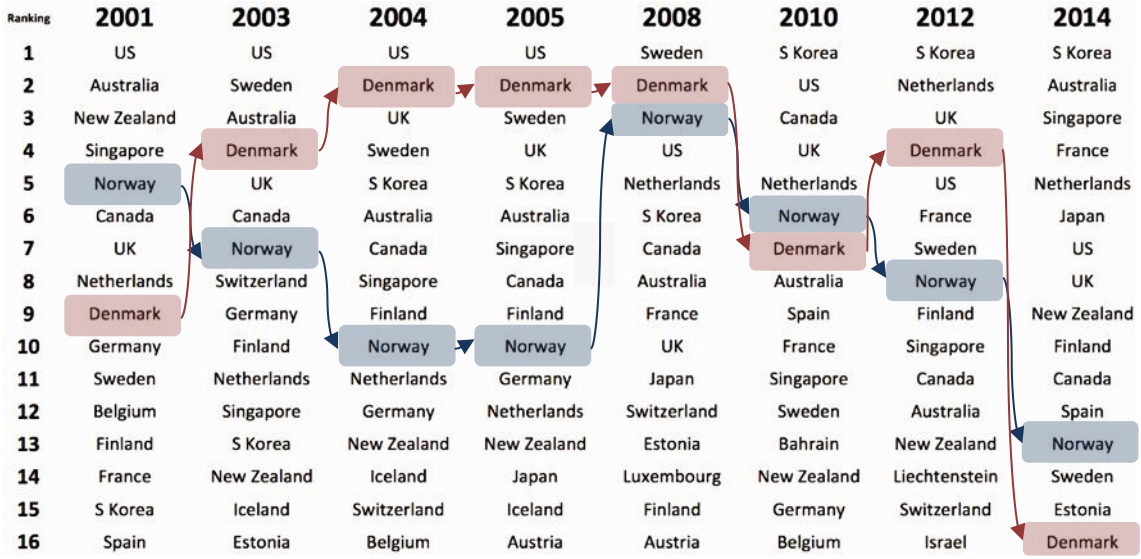
3 Country-Level Findings

3.1 Introduction

Denmark and Norway have continuously performed strongly in global analyses regarding broadband networks and public digital services. This is well documented in several studies, one being the United Nations e-Government Survey that is published every second year. The survey defines e-Government as:

"*The use and application of information technologies in public administration to streamline and integrate workflows and processes, to effectively manage data and information, enhance public service delivery, as well as expand communication channels for engagement and empowerment of people.*"

From 2001 to 2012, Denmark and Norway has constantly positioned themselves in the top 10 rankings out of all the participating countries (this is illustrated in Figure 5)[4]. However, in 2014 Norway achieved a rank of 13 and Denmark ended up on the 16th place. In 2016, Denmark managed to regain its top ten placement by taking the ninth place, whereas Norway obtained a rank of 18th place[5].



Ranking	2001	2003	2004	2005	2008	2010	2012	2014
1	US	US	US	US	Sweden	S Korea	S Korea	S Korea
2	Australia	Sweden	Denmark	Denmark	Denmark	US	Netherlands	Australia
3	New Zealand	Australia	UK	Sweden	Norway	Canada	UK	Singapore
4	Singapore	Denmark	Sweden	UK	US	UK	Denmark	France
5	Norway	UK	S Korea	S Korea	Netherlands	Netherlands	US	Netherlands
6	Canada	Canada	Australia	Australia	S Korea	Norway	France	Japan
7	UK	Norway	Canada	Singapore	Canada	Denmark	Sweden	US
8	Netherlands	Switzerland	Singapore	Canada	Australia	Australia	Norway	UK
9	Denmark	Germany	Finland	Finland	France	Spain	Finland	New Zealand
10	Germany	Finland	Norway	Norway	UK	France	Singapore	Finland
11	Sweden	Netherlands	Netherlands	Germany	Japan	Singapore	Canada	Canada
12	Belgium	Singapore	Germany	Netherlands	Switzerland	Sweden	Australia	Spain
13	Finland	S Korea	New Zealand	New Zealand	Estonia	Bahrain	New Zealand	Norway
14	France	New Zealand	Iceland	Japan	Luxembourg	New Zealand	Liechtenstein	Sweden
15	S Korea	Iceland	Switzerland	Iceland	Finland	Germany	Switzerland	Estonia
16	Spain	Estonia	Belgium	Austria	Austria	Belgium	Israel	Denmark

Figure 5 - United Nations E-Government Development Index

In spite of the fact that Denmark and Norway is no longer in the top ten raking of the United Nations E-Government survey, the picture is not entirely bleak. Both countries perform well in similar rankings such as *The Global Information Technology Report 2015*[6] and the *OECD Government at a Glance 2015*[7]. However, the NBCI study found that while Denmark and Norway have been able to perform well in several studies, there is substantial room for improvement.

[4] UN E-Government EGDI ranking summary provided by Craig Thomler, eGovernment and Gov 2.0 thoughts and speculations, accessed 17th of October 2016, <https://egovau.blogspot.no>

[5] UN E-Government Survey 2016, United Nations, 2016, ISBN: 978-92-1-123205-9, <https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2016>

[6] The Global Information Technology Report 2016, World Economic Forum, 2016, ISBN: 978-1-944835-03-3, <https://www.weforum.org/reports/the-global-information-technology-report-2016>

[7] Government at a Glance 2015, OECD, 2015, ISBN: 978-92-64-23347-8, <http://www.oecd-ilibrary.org/governance/government-at-a-glance-2015_gov_glance-2015-en>

3.2 Main Findings

The NBCI normalizes the score for each of the three investigated areas (Mobile Network Deployment, Fixed Network Deployment and Digital Services), resulting in a maximum score of ten. The mobile and fixed area had variables in 2016 which were unaltered compared to 2014. However, the variables for Digital Services were renewed due to the several developments in this sector. Consequently, one ought to consider this when comparing the Digital Services score from 2014 and 2016.

On average, the municipalities in both Denmark and Norway has performed well (in relation to 2014) regarding mobile and fixed network deployment, this is illustrated in Figure 6.

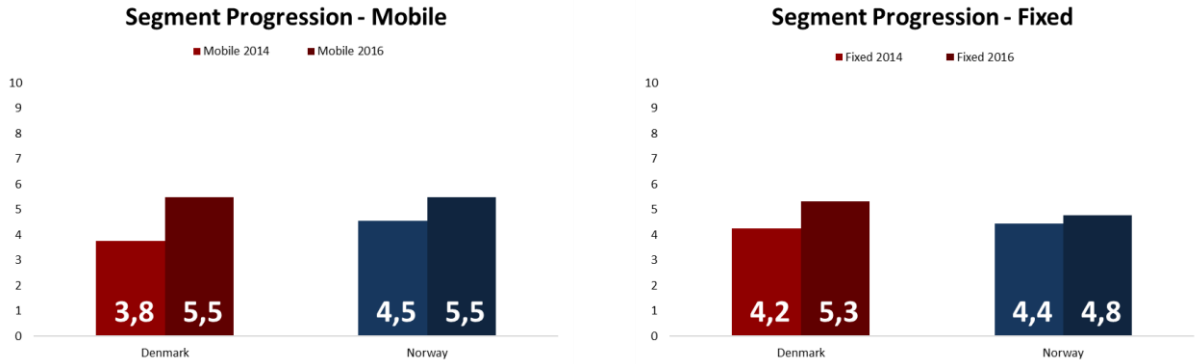


Figure 6 - Segment Progression - Mobile and Fixed Network Deployment 2014 and 2016

Mobile Network Deployment

There are three main reasons for the improvement of the mobile network deplyment. Firstly, There is an increased acceptance of mobile network equipment on municipal grounds, mainly due to the municipalities having a better understanding of mobile coverage and how it affects the daily lives of its citizens (an understanding sparked by the citizens communicating directly with the municipalities about the coverage issues). Secondly, the case-handling processes are more efficient, mainly due to mobile network rollouts currently focusing on swaps and not new constructions. Finally, there has been an improvement in planning. While most municipalities in both countries still have no comprehensive plans regarding mobile coverage, there is a better understanding of the importance of coverage for the citizens. As a consequence, operators are sometimes involved in an early stage of new constructions (e.g. schools).

The municipalities have a better understanding of the importance of mobile coverage, mainly due to citizens communicating directly with the municipalities about the coverage issues

Looking forward, two main potential challenges have been identified. Firstly, there exists an ironic paradox in the communication between the operators and the municipalities. The operators would generally like to see that the municipalities have better plans for mobile coverage in their respective communities. At the same time, some municipalities have asked mobile operators for a long-term plan (10 years) regarding their mobile network deployments. Such long-term plans are very difficult for the operators to deliver in a relatively fast-changing landscape. This means that both parties need to find a balance were both parties' needs can be satisfied.

Secondly, the current mobile network deployments in both countries focus on swaps of existing equipment. This means that the dialogue with the different municipalities has decreased in general due to a lower amount of cases of new installations. The next generation of mobile network deployments (5G) could potentially require several new installations due to smaller antennas and sites being used in the infrastructure. Thus, it is important for the municipalities and the operators to maintain a close dialogue in order to secure an efficient rollout of the next generation mobile networks.

Fixed Network Deployment

Both countries have improved their score from the previous analysis in 2014. The Danish municipalities display almost no variations between the municipalities, a consequence of a higher degree of national regulations compared to Norway. Norway displays more variation among the municipalities, and holds the position for both the best municipality (Skien, 6.4) and the municipality with most improvement (Asker, 2.9). Finally, there exists significant

room for improvement for fixed network deployment for all of the surveyed municipalities. Although there has been an improvement since 2014, it seems that many cities do not see the importance of fixed network deployment and fail to see the connection between (e.g.) strict digging regulations and poor network quality. However, there has been a noteworthy improvement in the municipalities' understanding of the importance of digital services and mobile coverage. Sustaining and strengthening the dialogue between the operators and municipalities could bridge the remaining information gap that exists in the fixed deployment area.

Digital Services

Figure 7 illustrates the segment progression for digital services and all segments. The score for digital services was heavily revised for 2016: four new variables (mainly focusing on Smart City initiatives) were added and weights of the variables were adjusted accordingly (see section 4.4 for more information). Of the 30 Norwegian and Danish municipalities in this study, Bærum, København, Trondheim, Stavanger and Aarhus came out as top five for digital services, all with scores between 7.9 and 8.9. These municipalities displayed high scores in almost all of the different variables of digital services and showed a solid understanding of the importance of digitalizing services. The main difference between the best practice municipalities and the other municipalities in this study is how comprehensive and holistic their strategy documents and planning processes regarding ICT, Smart City, digitalization and welfare technology are developed.

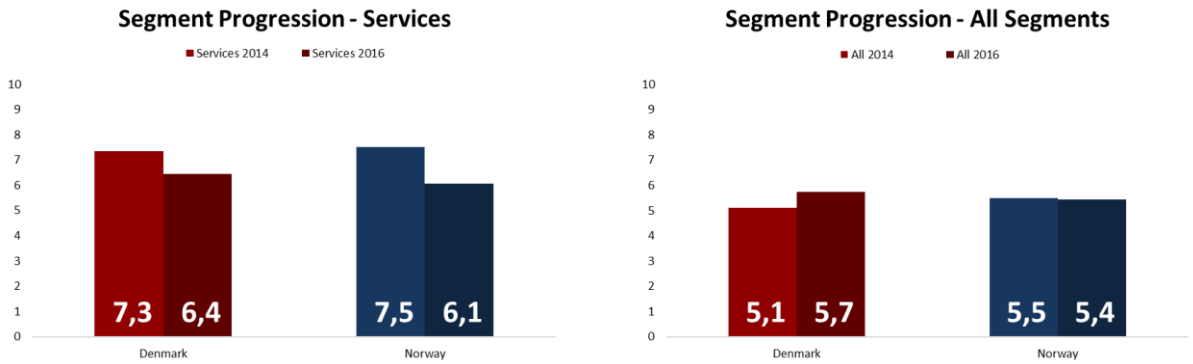


Figure 7 - Segment Progression - Digital Services and All Segments 2014 and 2016

3.2.1 Top Ten Municipalities

Overall, several municipalities performed well in the 2016 NBCI. The revised section for digital services reduced the gains achieved by both Denmark and Norway in the mobile and fixed network deployment sections. However, due to strong performance among Danish municipalities in the mobile sector, Denmark managed to increase its overall score from 5.1 to 5.7. Norway obtained 5.4, a slight decrease from the 5.5 score obtained in 2014. Furthermore, the Danish municipalities show less variation than Norway, which is outlined in Figure 8, This is mainly due to national rules and regulations.

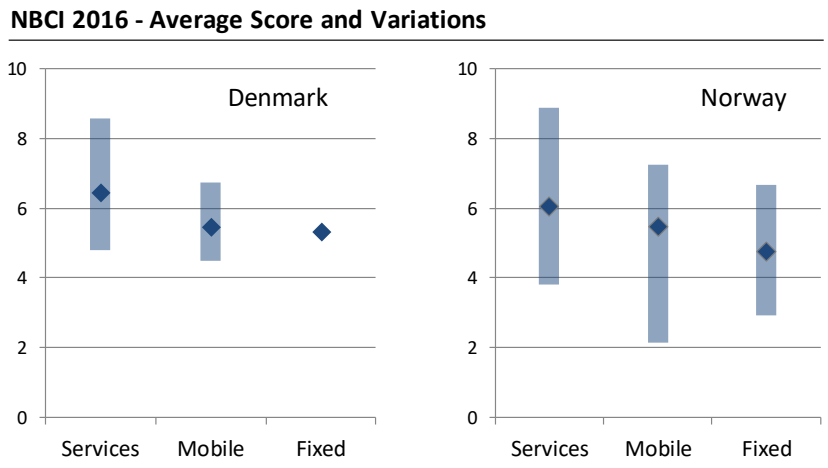


Figure 8 - Average Score and Variations

Figure 9 illustrates the top ten-performing municipalities in the NBCI 2016 survey. In 2014, Norway managed to take nine out of the top ten positions[8] and Denmark best performing municipality (København) only reached a 10th place. This Norwegian dominance has changed in 2016 and the top ten list is evenly split between Danish and Norwegian municipalities.

NBCI 2016 - Top Ten Municipalities

Rank	Country	Municipali	Services	Mobile	Fixed	Final Score
1	Denmark	København	8,6	6,7	5,3	6,9
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3	Norway	Bodø	5,8	7,2	5,6	6,2
4	Norway	Skien	5,3	6,3	6,7	6,1
5	Norway	Trondheim	8,1	6,0	4,2	6,1
6	Denmark	Frederiksberg	7,3	5,5	5,3	6,0
7	Denmark	Aarhus	7,9	4,8	5,3	6,0
8	Denmark	Viborg	6,6	6,0	5,3	5,9
9	Norway	Bærum	8,9	5,2	3,8	5,9
10	Norway	Bergen	7,2	5,4	5,0	5,8

Figure 9 - NBCI 2016 - Top Ten Municipalities

The winner of the NBCI 2016 survey is København with a final score of 6.9, strongly ahead the runner-up Odense with a final score of 6.2. København and Odense have climbed nine and ten positions respectively in this year's ranking, an achievement shared by the following Danish municipalities on the top ten list. This is illustrated in Figure 10. The main reason behind København's strong performance is its improvement in the mobile area where more aligned municipal lease costs (relative to its peers and the real estate market), increased application management effectiveness and clearer municipal guidelines surrounding mobile deployment have played a central role.

Kristiansand (3rd place in 2014) and Asker (rank 9th place in 2014) lose considerable standings in this year's survey (15th and 28th place respectively). The main reason behind this is their decreased score in the Digital Service section. Both Kristiansand and Asker had a strong ICT strategy in 2014. However, this year, the ICT strategy is measured against the municipalities efforts in the Smart City sector, an area where the two municipalities fall short. They both lack a clear Smart City strategy and, consequently, an alignment toward the ICT strategy.

NBCI 2014-2016 Rank Progression

Country	Municipality	Rank 2014	Rank 2016	Rank Progression
Denmark	København	10	1	9
Denmark	Odense	12	2	10
Norway	Bodø	2	3	-1
Norway	Skien	4	4	0
Norway	Trondheim	7	5	2
Denmark	Frederiksberg	14	6	8
Denmark	Aarhus	18	7	11
Denmark	Viborg	20	8	12
Norway	Bærum	9	9	0
Norway	Bergen	6	10	-4

Figure 10 - NBCI 2014-2016 Rank Progression (Rank for 2014 excludes Swedish Municipalities)

Digital Inclusion

Firstly, Norwegian municipalities are, on a general level, more digitally active than Danish municipalities (see Figure 11). However, Denmark uses more municipal online services than Norway, but the Danish citizens do not necessarily

[8] 2014 ranking used for comparison excludes Swedish municipalities

know that they are provided by the municipality. A reason for this could be that many of the services are perceived as national services in Denmark.

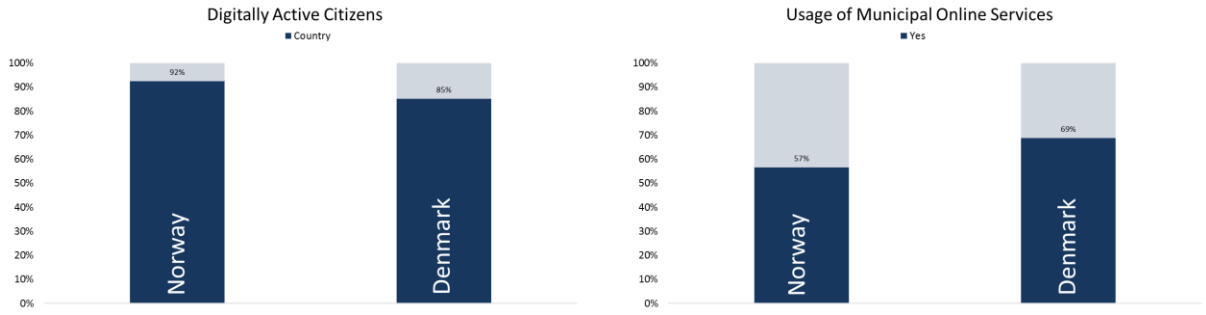


Figure 11 - Digital Active Citizens and the Usage of Municipal Online Services

Furthermore, digitally active citizens' experience with digital online municipal services are very similar in both Denmark and Norway. Overall people are generally satisfied with the experience.

Finally, the behavior and experience among Denmark's and Norway's digitally inactive citizens are very similar. In both countries, the digitally inactive citizens have few plans to become digitally more active, a consequence of them experiencing very few problems of being digitally inactive in today's society. This is illustrated in Figure 12.

Figure 12 - Digital Inactive Citizens' Plans and Experiences

Section 4

Digital Services

4 Digital Services

The five municipalities with highest scores in this category can be seen as best practice municipalities for digital services. In both Norway and Denmark, there are significant variations between the highest and lowest scores, especially related to strategies for ICT, Smart City and welfare technology.

The main difference between the best practice municipalities and the other municipalities in this study is how comprehensive and holistic their strategy documents and planning processes regarding ICT, Smart City, digitalization and welfare technology are developed.

4.1 Main Findings – Digital Services

Of the 30 Norwegian and Danish municipalities in this study, Bærum, København, Trondheim, Stavanger and Aarhus came out as top five for digital services, all with scores between 7.9 and 8.9. These municipalities displayed high scores in almost all of the different variables of digital services and showed a solid understanding of the importance of digitalizing services. Thus, these five municipalities can be seen as best practice municipalities for digital services.

Both Bærum's, Københavns, Stavanger's and Aarhus' high scores are due to comprehensive and aligned ICT, Smart City and welfare technology strategies in combination with well-developed digital services. Trondheim's holistic and well-structured *Temaplan* for ICT, digitalization and welfare technology for 2015-2018, with a corresponding program for welfare technology toward 2020 and an action plan for welfare technology 2015-2016, contributes to Trondheim's high score in addition to well-developed digital services.

On average, the Danish municipalities did slightly better than the Norwegians (6.4 versus 6.1). It is interesting to notice that 2/3 of the Danish municipalities came out with scores higher than 6.0, while only 1/3 of the Norwegian municipalities reached this level. On the other hand, the top three municipalities in Norway (Bærum, Trondheim and Stavanger) had a higher average score than the top three municipalities in Denmark (København, Aarhus and Odense).

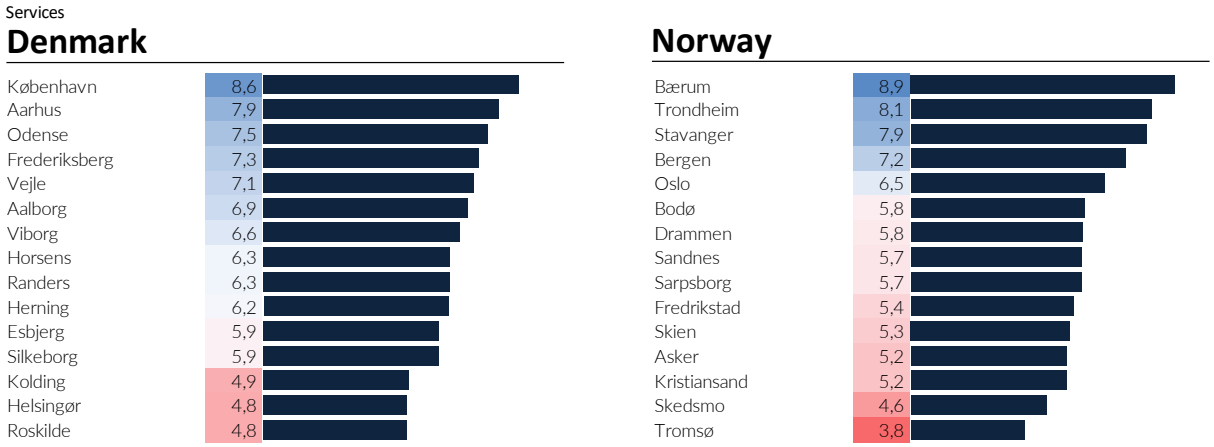


Figure 13 - Services Score for Individual Municipalities

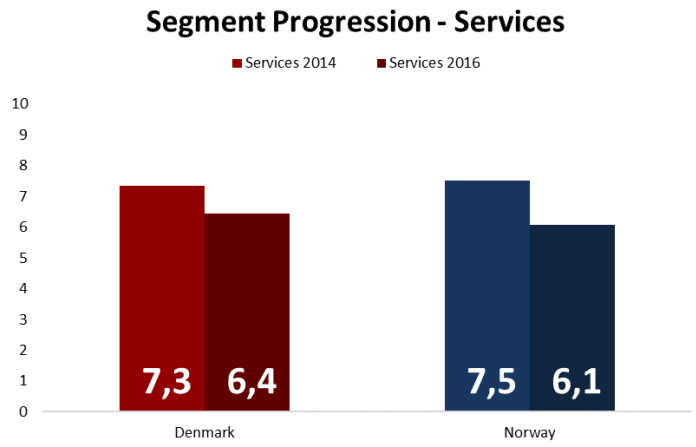


Figure 14 - Segment Progression for Digital Services

The average scores for digital services has decreased in both countries from 2014 to 2016; from 7.3 to 6.4 in Denmark, and from 7.5 to 6.1 in Norway. However, since four new variables for digital services have been added in this year's survey and the weights of the variables have been adjusted (see section 4.4 for more information), it is less relevant to compare scores with the 2014 survey for this category. (The mobile and fixed category have maintained the same weights and variables as in 2014.)

4.2 Specific Findings for Norway

The following observations were made in relation to digital services in Norway:

- About 1/3 of the Norwegian municipalities in this study have a holistic and updated ICT strategy, which is easily available on their websites. For the remaining municipalities, it is a mixed situation. Some municipalities have not published any ICT strategies at all, while others have published strategies which are not updated. Bærum, Trondheim and Stavanger are the Norwegian municipalities with the highest scores as far as the ICT strategy is concerned.

- More than 1/3 of the Norwegian municipalities in this study are lacking a Smart City strategy. On the other hand, some municipalities have developed quite comprehensive and forward-looking strategies, programs or concepts for developing Smart Cities/Municipalities. Bærum and Stavanger seem to be in front in this area in Norway, followed by Oslo, Sarpsborg and Bodø.

- When it comes to alignment of the ICT strategies and Smart City strategies/initiatives, most of the Norwegian municipalities got a low score. The exceptions were Bærum, Stavanger and Trondheim.

- The welfare technology readiness seems to be fairly high in most of the Norwegian municipalities in this study. Only a couple of the 15 municipalities are lacking a strategy or plan in this area. Trondheim has developed a program plan for welfare technology toward 2020 and a corresponding action plan for 2015-2016, which stands out as the most advanced welfare strategy among the Norwegian municipalities.

- All Norwegian municipalities achieved a full score on the variables *Online daycare service*, *Online build-permit service* and *Digital learning platforms*. Most of the municipalities also offer a similar online fix-my-street service, but only the solutions in Bærum and Tromsø obtained the highest score for this service.

100 % of the municipalities offer daycare applications, build-permits and digital learning services online for its citizens

- Most of the municipalities achieved lower scores on use of welfare technology than on welfare technology readiness. However, some municipalities also got fairly high scores on the variable *Use of welfare technology*. Oslo, Trondheim and Bærum seem to have the best developed welfare technology offerings among the Norwegian municipalities in this study.

- About 50 % of the Norwegian municipalities in this study have published plans/processes for migrating from analogue fixed-based safety alarms to digital mobile safety alarms.

- All Norwegian municipalities offer secure digital communication. In addition, the municipalities have a portfolio of electronic communication channels, and some are present on different social medias. Five out of the 15 municipalities got the highest score for this variable.

4.3 Specific Findings for Denmark

The following observations were made in relation to digital services in Denmark:

- As in case of Norway, about 1/3 of the Danish municipalities in this study have a holistic and updated ICT strategy easily available on their websites. For the remaining municipalities, it is a mixed situation. Some municipalities have not published any ICT strategies at all, while others have published strategies which are not updated. København, Aarhus and Randers are the Danish municipalities with the highest scores on the ICT strategy variable. However, it must be pointed out that the Danish central government, regions and municipalities agreed (in May 2016) to a *Digital Strategy 2016-2020* in order to accelerate the adoption of digital solutions in the public sector.

- Several Danish municipalities have developed quite comprehensive and forward-looking strategies, programs or concepts for developing Smart Cities/Municipalities. København, Aarhus, Aalborg, Odense, Vejle and Fredriksberg are in the forefront of this area.

- When it comes to alignment of the ICT strategy and Smart City strategies/initiatives, most of the Danish municipalities obtained a low score. The exceptions were København, Aarhus and Odense.

- As in Norway, the welfare technology readiness seems to be fairly high in most of the Danish municipalities in this study. The comprehensiveness of welfare technology strategies varies among the Danish municipalities, but overall the scores are high, with København, Odense, Esbjerg, Vejle, Fredriksberg, Randers and Silkeborg in the forefront of this area.

- While most of the Norwegian municipalities achieved lower scores on use of welfare technology than on welfare readiness, many Danish municipalities also got high scores on the variable *Use of welfare technology*. In addition to the previously mentioned municipalities with high score on welfare readiness, Viborg and Horsens have well-developed welfare technology offerings.

Several Danish municipalities have developed quite comprehensive and forward-looking Smart City strategies

- Due to limited information on Danish municipalities' websites about migrating from analogue, fixed-based safety alarms to digital mobile safety alarms, it has not been possible to identify differences among Danish municipalities in this area.

- As in Norway, all Danish municipalities achieved full score on the variables *Online daycare service*, *Online build-permit service* and *Digital learning platforms*. All of the municipalities also offer a similar online fix-my-street service, and 12 out of the 15 implemented solutions obtained the highest score for this service.

- All Danish municipalities offer secure digital communication. In addition, the municipalities have a portfolio of electronic communication channels, and some are present on different social medias. Seven out of the 15 municipalities got the highest score for this variable.

4.4 Variables and Weights

The services part of the index is a composite of 12 different variables this year, up from eight in 2014 and six in 2012. These 12 variables are illustrated in Table 1. Four of the variables in this year's study are related to strategies and plans, while the remaining eight variables consider availability and implementation of specific municipal services. The four variables related to strategies and plans are given a total weight of 50 % (12.5 % each), and the remaining 50 % is divided between the eight services (6.25 % each).

Area	Low Score	High Score	%
Strategy and Planning			
• The presence of an ICT strategy	Not or only partly present	Comprehensive (services + infrastructure), updated, followed up	13
• The presence of a Smart City strategy	Not or only partly present	Comprehensive (plan regarding services, infrastructure, resources, information, etc.), updated and followed up	13
• Alignment of a Smart City strategy with the ICT strategy	Not or only partly aligned	Highly aligned (goals highly correlated between separate strategies)	13
• The municipal readiness for welfare technologies	Not present in municipal plans or budgets	Welfare technologies in use or active participation in pilot projects	13
Availability of Digital Services			
• The availability and quality of Digital Learning platforms in primary schools	Not or only partly present	Available, high functionality and easy to use	6
• Online daycare application and selection process	Not available	Available, high functionality and easy to use	6

• Online residential building permit application and approval process	Not available	Available, high functionality and easy to use	6
• Online feedback/reporting for "Fix my Street" functionalities	Not available	Available, high functionality and easy to use	6
Electronic Communication with the Municipality			
• Secure communication with public authorities	Not or partly available	Available, promoted, standards-based, easy to use	6
• Availability of electronic communications channels	Available, but limited promotion / usage	Widely available and actively promoted	6
Welfare Technologies			
• The municipal use of welfare technologies	Not available	Available, high functionality and easy to use	6
• Implementation status of static and mobile (2G/3G/4G connectivity) personal safety alarms.	Static only	Static and mobile, high functionality and easy to use	6

Table 1 - Digital Services Variables

4.4.1 Strategies and Plans

The following section will present the four variables which composite 50 % of the Digital Services' score.

ICT Strategy

In Denmark, the central government, regions and municipalities agreed on a *Digital Strategy 2016-2020* in May 2016 in order to accelerate the adoption of digital solutions in the public sector. The strategic digital initiatives in this strategy document make it possible for the public sector in Denmark to make joint investments in areas which are particularly complex, and in which there are interdependencies across different authorities and sectors.

The *Digital Strategy 2016-2020* concerns the authorities at all levels of government, from central government to regions and municipalities - i.e. both the administrative institutions such as ministries, agencies and municipal and regional administrations, and the executive institutions such as hospitals, public schools, universities, etc. This should implicate high scores for all of the Danish municipalities for the variable ICT strategy. However, since this common public digital strategy – so far – only has been adapted/implemented to a small degree into concrete ICT strategies for the individual municipality, the scores for this variable do not fully reflect that Denmark got a common public digital strategy in May this year.

Bærum, Trondheim and Stavanger have constructed comprehensive ICT strategies with goals, priority areas and implementation plans

In Norway, the following strategy documents stand out as examples of comprehensive, well-structured ICT strategies which combine strategic goals, priority areas and implementation plans:

- Trondheim: *Temaplan: IKT, digitalisering og velferdsteknologi 2015-2018*
- Bærum: *IT-strategi, Smart IT – en enklere hverdag 2014-2020*
- Stavanger: *IKT-strategi 2014-2017*, based on a long-term digital strategy for 2014-2029

For the rest of the Norwegian municipalities in this study, there is a mixed situation. Some municipalities have not published any ICT strategy on their websites at all, while others have published strategies which are not updated.

Smart City Strategy

Smart City has become a widely publicized concept the last year. In short, Smart City is about to make traditional networks and services more efficient, stimulate innovation and make cities more sustainable through the use of digital technology, all for the benefit of inhabitants and businesses. The Smart City concept goes beyond the use of ICT for better resource use and less emissions, including smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It also encompasses a more interactive responsive city administration, safer public spaces and meeting the needs of an ageing population.

Different Smart City strategies and activities have been initiated in many Danish and Norwegian municipalities the last years. However, it is not straightforward to consider which of these strategies and activities that are based on the most advanced and future-proof concepts. Therefore, scores for this variable are based on a mix of availability of Smart City strategy documents, organization and conceptualization of Smart City projects as well as municipal involvement and efforts regarding Smart City initiatives.

In the report *Growing smart cities in Denmark*[9], it is determined that the Smart City activities carried out of Danish municipalities cover a wide range of areas, such as environment, safety and health care, mobility, political awareness, citizen involvement and business growth. Nevertheless, it seems to be a common feature for the most advanced and future-proof concepts that municipalities collaborate closely with other sectors to deliver Smart City initiatives, including private sector, academia and civil society. There are many consortia involving municipalities, regions, universities and private business in the field of Smart Cities. København is a good example in this context, where parallel initiatives are supporting a common goal. The *Gate 21 partnership* is focused in the greater København region, while the *EnergyLab Nordhavn* focuses on smart energy solutions in a part of the city. In addition, *The København Solutions Lab* is a cross-departmental incubator for Smart City initiatives for the municipality of København. The lab collaborates with citizens, companies and knowledge institutions.

Another good example of a partnership model in Denmark is *Smart Aarhus*, which is a collaboration between the city of Aarhus, the Central Denmark Region, Aarhus University, The Alexandra Institute, VIA University College, IT-Forum, the Danish Technological Institute, Creuna and Systematic. Through this partnership, *Smart Aarhus* offers a platform for everyone who wants to make use of opportunities of digitalization across sectors and hierarchies. *Smart Aarhus* consists of the Smart Aarhus Board with directors from the member organizations, and also of the Smart Aarhus Sectretariat, which is constituted by members of the partaking organizations.

In addition, municipalities in Denmark are sharing knowledge with each other through national and regional Smart City networks. The Danish Business Authority and the University of Aarhus coordinates such a national network that brings together national policy makers, municipalities, organizations and researchers to exchange knowledge, experience and ideas on Smart City issues.

Municipalities in Denmark are sharing knowledge, experience and ideas with each other through national and regional Smart City network gatherings

Some of the Norwegian municipalities in this study, also have good approaches and show progress in their Smart City projects and initiatives. *Smart City Bærum* for instance was established in 2012, and is a partnership where the municipality collaborates with local businesses and organizations. The municipalities of Oslo, Sarpsborg and Bodø have also recently established Smart City projects:

- *Oslo Smart City* is initially focusing on mobility, environment and welfare technology.
- *Smart City Sarpsborg* is a collaboration project between the municipality, local businesses and researchers at Norwegian Centre of Expertise and Smart Energy Markets in Halden.
- The initiative in Bodø is a collaboration between the local project *New City – New Airport* and a think tank of representatives from the municipality, the University of Nordland, the Research Council of Norway and the Norwegian Public Roads Administration.

Stavanger is one of three flagship cities participating in the EUR 30 million Smart City project *Triangulum*

Stavanger is, together with Manchester (UK) and Eindhoven (NL), defined as a flagship city in the European Commission's Smart City project *Triangulum*. These three cities will from 2015 until 2019 work together in order to develop, implement and share smart solutions related to mobility, energy and ICT. The project consortium combines interdisciplinary experience and expertise of 22 partners from industry, research and municipalities who share the same objective and commitment to develop and implement smart solutions in order to replicate them in the three follower-cities Leipzig (D), Prague (CZ) and Sabadell (ESP). The overall budget of *Triangulum* is EUR 30 million (2015-2020). The European Commission funding (Horizon 2020) accounts to EUR 25 million. The project is coordinated by Fraunhofer IAO in Stuttgart and supported by the Steinbeis-Europa-Zentrum.

Alignment of a Smart City Strategy with the ICT Strategy

Except for a couple of municipalities in both Norway and Denmark, it is – so far – no clear signs of close alignment of Smart City strategies with municipal ICT strategies. Thus, this is a field for improvement for most of the municipalities in this study. Development of Smart City strategies and ICT strategies often seems to be handled as separate activities, and the scores for this variable in the index are therefore quite low for most of the municipalities.

[9] *Growing smart cities in Denmark*, Arup and CEDI (2016)

Welfare Technology Strategy - Readiness of Welfare Technologies

The welfare technology readiness seems to be fairly high in most of the Norwegian municipalities in this study. Only a couple of the 15 municipalities have not published a strategy or plan in this area on its website. Trondheim has developed a program plan for welfare technology toward 2020 and a corresponding action plan for 2015-2016, which stands out as the most advanced welfare strategy among the Norwegian municipalities. But also Bærum's *Strategisk plan for velferdsteknologi 2013-2017*, Bodø's *Handlingsplan for velferdsteknologi 2014-2018*, Drammen's *Digitaliseringsstrategi for Helse-, sosial- og omsorgstjenestene 2015-2018* and Bergen's *Strategi for bruk av velferdsteknologi* from 2013 are examples of comprehensive welfare technology strategies.

Also in Denmark, the welfare technology readiness is high. The comprehensiveness of welfare technology strategies varies among the Danish municipalities, but overall the scores are high, with København, Odense, Esbjerg, Vejle, Fredriksberg, Randers and Silkeborg in the forefront of this area.

In 2013 the Danish government, Local Government Denmark and Danish Regions jointly launched a common public sector Strategy for Digital Welfare (2013-2020). The aim of this strategy was to accelerate the use of ICT and welfare technology in frontline public service delivery, specifically to speed up the use of efficient and effective digital and technological solutions in healthcare, care for the elderly, social services and education. The high scores for the Danish municipalities on readiness of welfare technologies indicates that this common public sector strategy form 2013 has contributed to good strategy processes within most of the municipalities.

4.4.2 Availability of Digital Services

The following section will present the eight variables which composite 50 % of the Digital Services' score.

Digital Learning Platforms in Primary Schools

All municipalities in this study have got full score on the variable *Digital learning platforms*. However, there are some degree of uncertainty behind these scores since all municipalities require a log-in for this service.

A new digital user platform for all compulsory schools is aimed to be in place in Denmark by 2018

According to the report *Denmark – Country Report on ICT in Education*[10], the Danish market of digital learning platforms is currently dominated by two brands; *Skoleintra* (with more than 90 % of all compulsory schools) and *Lectio*, which is also a student administration system at greater upper secondary education. However, according to the report, the Government and the Local Government Denmark (representing the municipalities) have agreed on a joint project developing a new virtual infrastructure for public schools: a digital user platform for compulsory schools, where the infrastructure is expected to be in place at all schools by 2018.

Also in Norway the impression is that all municipalities offer proven digital learning platforms. A couple of the Norwegian municipalities have recently changed providers of their digital learning platforms (Trondheim and Fredrikstad).

Online Daycare Application

Online daycare application is a widely available service, both in Norway and Denmark. All municipalities in this study had an online daycare application service. However, since all municipalities require a log-in for this service, this study has only considered the front end of such a service. The scores have been set as if all municipalities had a fully electronic service, and not only an electronic front which have to be followed up by paper application through traditional mail.

Online Building Permits

In the 2012 survey, 12 out of 15 Danish cities and 13 out of 15 Norwegian cities had the service available. Two years ago all of the municipalities in Denmark and Norway offered an online building permit service to their inhabitants, and no municipalities have removed this digital service the last two years.

[10] *Denmark – Country Report om ICT in Education*, European Scoolnet (2015)

Fix-My-Street

The Fix-My-Street services differs among the municipalities. Some municipalities have a full-fledged solution with multiple response alternatives, including mobile apps, while others still only offer a telephone and/or e-mail solution.

12 of 15 Danish municipalities obtained top scores in the Fix-My-Street category, a score only received by two Norwegian municipalities

Some municipalities have implemented systems which allow inhabitants to give feedback on almost everything, from pot holes and street lamps to garbage, rats and food poisoning. To achieve a full score, a municipality had to have a well-integrated Fix-My-Street solution that was easy to find. It also needed to be intuitive and give the user several different ways of inputting data. In addition, it needed to give the user an easy overview of other user's remarks and complaints, as well as online feedback from the municipality when the issue was taken care of or fixed. Excellent examples were seen in Denmark, where 12 of the 15 municipalities obtained top score. In Norway only 2 municipalities obtained top score.

Use of Welfare Technologies

Most of the Norwegian municipalities achieve lower scores on the variable *Use of welfare technology* than on *Welfare technology readiness* (see section *Welfare Technology Strategy - Readiness of Welfare Technologies*). However, some municipalities also obtained fairly high scores on the variable *Use of welfare technology*. Oslo, Trondheim and Bærum seem to have the best developed welfare technology offerings among the Norwegian municipalities in this study.

A concrete project worth mentioning in this context is a project initiated in 2015 by the National welfare technology program. The program includes the municipalities of Trondheim, Sarpsborg, Stavanger and Oslo and the aim is to test how welfare technological solutions can contribute to greater achievement and more control over people's health. NOK 28 million has been allocated to this project by Parliament, and the project includes around 500 home patients in the four municipalities.

In April 2016 an evaluation report from the introduction of welfare technology in four of Oslo's districts were published[11]. This report shows good results from the use of welfare technology in theses city districts since 2014, in collaboration with the project *Velferdsteknologi i Sentrum*.

While most of the Norwegian municipalities achieved lower scores on the variable *Use of welfare technology* than on *Welfare technology readiness*, many Danish municipalities also got high scores on the variable *Use of welfare technology*. Both København, Odense, Esbjerg, Vejle, Fredriksberg, Randers, Silkeborg, Viborg and Horsens have well-developed welfare technology offerings.

Implementation of Personal Safety Alarms

Digital mobile safety alarms are available in the Danish *Hjælpemiddelbasen*, but there is little information available on how active the various Danish municipalities have been in replacing existing analog solutions with digital solutions.

According to The Norwegian Directorate of eHealth, the shift from analog to digital safety alarms is underway in Norway. The Directorate has given some overall recommendations related to the acquisition of such digital solutions, and will (during 2016) publish more detailed recommendations related to equipment, communication and response centers for new digital solutions.

On behalf of Trondheim municipality, SINTEF published a report in April 2016 on safety alarms for the future[12], focusing on both user needs and technical issues that municipalities need to consider when developing requirements specifications for migration from analogue to digital safety alarms. This report could be used of other municipalities in their migration from analogue fixed-based safety alarms to digital mobile solutions.

In addition to Trondheim, Oslo, Stavanger, Skien, Asker and Bergen, Fredrikstad are examples of Norwegian municipalities which currently are in a planning or implementing process for migration from analogue fixed-based safety alarms to digital mobile safety alarms.

[11] *Velferd i Sentrum – Innføring av velferdsteknologi i sentrumsbydelene i Oslo*, Intro International and AHO (2016)

[12] *Fremtidens trygghetsalarm – Kunnskapsutvikling for funksjonsinnhold i fremtidens trygghetsalarm*, SINTEF Teknologi og samfunn, Avdeling helse (2016)

Secure Communication

As described in the 2014 survey, already in 2007 Denmark required organizations to implement a common IT security standard. Anyone over the age of 15 holding a Danish CPR number and who is a registered resident of Denmark can today obtain a digital signature. This ensures that the Danish municipalities all receive the highest score since they already have secure communication between the municipalities and all its inhabitants, ensuring the ability to share sensitive information in digital channels.

Both Denmark and Norway have implemented secure login alternatives for its inhabitants, ensuring a vital part of the digital value chains

There have also been large changes in Norway since the first NBCI in 2012 for secure communications; all municipalities that we studied in 2014 offered secure communication to their inhabitants. Norway has introduced a common secure and free infrastructure toward the public sector (ID Porten). Inhabitants can choose different ID solutions in order to log in to ID Porten. Min ID is public and Bank ID, Buypass and Commfides are the commercial options users can log in with.

Electronic Communication Channels

All municipalities in this study have a portfolio of electronic communication channels, and some are present on different social medias. Five out of the 15 Norwegian municipalities and seven out of the 15 Danish municipalities achieved the top score for this variable.

Section 5

Mobile Network Deployment

5 Mobile Network Deployment

The trend that mobile and fixed network deployments were becoming more and more similar, was observed during the last NBCI, and the trend continues. However, due to separate legislation and processes these areas will still encounter unique issues which is why they are divided into two groups in this report.

Mobile network deployment has improved the last two years, mainly due to increased awareness and focus on mobile coverage among municipalities

5.1 Main Findings for Mobile Network Deployment

The underlying variables which create the mobile score have not been changed since the NBCI from 2014. The 2014 and 2016 numbers are therefore comparable to a high degree. In Figure 15, the aggregated mobile score for Denmark and Norway from both 2014 and 2016 are shown. Firstly, the average national score for both countries have increased with approximately 20 % and 40 % for Norway and Denmark respectively. The main contributions to this increase in both countries are:

1) Increased Acceptance of Mobile Network Equipment on Municipal Grounds

   One of the more concrete trends observed was that the municipalities in general have a better understanding of mobile coverage and how it affects the daily lives of its citizens. This is mainly because more and more citizens are reaching out to the municipalities and telling them about their coverage issues. Consequently, some municipalities have initiated collaboration projects with the operators (where the municipalities are offering to take the installation cost of, e.g., the mobile mast) in order to effectively solve the issues.

2) Better Communication and Case Handling

   In general, the communication and the case handling has improved among municipalities in both countries. There are two main contributing factors to this change. Firstly, some municipalities are considering mobile-related construction requests in the same process as general construction requests. This means that a mobile-related case will not be considered as a separate issue and therefore be incorporated in a standardized process with a predictable timeline. Secondly, the mobile network rollouts are currently mainly focused on swaps and not new construction. Many of the swaps do not require new applications for the municipalities to handle and, thus, results in fewer cases for the municipality resources to handle.

3) Improvement in Planning

   Municipalities in both countries still have no comprehensive plans regarding mobile coverage in their respective areas (see section 5.1.1 for explanation). However, there is a better understanding from both municipalities and contractors of the importance of coverage for the citizens. As a consequence, operators are sometimes involved in an early stage of new constructions (e.g. schools), thus enabling the coverage to be built efficiently for both parties.

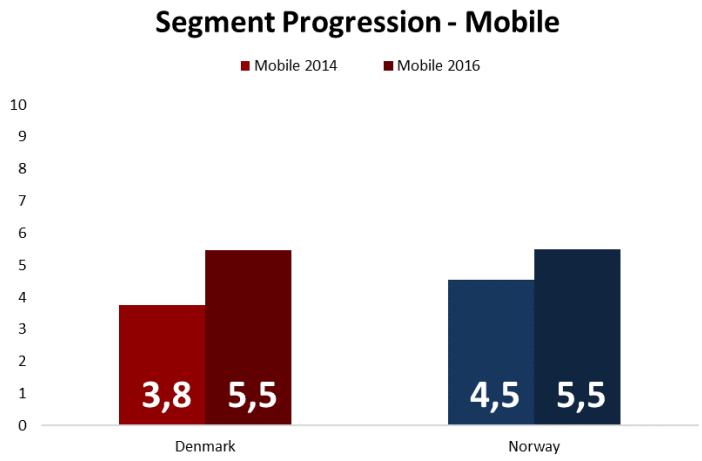


Figure 15 - Segment Progression for Mobile

The municipalities reaching the top places (in respective countries) in this year's NBCI were Oslo and Køpenhavn (illustrated in Figure 16). They both offer effective and flexible application management and have municipal lease costs which are in line with residential lease costs. This makes the rollout of modern, mobile services smooth and effective.

Furthermore, it is noticeable that Denmark has a more homogeneous score among its municipalities whereas Norway has both the best performing as well as the municipalities with the highest room for improvement. Denmark still struggles with high lease costs for sites in relation to lease costs in the real estate market, a metric which is more

balanced in Norway (the high prices on mobile site costs in Denmark compared to Norway can be seen in the graph to the right in Figure 17).

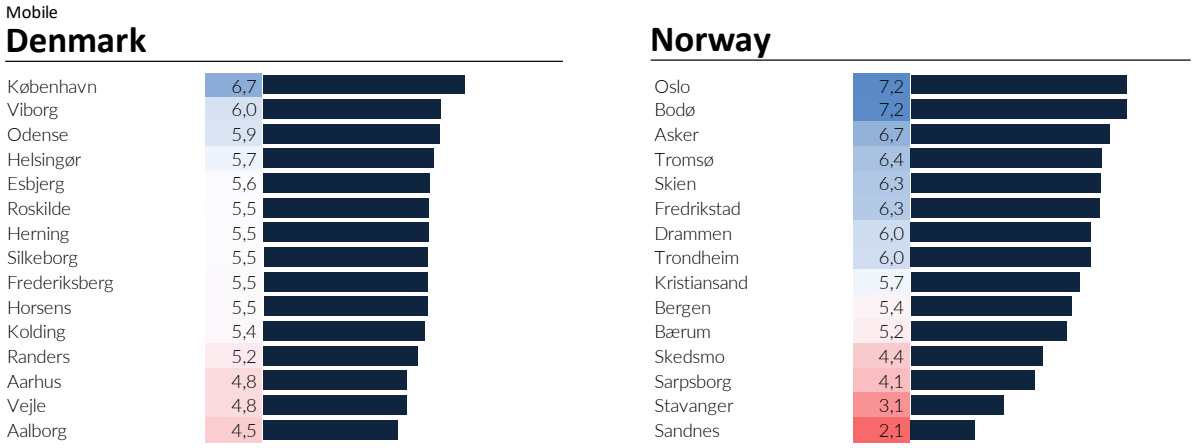


Figure 16 - Mobile Score for Individual Municipalities

In Figure 17, an overview of different metrics regarding mobile site costs are illustrated. As the first graph indicates, there is an even share of sites on public property in Norway (14 %) and Denmark (13 %). It is noteworthy that Denmark used to have a higher percentage (19 %) of sites on municipal grounds in 2014.

The second graph analyzes the public site cost as a percentage of private costs. Both Denmark and Norway have a similar share of 78 % and 81 % respectively. This metric can, to a certain extent, explain the difference in private versus public sites in the different countries. As an example, the share for Sweden was 54 % in 2014, a country with a lot of sites on public property.

The third and final graph outlines the number of residential square meters a yearly site cost will buy. Denmark is a lot higher than Norway which could potentially impede future capacity and coverage growth.

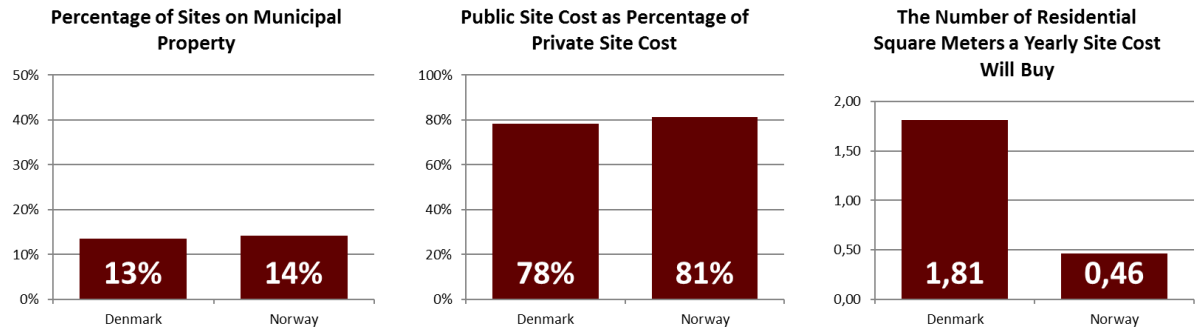


Figure 17 - Mobile Site Costs Information

5.1.1 Challenges Looking Forward

Looking forward, two main potential challenges have been identified.

Firstly, there exists an ironic paradox in the communication between the operators and the municipalities. The operators would generally like to see that the municipalities have better plans for mobile coverage in their respective communities. At the same time, some municipalities have asked mobile operators for a long-term plan (10 years) regarding their mobile network deployments. Such long-term plans are very difficult for the operators to deliver in a relatively fast-changing landscape. This means that both

A close dialogue between operators and municipalities could be increasingly important in the next generation of mobile networks, which potentially requires new installations of smaller antennas on buildings

parties need to find a balance were both parties' needs can be satisfied. This can only be achieved through a close and honest dialogue.

Secondly, the current mobile network deployments in both countries focus on swaps of existing equipment. This means that the dialogue with the different municipalities has decreased in general due to a lower amount of cases of new installations. The next generation of mobile network deployments (5G) could potentially require several new installations due to smaller antennas and sites being used in the infrastructure. Thus, it is important for the municipalities and the operators to maintain a close dialogue in order to secure an efficient rollout of the next generation mobile networks.

5.2 Specific Findings for Norway

This section relates to the expert interviews performed in regards to mobile network deployment in Norway. The following observations were made:

- There is an increased focus of placing antennas on buildings in such a manner that they are not visible to the public eye. In the near future, this could potentially become a more problematic area if the next generation high-capacity networks will demand an increased number of antennas.
- Radiation from antennas is still an issue in some municipalities. Radiation guidelines and limits set by Statens Strålevern are set aside, and individual political agendas are prioritized before statutory limit values. Consequently, some municipalities' attitudes affect the attitude of private property owners and other commercial activities in the municipality. As a result, it becomes difficult for telecom operators to establish well-functioning mobile networks in certain areas.
- Several small municipalities have become increasingly aware of how its citizens are becoming more and more digitally active in their daily lives. As a consequence, it has become increasingly popular among small municipalities to engage into collaboration projects with operators in order to establish adequate mobile coverage for the citizens.

5.3 Specific Findings for Denmark

In Denmark, Telenor's mobile network is a joint venture together with the operator Telia. The joint venture, named TT-Network, was created in 2012 and is responsible for both 2G, 3G and 4G technologies.[13] The following findings are related to the expert interviews performed in regards to mobile network deployment in Denmark:

- Entrepreneurs and Telenor are experiencing very constructive dialogues with the municipalities and are, in general, very satisfied with the ongoing collaborations. As in the case of Norway, the mobile networks have matured and are currently in a phase of swapping out old equipment with new. In the past year, approximately 95 % of all construction-related work in mobile deployment in Denmark were upgrades. In contrast, this figure was approximately 30 % in 2010[14].

95 % (approximately) of all construction-related work in mobile deployment in Denmark the past year were upgrades

- One of the strongest trends occurring in Denmark, is how municipalities are becoming more aware of the benefit of mobile coverage. This trend is especially strong in rural municipalities. In Holstebro, a city in west Denmark with a population of approximately 60 000, this has become evident through a collaboration project between Telenor and the Holstebro municipality (including an additional five municipalities). The municipality has agreed to deliver the mobile tower, the power supply and the housing for operator equipment in order to secure coverage for its citizens. This project is a first of its kind in Telenor Denmark history, and it is a result from the constructive dialogue between the operator and the municipality. A similar standalone project is progressing in Norddjurs municipality where the goal is to be operational by the end of 2016.

[13] TT-Netværket, accessed the 6th of October 2016, <http://www.tt-network.dk/>

[14] Data acquired from Telenor Mobile Deployment Division in Denmark (October, 2016)

- In Denmark, a newly updated national policy introduces deadlines for certain applications (*Bygge-anmeldelse*) regarding changes to a mobile site (and infrastructure in general). The policy states that the municipalities have to respond in two weeks if no major changes are proposed in the application. This policy has been very helpful to the process of efficiently rolling out mobile networks. Unfortunately, the policy is not applicable to all site changes.[15]

5.4 Variables and Weights

The variables, weights and score definitions for each element are outlined in Table 2. The four different elements together comprise the mobile component of the NBCI, which accounts for a third of the total NBCI score.

Area	Low Score	High score	%
• Access to public ground and buildings	No access	Active support and relatively many installations	40
• Site lease costs	Relatively high lease costs	Relatively low lease costs	30
• Effectiveness and operator service	Normally long waiting times to get applications approved	Short waiting time, can-do attitude, proactive ("we need coverage"), an infrastructure masterplan; operators know when applications can be expected	20
• Mobile masterplan	No such thing	Predictable and transparent	10

Table 2 - Mobile Deployment Variables

5.4.1 Access

When building a mobile network, getting access to public buildings and grounds is very important. Due to the importance of access, access was assigned 40 % of the total score for mobile deployment.

The score for access is based on two equal inputs, with 50 % consisting of what have been told by local contractors, consultancies and other experts, and 50 % consisting of the share of Telenor (and Telia in Denmark) sites on public grounds in the municipality.

The percentage of sites the operator has on public properties is a good indicator of whether or not the municipalities have successfully facilitated mobile network deployment. The analysis, however, should be taken with a grain of salt. Some municipalities have few sites on their properties because the network operators rarely asked to put up any sites. Therefore, we gave equal importance to qualitative information from the expert interviews as well as from the quantitative information (site share of public grounds).

Municipalities that achieved the highest scores and the lowest scores were all Norwegian, with Asker and Fredrikstad at the top of the list and Stavanger and Sandnes at the bottom of the list.

5.4.2 Lease Cost

Lease cost is a difficult area to analyze for several reasons:

- Prices are higher in the larger cities than in smaller cities. It would not be fair to compare actual prices since the smaller municipalities would do a lot better than the larger municipalities.
- The general real estate price level differs between and within the countries.

In order to conduct a fair analysis, site costs from two different angles were looked into: the public site cost as a percentage of private site cost and the number of residential square meters (in the city) a yearly site cost will buy.

[15] Bygningsreglementet (Byggeanmeldelse), accessed the 7th of October 2016, < http://bygningsreglementet.dk/br15_01_id2008/0/42>

Access was received to Telenor´s site information (and Telia's in Denmark) for more than 2 700 public and private sites in the 30 NBCI cities.

Public Site Cost as a Percentage of Private Site Cost

Since it was deemed unfair to directly compare site costs in one municipality with costs in another municipality, it was decided to compare the public site cost to the private site cost within each municipality. In this way, it was possible to see if the public site cost was a lot higher or a lot lower than the site cost on private properties. Generally, private sites were significantly more expensive than the public sites.

The Number of Residential Square Meters a Yearly Site Cost Will Buy

In order to compare site costs between municipalities, the housing price information for the respective municipalities were looked into.[16] The price per square meter for apartments was used to calculate how many square meters of property one could get for the cost of a public site in the municipality. Consequently, actual site costs between the municipalities was compared, independent of country and size. The main finding in this area was that Denmark has very high site costs (although there has been an improvement since 2014). Norwegian lease costs are more affordable when compared to the general level of housing prices.

5.4.3 Overall Impression, Collaboration and Effectiveness

In this part, network building entrepreneurs, consultancies and other experts were asked to give feedback on how easy or difficult it is to work with the municipalities. The following issues were considered in the analysis:

- How easy it is to collaborate with the municipality.
- The efficiency of the municipality.
- An overall impression of the experience with the municipality.

In order to grade all the municipalities, several sources were interviewed per municipality. When the grade given by the different experts differed, an average grade was used.

It was noted that it might be more difficult for the larger municipalities to get a high score since they often have several departments one had to communicate with in order to get things done and permits accepted. However, this supposition was not supported by the findings, with Oslo and København receiving high scores.

The municipalities that obtained the highest score on collaboration and effectiveness were Fredrikstad (NO), Kristiansand (NO), Skien (NO) and Oslo (NO). The municipalities with the highest room for improvement were Sarpsborg (NO), Vejle (DK), Aarhus (DK) and Aalborg (DK).

Several of the network contractors, consultancies and other experts pointed out the importance of sustaining a dialogue with the municipalities. Many issues could be solved more efficiently if there already existed a line of communication between the parties.

5.4.4 Mobile Master Plan

For a mobile network builder, having clear rules and regulations can be paramount since it can make it a lot easier to plan, build and deploy a network. Consequently, a mobile master plan was included in the survey. The variable investigated if the municipalities had clear plans for mobile deployment in their areas.

In 2014, if was found that most cities did not have a mobile master plan and that only very few municipalities found such a plan important. This has changed significantly in 2016. Municipalities in both countries still have no comprehensive plans regarding mobile coverage in their respective areas (see section 5.1.1 for explanation). However, there is a better understanding from both municipalities and contractors of the importance of coverage for the average citizen. As a consequence, operators are sometimes involved in an early stage of new constructions (e.g. schools), thus enabling the coverage to be built efficiently for both parties.

[16] «Gennemsnitlige kvadratmeterpriser på ejerlejligheder i Danmark», accessed September 2016, <http://www.boliga.dk/kvadratmeter-priser-kommuner.html?houseType=3>
«Snittpriser i leilighet 2016», information obtained in September 2016, Eiendomsverdi AS

Section 6

Fixed Network Deployment

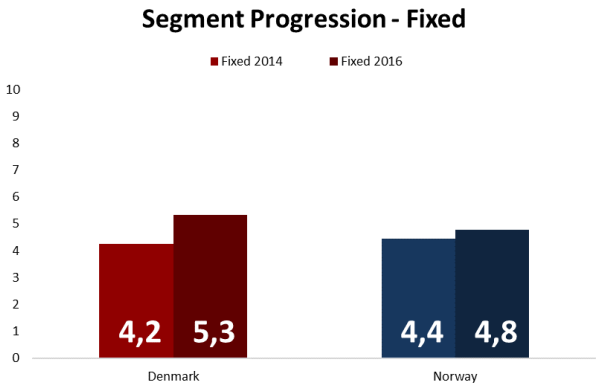
6 Fixed Network Deployment

The municipalities' ability to secure a smooth and flexible facilitation of fixed broadband received an average score for all municipalities of 5.1 out of 10. This is an increase from both the 4.3 in 2014 and 4.7 in 2012.

6.1 Main Findings for Fixed Network Deployment

Denmark received an average score of 5.3 and Norway received an average score of 4.8, this is illustrated in Figure 18. Both countries have improved their score from the previous analysis in 2014. The Danish municipalities display almost no variations between the municipalities, which is illustrated in Figure 19. This is a consequence of a higher degree of national regulations compared to Norway. The many national rules and regulations in Denmark results in a more predictable business environment for network operators. Unfortunately, there is also ways where the national regulations inhibit operators from using options open to operators in Norway.

Furthermore, Norway displays more variation among the municipalities, and holds the position for both the best municipality (Skien, 6.4) and the municipality with most improvement (Asker, 2.9).



Finally, there exists significant room for improvement for fixed network deployment for all of the surveyed municipalities. Although there has been an improvement since 2014, it seems that many cities do not see the importance of fixed network deployment and fail to see the connection between (e.g.) strict digging regulations and poor network quality. However, there has been a noteworthy improvement in the municipalities' understanding of the importance of digital services and mobile coverage. Sustaining and strengthening the dialogue between the operators and municipalities could bridge the remaining information gap that exists in the fixed deployment area.

Figure 18 - Segment Progression for Fixed

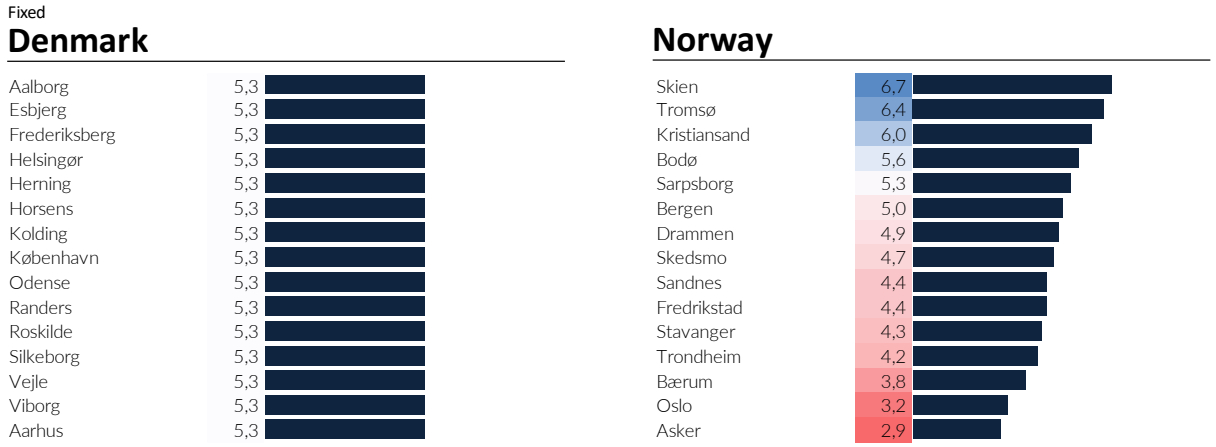


Figure 19 - Fixed Score for Individual Municipalities

6.2 Specific Findings for Norway

This section relates to the expert interviews performed in regards to fixed network deployment in Norway. The following observations were made:

- There have been some signs of potentially stricter requirements for excavation of roadways. Some of the Norwegian municipalities have signaled that they will tighten the rules in order to maintain the quality of the roads. This could potentially negatively affect the efficiency of fixed network deployment.
- Microtrenching is still not, from a policy standpoint, particularly favorable in the municipalities. The main reason is the fear of how certain roadways with poorer quality will be able to handle the microtrenching process. However, the attitude toward microtrenching has improved, main reason being the dialogue between the operator and the municipality in question.
- The case handling process still takes a lot of time in certain municipalities. The experts that were interviewed pointed to the fact that the municipalities' understanding of mobile deployment and digital services has improved over the years. However, the correlation between mobile and fixed deployment is an area where additional focus needs to be allocated.

The municipalities' understanding of mobile deployment and digital services has improved over the years. However, the correlation between mobile and fixed deployment is an area where additional focus needs to be allocated.

- The regulation «*Forskrift om saksbehandling og ansvar ved legging og flytting av ledninger over, under og langs offentlig veg*»[17], which is in effect from the 8th of October 2013, states the following in the 16th paragraph:

  "Vegmyndigheten kan, i forbindelse med tillatelsen, kreve at det legges ekstra trekkrør i lednings- og kabelgrøfter. Vegmyndigheten skal eie trekkrørene og bære kostnadene for trekkrørene."

  More and more municipalities are using this regulation to its full effect which has had a positive impact for operators and the fixed network deployments.
- There exists an extensive network suspended in the air in Norway. More and more municipalities require these cables to be buried, mainly due to aesthetic and safety reasons. This could potentially create some future challenges if digging restrictions become stricter.

6.3 Specific Findings for Denmark

This section relates to the expert interviews performed in regards to fixed network deployment in Norway. The following observations were made:

- Denmark municipalities are under a high degree of regulation compared to Norway. The many national rules and regulations in Denmark results in a more predictable business environment for network operators. Unfortunately, there are also ways where the national regulations inhibit operators from using options open to operators in Norway. As an example, municipalities are not allowed to deploy ducts for other use than strictly their own. Another example is the lack of fibers to be rented from municipalities, a consequence of the strict regulations.
- Fixed networks are, in general, located beneath the ground to a large extent in Denmark. There are several reasons why this is the case.

  Firstly, digging is, in contract to other methods, rather cheap in Denmark due to the soft ground. This is also one of the main reasons why microtrenching is barely used at all.

  Secondly, when crossing roads with cables, the main goal is to reestablish the roads in its original condition. As a consequence, there are no additional requirements from the municipalities to resurface larger parts of the road than the contractor originally has worked with.

[17] «*Forskrift om saksbehandling og ansvar ved legging og flytting av ledninger over, under og langs offentlig veg*», LOV-1963-06-21-23-§32, Samferdselsdepartementet, accessed 12th of October 2016, <https://lovdata.no/dokument/SF/forskrift/2013-10-08-1212#KAPITTEL_4>

Finally, the Danish municipalities only charge small administrative fees in relation to resurfacing roads. This is in stark contrast to Norway where it is more common with additional fees.

- Denmark has adopted a nationwide system for information about buried cables and synchronizing digging events. The *Ledningsejerregistret* (LER) informs about infrastructure in place underground, enables contractors to be informed about digging events, illustrates where they take place and lists the involved stakeholders.
- The Danish Government has launched an initiative called *Bredbåndspuljen* where DKK 200 million from 2016-2019 has been earmarked for improving broadband connections in areas where the coverage is poor[18]. This new initiative enables operators to construct networks where it has been previously commercially unviable to operate. The allocation of the money is technology-neutral and part of the Danish government's program *"Vækst og udvikling i hele Danmark"*.

6.4 Variables and Weights

The variables, weights, and examples for scores for each element are outlined in Table 3. There are four main elements that together comprise the fixed network component of the NBCI (which accounts for a third of the total NBCI score).

Area	Low Score	Medium Score	High Score	%
Flexible use				20
• Microtrenching	Never allowed	Open to testing	Generally allowed	
• Pole usage	Take down requirement	No to new poles	Yes to new poles	
Fair pricing/costs				30
• Trench depths along suburban, low traffic road (when not microtrenching)	>= 61 cm	41-60 cm	<= 40 cm	
• Resurfacing requirements (for one simple crossing)	Very strict		Sensible	
• Fees (48 m^2 example)	High		Low	
Operator neutrality				30
• Does the municipality treat telecom operators in a fair and neutral fashion?	Consistently operator non-neutral	Some evidence of unfair treatment	Consistently operator neutral	
Role in network deployment and operations				20
• Maintains system for digging information available for operators	No		Yes, and 100 % usage	
• Deploys ducts on own (or owned company) behalf when deploying other municipal infrastructure (e.g. roads)	No		Yes - always	
• Rents ducts to operators (if yes to above) • Rents fiber to operators	No	A little	Yes - on fair terms	

Table 3 - Fixed Deployment Variables

[18] *Bredbåndspuljen*, accessed the 12th of October 12, 2016, <https://ens.dk/ansvarsomraader/bredbaand/bredbaandspuljen>

6.4.1 Flexible Use

Flexible use has two main variables: Microtrenching and pole usage.

Microtrenching

Microtrenching technologies for laying fiber cables have been tested out in several municipalities. Digging and reinstating the road for a traditional trench can be a time-consuming and expensive exercise. Microtrenching can avoid costs as it does not open up a large trench, but merely cuts a narrow slit that is sliced or sawn in the surface of the road. It makes use of micro-ducts with narrow, vertical cross-sections and small-diameter fiber cables. Microtrenching can significantly reduce the cost of fixed network deployment since it is possible to dispense with expensive backfill material and road resurfacing. However, microtrenching cannot be used everywhere and should not be relied upon as a ubiquitous solution. Microtrenching should be treated as just one of a number of techniques, with different methods used in different places according to which are most suitable and cost-effective. Microtrenching is not favorable in most municipalities in both Denmark and Norway. Some municipalities are currently testing it, but the large majority of municipalities decline microtrenching in their area. According to one of the interviewed experts, a reason for declining microtrenching may be because the municipalities want the operators to pay for resurfacing of the roads.

Pole Usage

Poles are important in Norway, while they are rarely used in Denmark. This part is therefore only applicable for Norway. When building and deploying a network in Norway, using poles is important due to the topology and problems associated with digging in stone. In an area where it is problematic to dig in the ground, it can often be cheaper to use poles in network deployment instead of having to dig trenches for fiber.

6.4.2 Fair Pricing/Costs

The following different issues were looked at under fair pricing/costs: trench depths required when deploying fiber, resurfacing required after having dug a trench, and the fees the network operator is required to pay the municipality for being able to dig on public grounds.

Trench Depth

The depth required when digging a trench is important from a cost perspective. The cost will in most cases increase the deeper you dig. In the questionnaire it was asked how deep one had to dig in order to put down fiber on a low-traffic road. Denmark had a national standard of 40-60 cm (depending on the quality of the road and existing infrastructure in place), while Norwegian municipalities were fairly unified at 60 cm.

Resurfacing

Resurfacing was considered another important cost element and some stark differences between the countries were identified. Denmark has a national requirement for all municipalities and had therefore no variations. Norway, on the other hand, showed the largest variations from one meter on each side of the duct to several meters on each side. The municipalities with very strict digging requirements (e.g. Skedsmo, which demanded 25 meters on each side in 2014) have shown a tendency to be more flexible in 2016. A reason for this could be the municipalities' prioritizing infrastructure development (and thus the digitalization of its cities) rather than focusing on additional resurfacing of roads.

Fees

Another cost element when digging a trench is the municipal fees one has to pay in order to obtain a digging permit. The Danish municipalities only charge small administrative fees in relation to resurfacing roads. This is in stark contrast to Norway where it is more common with additional fees. In Norway Bergen, Trondheim, Bærum, Asker and Drammen have the highest fees.

Interestingly, smaller municipalities tend to be grateful that the network operators ensure good broadband networks to the people living in the municipality. Furthermore, the municipalities are also happy about the resurfacing of the roads in their area. One expert that was interviewed mentioned that the smaller municipalities focus strongly on not getting behind the digitalization of the society, mostly because of the fear of potentially losing its citizens.

6.4.3 Operator Neutrality

Bearing in mind that municipal regulations and behavior have a major impact on operator cost levels, it is essential that operator neutrality is an important part of the network deployment scorecard. Operators that are treated unfairly by cities will have a distinct disadvantage compared to other operators.

Based on the expert interviews, almost all Norwegian and Danish cities are operator neutral. In two cities in Norway there have been instances of digging permit "queue jumping", where one operator has received preferential treatment over others. The analysis was not able to identify other examples of non-operator neutrality in Denmark and Norway.

6.4.4 Role in Network Deployment and Operations

The municipalities that understand the importance of network deployment usually take a more active role in ensuring that the inhabitants are able to benefit from mobile and fixed networks. Consequently, the following questions were asked to the municipalities:

1. Do you have a digging information system (such as “K-Grav” in Oslo)?
2. Do you dig your own ducts and do you let other operators get access to the ducts?
3. Do you have your own fiber and do you give other network operators access to the fiber?

Digging Information Systems

Many municipalities have understood the importance of a digging information system where they force the network operators to co-ordinate their digging in the area. When a network operator would like to dig a duct, they have to ask all the other network operators if they want access to the same duct. When the digging is done, the municipality will deny digging in the same area/duct for a time period. This ensures that the people living in the municipality do not have to live with their city being constantly under construction. Almost all of the Danish and Norwegian municipalities had a digging information system. However, in some Norwegian municipalities it is up to the contractors to document their own work. While there exists an ambition to share this information, it is – in practice – rarely done. This implicates the importance of such systems to be rolled out on a larger scale.

Duct Deployment

When investigating duct deployment, the municipalities were asked if they deployed their own ducts. There is a stark contrast between the two countries: none of the Danish municipalities dug their own ducts, while approximately half of the Norwegian municipalities had some experience with deploying own ducts.

Duct and Fiber Rental

Duct rental was more positively accepted among Norwegian municipalities if spare capacity could be found, even among municipalities which do not deploy their own ducts. None of the Danish municipalities rented out ducts. In the case of fiber rental, the situation was very similar in Denmark; none of the Danish municipalities rented out fiber. In Norway, only one example of fiber rental was identified.

Section 7

Digital Inclusion

7 Digital Inclusion

The digital inclusion (also known as digital use or digital engagement) analysis aims to address the results of the municipalities' efforts of including its citizens in the digitalization of the society. A 3rd party research company (Norstat) performed interviews with people living in 30 cities, evenly split between Denmark and Norway. The results were then analyzed and summarized by Norstat, Nexia and Telenor.

The survey divides the interviewees into two main categories:

1. Digital Active Citizens – people who actively use a computer, tablet or a phone on a daily basis to read the news, watch videos or communicate via e-mail.
2. Digitally Inactive Citizens – people who do not fall into the Digitally Active category.

7.1 Main Findings

Firstly, Norwegian municipalities are, on a general level, more digitally active than Danish municipalities. However, Danish citizens use more municipal online services than Norwegian citizens, but the Danish citizens do not necessarily know that they are provided by the municipality. A reason for this could be that many of the services are perceived as national services in Denmark.

Furthermore, digitally active citizens' experience with digital online municipal services are very similar in both Denmark and Norway. Overall people are generally satisfied with the experience.

Finally, the behavior and experience among Denmark's and Norway's digitally inactive citizens are very similar. In both countries, the digitally inactive citizens have few plans to become digitally more active, a consequence of them experiencing very few problems of being digitally inactive in today's society. However, in a society where processes and products are becoming more and more digitalized, one can assume that the digitally inactive citizens will encounter stronger incentives in the future to become digitally active members of the society. Thus, a stronger demand for educational tools will arise.

7.2 Analyses of Digitally Active Citizens

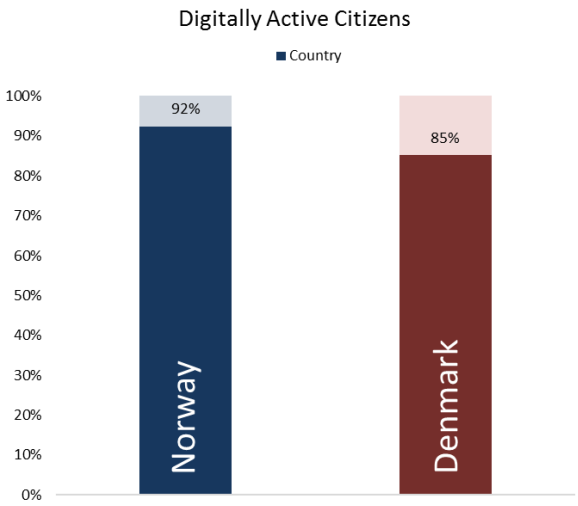


Figure 20 - Digitally Active Citizens

Norwegian municipalities are, on a general level, more digitally active than Danish municipalities. This is illustrated in Figure 20. The results are summarized observations from 15 cities in Norway and 15 cities in Denmark. When one investigates the individual municipalities (see Figure 21) there exists a clear divide between the performance of the individual municipalities on a country level. Nine out of ten Norwegian municipalities qualify in the top ten places whereas ten out of ten Danish municipalities are found in the bottom ten places.

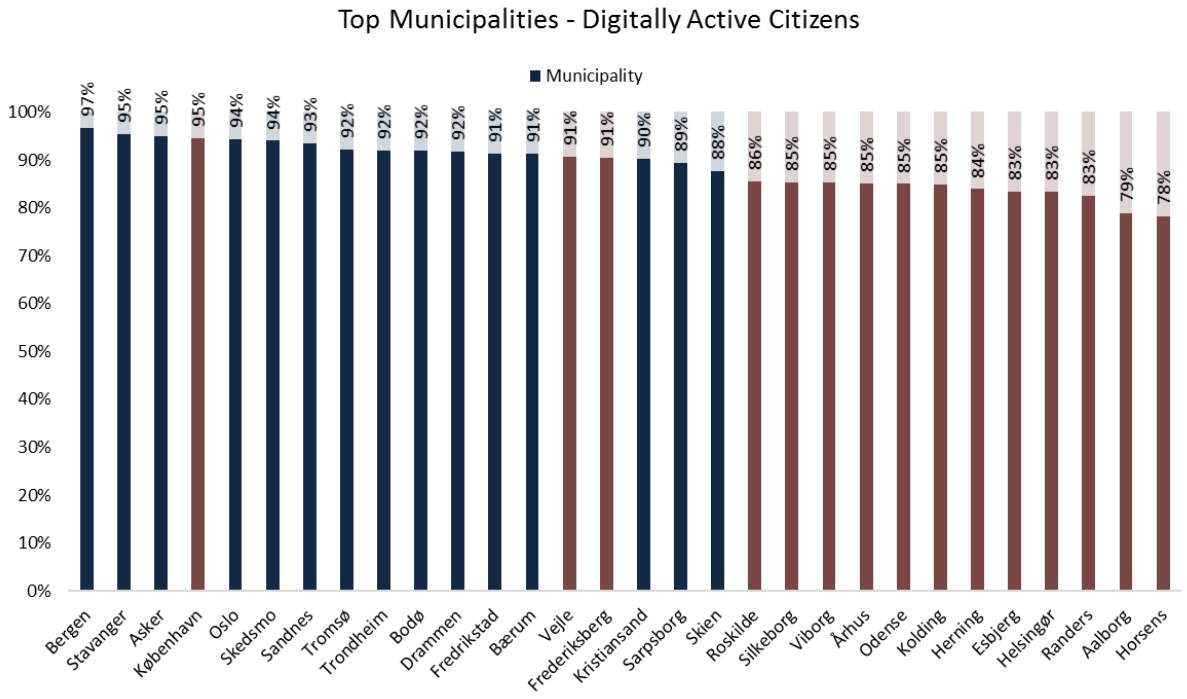


Figure 21 - Top Municipalities - Digitally Active Citizens

Furthermore, citizens in both countries were asked whether they had heard of online services in the municipality. This is illustrated in Figure 22. Approximately 2/3 of the population in both countries are aware of municipal online services[19], the remaining third have either never heard of municipal online services or they have used a service which they do not know are provided by the municipality. The latter explains the second graph (*Usage of Municipal Online Services*) in Figure 22. In this question, citizens were asked if they had used any of four different services in the municipality[20]. The graph illustrates that 69 % of the Danish interviewees had used a municipal online service which is contradictory to the initial 64 % who knew about the existence of these services. This creates the hypothesis that Danish citizens use more municipal online services than Norwegian citizens, but doesn't necessarily know that they are provided by the municipality. A reason for this could be that many of the services are perceived as national services.

There also exists a noticeable difference between Norway and Denmark in the usage of municipal online services (57 % and 69 % respectively). One contributing factor is to this, is how several Danish municipalities have developed quite comprehensive and forward-looking strategies, programs or concepts for developing Smart Cities/Municipalities.

[19] It is important to point out that Norway was asked if they have knowledge of digital online services in the municipality (*Norwegian: Kjenner du til noen digitale, Internettbaserte tjenester i din kommune?*) whereas Denmark was asked if they have knowledge of digital online services provided by the municipality (*Danish: Kender du til digitale online tjenester, som udbydes af din kommune?*). When analyzing the results, one ought to be wary of the fact the Norwegian translation potentially could make interviewees think of online services provided by private companies as well.

[20] Interviewees were asked if they had used any of the following municipal online services: communication between the home and the school, home care services, general applications (e.g. building permits) or feedback to political and administrative proceedings.

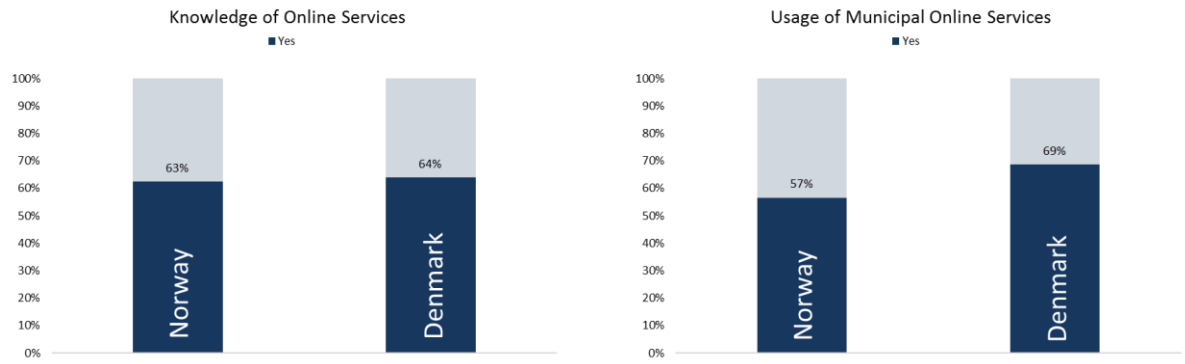


Figure 22 - Knowledge and Usage of Municipal Online Services

In Figure 23, the usage of municipal online services and its corresponding differences between cities have been illustrated with the help of a heat map.

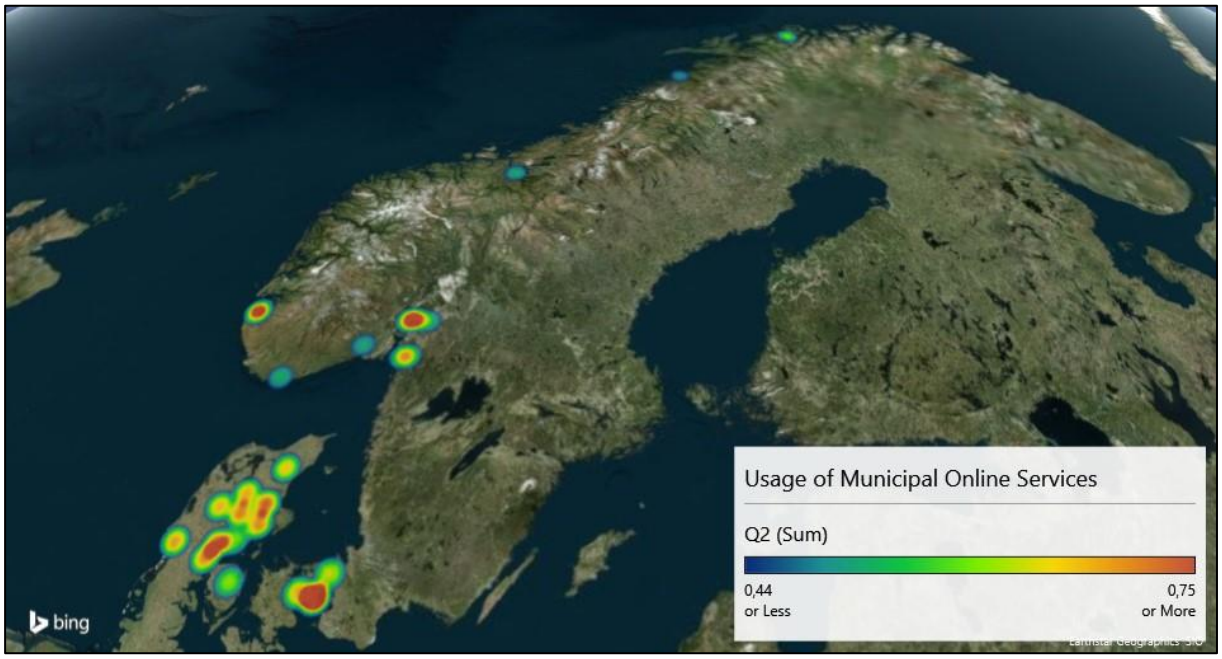


Figure 23 - Usage of Municipal Online Services (Heat Map)

In Figure 24, the usage of municipal online services has been arranged from the municipalities with the highest amount of citizen usage to the lowest amount of citizen usage.

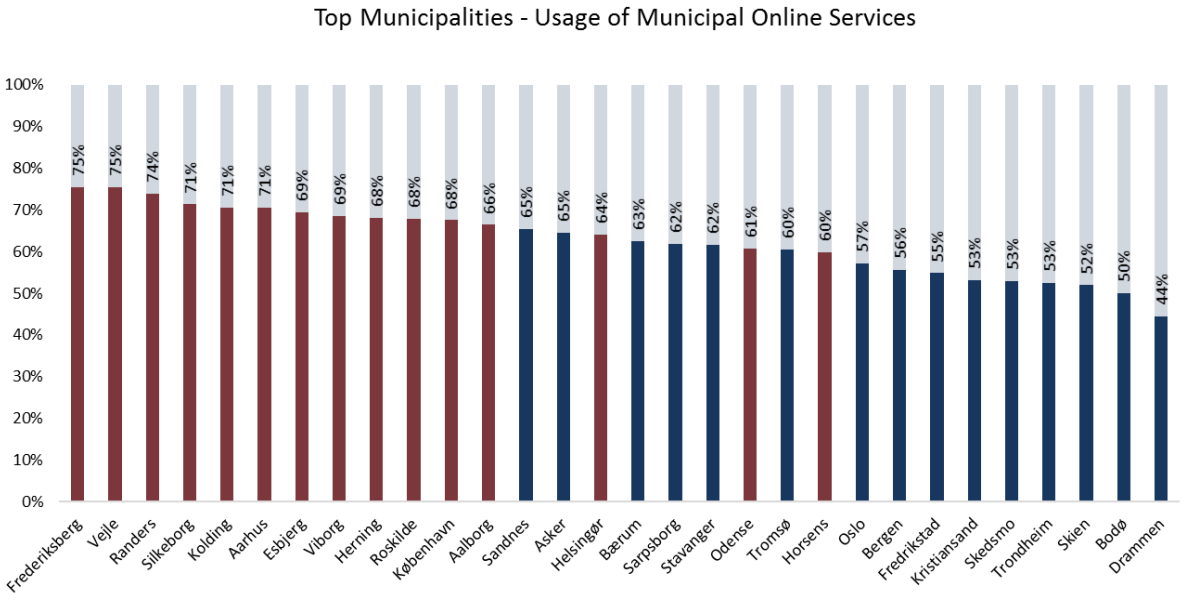


Figure 24 - Usage of Municipal Online Services

Digitally active citizens' experience with digital online municipal services are very similar in both Denmark and Norway. Overall people are generally satisfied with the experience. This is illustrated in Figure 25.

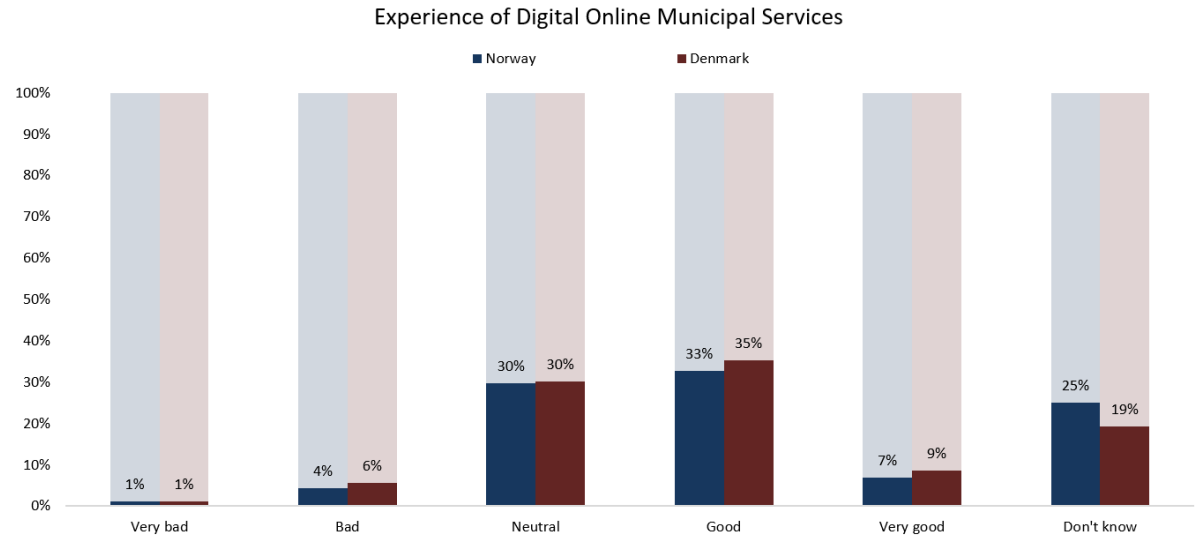


Figure 25 - Experience of Municipal Online Services

7.3 Analyses of Digitally Inactive Citizens

The following section analyzes and discusses the results from the summary of the digitally inactive citizens. Due to the very small share of digitally inactive citizens in the survey[21], there is a rather small sample size for the following analyses. Consequently, the margin of error increases. However, the sample size is sufficient for drawing conclusions of the general trends among digitally inactive citizens.

Firstly, the behavior and experience among Denmark's and Norway's digitally inactive citizens are very similar (see Figure 26). In both countries, the digitally inactive citizens have few plans to become digitally more active (see Figure 26 - left graph), a consequence of them experiencing very few problems of being digitally inactive in today's society (see Figure 26 - right graph). In a society where processes and products are becoming more and more digitalized, one can assume that the digitally inactive citizens will encounter stronger incentives in the future to become digitally active members of the society. Thus, a stronger demand for educational tools will arise.

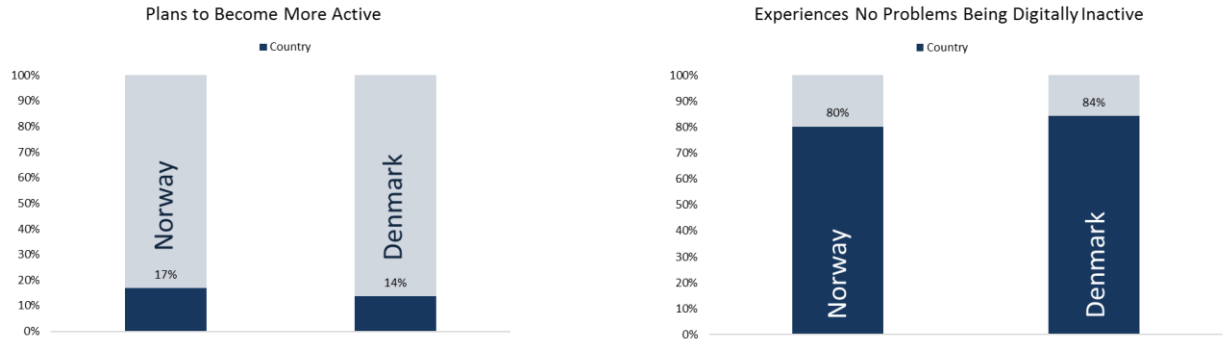


Figure 26 - Plans and Experience Among Digitally Inactive Citizens

Furthermore, half of the digitally inactive citizens knows the existence of learning tools. Hence, there exists a potential improvement in raising the awareness among this group. This is illustrated in the left graph of Figure 27. Out of the survey's 1 800 (Norway) and 1 500 (Denmark) people, less than 5 % had used learning tools. However, it is noticeable that people are generally positively pleased with the experience of using the learning tools (see Figure 27 – right graph).

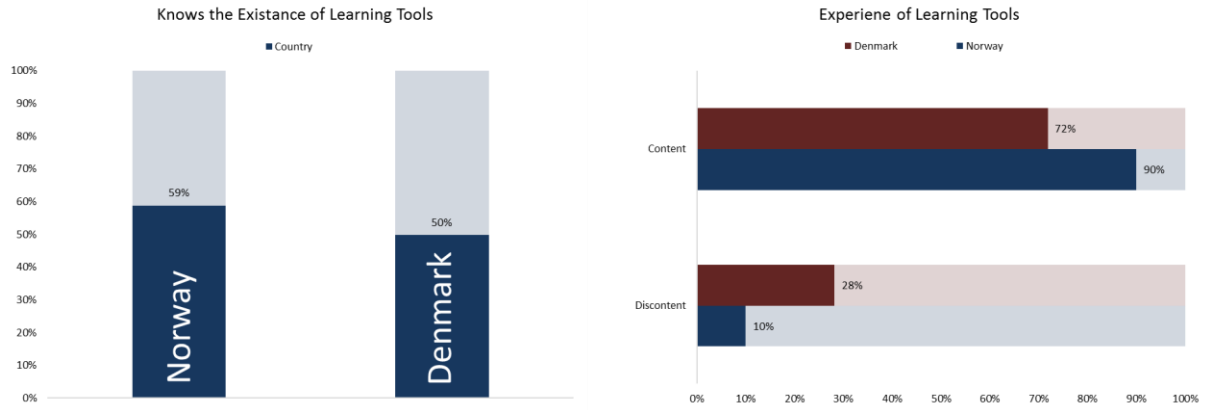
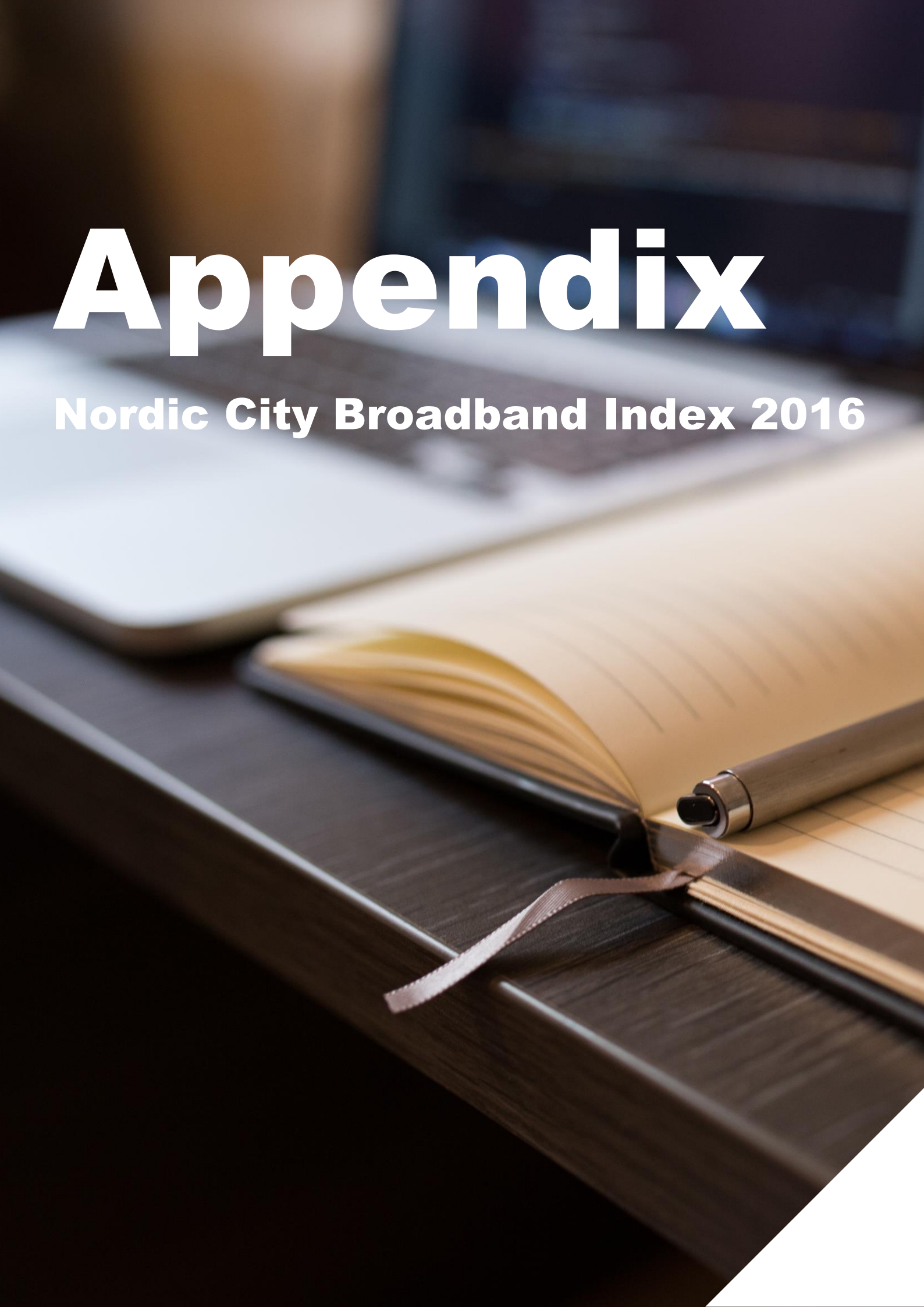


Figure 27 - Knowledge and Experience of Learning Tools

[21] 8 % and 15 % for Norway and Denmark, corresponding to 135 and 224 interviewees respectively.



Appendix

Nordic City Broadband Index 2016

Appendix A: NBCI 2016 Score

NBCI 2016 Score

Rank	Country	Municipali	Services	Mobile	Fixed	Final Score
1	Denmark	København	8,6	6,7	5,3	6,9
2	Denmark	Odense	7,5	5,9	5,3	6,2
3	Norway	Bodø	5,8	7,2	5,6	6,2
4	Norway	Skien	5,3	6,3	6,7	6,1
5	Norway	Trondheim	8,1	6,0	4,2	6,1
6	Denmark	Frederiksberg	7,3	5,5	5,3	6,0
7	Denmark	Aarhus	7,9	4,8	5,3	6,0
8	Denmark	Viborg	6,6	6,0	5,3	5,9
9	Norway	Bærum	8,9	5,2	3,8	5,9
10	Norway	Bergen	7,2	5,4	5,0	5,8
11	Denmark	Vejle	7,1	4,8	5,3	5,7
12	Denmark	Horsens	6,3	5,5	5,3	5,7
13	Denmark	Herning	6,2	5,5	5,3	5,7
14	Norway	Oslo	6,5	7,2	3,2	5,6
15	Norway	Kristiansand	5,2	5,7	6,0	5,6
16	Denmark	Esbjerg	5,9	5,6	5,3	5,6
17	Denmark	Randers	6,3	5,2	5,3	5,6
18	Denmark	Silkeborg	5,9	5,5	5,3	5,6
19	Denmark	Aalborg	6,9	4,5	5,3	5,6
20	Norway	Drammen	5,8	6,0	4,9	5,5
21	Norway	Tromsø	3,8	6,4	6,4	5,5
22	Norway	Fredrikstad	5,4	6,3	4,4	5,4
23	Denmark	Helsingør	4,8	5,7	5,3	5,3
24	Denmark	Roskilde	4,8	5,5	5,3	5,2
25	Denmark	Kolding	4,9	5,4	5,3	5,2
26	Norway	Stavanger	7,9	3,1	4,3	5,1
27	Norway	Sarpsborg	5,7	4,1	5,3	5,0
28	Norway	Asker	5,2	6,7	2,9	4,9
29	Norway	Skedsmo	4,6	4,4	4,7	4,6
30	Norway	Sandnes	5,7	2,1	4,4	4,1

Figure 28 - NBCI 2016 Score

Appendix B: Score Progression 2014 – 2016

NBCI 2014-2016 Score Progression

Rank	Country	Municipali	Services	Mobile	Fixed	Final Score
1	Denmark	København	-0,2	3,3	1,0	1,4
2	Denmark	Odense	-0,3	1,7	1,0	0,8
3	Norway	Bodø	-0,4	-0,2	0,1	-0,2
4	Norway	Skien	-1,1	0,1	0,8	-0,1
5	Norway	Trondheim	-1,0	1,9	0,4	0,4
6	Denmark	Frederiksberg	-1,1	1,9	1,0	0,6
7	Denmark	Aarhus	-0,6	2,0	1,0	0,8
8	Denmark	Viborg	-0,5	2,2	1,0	0,9
9	Norway	Bærum	-0,2	1,4	-0,0	0,4
10	Norway	Bergen	-1,0	1,1	0,0	0,0
11	Denmark	Vejle	0,2	1,1	1,7	1,0
12	Denmark	Horsens	-1,3	0,6	1,7	0,3
13	Denmark	Herning	-2,0	1,7	1,0	0,3
14	Norway	Oslo	-0,0	2,6	-1,5	0,3
15	Norway	Kristiansand	-3,6	0,5	0,4	-0,9
16	Denmark	Esbjerg	-2,3	1,6	1,0	0,1
17	Denmark	Randers	-1,6	1,4	1,0	0,3
18	Denmark	Silkeborg	-1,3	2,6	1,0	0,8
19	Denmark	Aalborg	0,6	1,5	1,0	1,0
20	Norway	Drammen	-1,0	1,1	-0,1	-0,0
21	Norway	Tromsø	-2,9	-0,2	0,7	-0,8
22	Norway	Fredrikstad	-1,1	1,6	1,4	0,6
23	Denmark	Helsingør	-1,1	1,3	1,0	0,4
24	Denmark	Roskilde	-1,2	0,8	1,0	0,2
25	Denmark	Kolding	-0,9	2,1	1,0	0,7
26	Norway	Stavanger	-0,6	-0,0	1,0	0,1
27	Norway	Sarpsborg	-1,5	1,3	1,7	0,5
28	Norway	Asker	-3,7	1,4	-1,1	-1,1
29	Norway	Skedsmo	-1,3	1,9	0,3	0,3
30	Norway	Sandnes	-2,3	-0,3	1,0	-0,6

Figure 29 - NBCI 2014-2016 Score Progression

Appendix C: Rank Progression 2014 – 2016

NBCI 2014-2016 Rank Progression

Country	Municipality	Rank 2014	Rank 2016	Rank Progression
Denmark	København	10	1	9
Denmark	Odense	12	2	10
Norway	Bodø	2	3	-1
Norway	Skien	4	4	0
Norway	Trondheim	7	5	2
Denmark	Frederiksberg	14	6	8
Denmark	Aarhus	18	7	11
Denmark	Viborg	20	8	12
Norway	Bærum	9	9	0
Norway	Bergen	6	10	-4
Denmark	Vejle	25	11	14
Denmark	Horsens	15	12	3
Denmark	Herning	13	13	0
Norway	Oslo	17	14	3
Norway	Kristiansand	1	15	-14
Denmark	Esbjerg	11	16	-5
Denmark	Randers	16	17	-1
Denmark	Silkeborg	23	18	5
Denmark	Aalborg	27	19	8
Norway	Drammen	8	20	-12
Norway	Tromsø	3	21	-18
Norway	Fredrikstad	24	22	2
Denmark	Helsingør	22	23	-1
Denmark	Roskilde	19	24	-5
Denmark	Kolding	29	25	4
Norway	Stavanger	21	26	-5
Norway	Sarpsborg	28	27	1
Norway	Asker	5	28	-23
Norway	Skedsmo	30	29	1
Norway	Sandnes	26	30	-4

Figure 30 - NBCI 2014-2016 Rank Progression

Appendix D: Questions to Construction Companies

1. What is the name of your company? Click here to enter text.
2. What is the name of the municipality you work with? Click here to enter text.

A. Mobile Infrastructure

3. Does the municipality you work with allow access to public grounds and buildings for mobile infrastructure such as antennas and masts?

   ☐ They do not allow such access
   ☐ They allow access only in rare instances
   ☐ They normally allow such access to some types of municipal buildings
   ☐ They normally allow such access to all municipal buildings
   ☐ Not sure
   ☐ Other – please comment: Click here to enter text.

4. How easy do you find it is to work with the municipality on a scale from 1-10? Click here to enter text.

5. How effective is the municipality in regards to getting applications approved?

   ☐ The municipality takes forever to get applications approved
   ☐ The municipality usually takes quite a while to get applications approved, but they try their best
   ☐ The municipality have short waits and a can do attitude
   ☐ Not sure
   ☐ Other – please comment: Click here to enter text.

6. Mobil masterplan – do you think the municipality have a plan or policy for the rollout of mobile infrastructure in the municipality?

   ☐ No, they do not
   ☐ Yes – the plan / strategy contains a spatial regulation for mobile purposes
   ☐ Yes – the plan / strategy contains guidelines for application, planning and rollout for mobile infrastructure
   ☐ Other – please comment: Click here to enter text.

B. Fixed Infrastructure

7. Does your municipality allow the use of microtrenching along public roads?

   ☐ Yes
   ☐ They are currently testing microtrenching
   ☐ They have not received any requests or applications for microtrenching
   ☐ No they do not allow microtrenching
   ☐ Other – please comment: Click here to enter text.

8. Telecom lines are sometimes deployed along telephony or electricity poles. What pole policy does the municipality have? (Check all that applies)

   ☐ They generally allow the deployment of new telecom poles
   ☐ They generally allow new lines in existing poles
   ☐ They generally do not allow the deployment of new telecom poles
   ☐ They generally do not allow new lines in existing poles
   ☐ Other – please comment: Click here to enter text.

9. When building new communications networks, it is often necessary to dig a trench along public roads. What are the requirements regarding trench depths along a suburban, low-traffic road where the annual average daily traffic is less than ca. 1 500?

   ☐ The distance from road surface to the top of the cable casing should be 39 cm or less
   ☐ The distance from road surface to the top of the cable casing should be between 40 cm and 59 cm
   ☐ The distance from road surface to the top of the cable casing should be 60 cm or higher
   ☐ Other – please comment: Click here to enter text.

10. When building new communications networks, it is often necessary to dig a trench across a public road. When crossing a suburban, low traffic road with a telecom trench, what are your requirements regarding *the width* of the road that needs to be resurfaced?

    ☐ They have no specific width requirements for resurfacing
    ☐ The area that needs to be resurfaced should in general be up to 1 meter wide on each side of the trench
    ☐ The area that needs to be resurfaced should in general be between 1 and 5 meters on each side of the trench

☐ The area that needs to be resurfaced should in general be more than 5 meters on each side of the trench
☐ Other – please comment: Click here to enter text.

11. If a telecom operator digs and resurfaces an area that is 8 meters wide and 6 meters long, what would the total municipal fees be in such a situation?

☐ The total fees would be: Click here to enter text.
☐ Other – please comment (or enclose a copy of the relevant price list for such services): Click here to enter text.

12. Does the municipality (or a company that the municipality partners with) maintain a system for digging information that is available to communications network operators? (For example Kgrav in Oslo)

☐ No
☐ Yes

Please comment on usage and completeness of information in the system: Click here to enter text.
Does the system have information about empty ducts? Click here to enter text.

13. Does the municipality (or a company that the municipality owns or partners with) deploy public ducts when a trench is opened along a public road? Er det kommunen som legger tomme rør til eget bruk?

☐ No
☐ Yes – sometimes
☐ Yes, always or almost always
☐ Other – please comment: Click here to enter text.

14. Does the municipality allow access to municipality-owned ducts or fiber to communications network operators?

Ducts:
☐ They do not allow access to ducts
☐ They sometimes allow access to ducts
☐ They always allow access when ducts are available

Fiber:
☐ They do not allow access to fiber
☐ They sometimes allow access to fiber
☐ They always allow access as long as there is fiber available
☐ Other – please comment: Click here to enter text.

15. If the municipality allows access to fiber/ducts to telecom operators, do they have similar terms and conditions (for similar services) to all operators?

☐ They do not rent access
☐ They have similar terms and conditions to all operators
☐ They have different terms and conditions to different operators
☐ Other – please comment: Click here to enter text.

16. Have you seen a change in working with the municipality over the past few years?

☐ I think the municipality has gotten better
☐ I do not believe there has been a change
☐ I think the municipality has gotten worse
☐ Other – please comment: Click here to enter text.

Appendix E: Digital Inclusion Questionnaire