Chapter 8
Business Ecosystem and Internet of Things (IoT): Learnings from an Experimental Ecosystem Approach in Norway

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Abstract Internet of Things (IoT) and artificial intelligence (AI) technologies support digitalization and innovative services and products, as well as more cost-efficient production processes. New technologies alone are, however, not sufficient to succeed with digital innovations; there are both organizational and commercial challenges that must be overcome and a high degree of uncertainty for the stakeholders involved. Telenor Group is an international mobile telecommunication operator in Scandinavia and Asia and drives digitalization through technologies and open innovation and ecosystems. One learning experience from working with digital innovations is the Start IoT ecosystem concept that Telenor established for research and experimentation in Norway. The Start IoT concept is based on open innovation in clusters of industrial companies, public actors, and small business entrepreneurs. In this paper, we first describe ongoing digitalization and IoT/AI trends; then, we introduce business model and ecosystem theories to make sense of the empirical data from the Norwegian experimental business ecosystem; and finally, we discuss how the Start IoT concept from Norway can be transferred to Asian business units.

Keywords Internet of Things · Open innovation · Ecosystem · Business model · Telenor

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1 Introduction

The wave of digitization sweeps over us and within a short time connection and interaction between things and objects will surpass the interaction between people. These are physical objects that process or monitor something and use wireless Internet to communicate, e.g., sensors in cars, boats, machines, houses, and buildings. IoT will contribute with increased values for many areas and industries by solving problems in a more innovative and productive manner or producing products and services in a more cost-effective manner. An explosive increase in the number of IoT devices is expected – some estimates say that there will be nearly 30 billion IoT units by 2020. According to the consulting firm Arthur D. Little (Arthur D. Little 2017), the Nordic countries are the world leaders within IoT partly because of the good 4G coverage. However, despite the positive envisioning of IoT, we still await the large growth. We suggest that this discussion is about the better IoT architecture, but even more the business models that enhance innovation and collaboration, and how the roles for mobile operators and other partners will emerge. Thus, this article asks: How does a mobile operator act in order to affect the evolution of a complex IoT ecosystem. This article kicks off with a review of systematic approaches to the evolution of IoT, continues with a description of IoT and artificial intelligence (AI) technology trends, and ends with a presentation and discussion of the emergence of a Norwegian IoT. The article is based on a single case study (Yin 2014) collected through discussions with the core ecosystem actors in workshops related to joint collaboration activities and projects during 2017, 2018, and 2019. Secondary data were gathered through studies of industry reports and market surveys. The discussion is consistent with the framework for mobile service ecosystem health (Iansiti and Levien 2004) and Moore's ecosystem development stages (1993); hence, transferability to similar ecosystems is made possible.

2 Business Models, Open Innovation, Ecosystem, and Triple Helix

A business model describes how one particular firm does business (Ritter and Lettl 2018). A review of the business model concept lead to five different perspectives on business models (Ritter and Lettl 2018): business model activities, business model logics, business models archetypes, business model elements, and business model alignment. These perspectives are complementary and offer a comprehensive understanding of organizations and their strategic options. Activities, logics, and elements represent concrete lower levels of aggregation, while archetypes and alignment represent an overall approach detailing the connection between parts. Osterwalder

(2004), Chesbrough and Rosenblom (2002), and Bouwman et al. (2008) relate their understanding of business models to activity and element perspectives (Ritter and Lettl 2018). The value chain is a specific logic for how value is created within one firm (Porter 1985). Despite the stickiness of the value chain concept, it has long been recognized that the telecommunication sector is not well illustrated by the linearity of a value chain. Instead, the nonlinear value network model has been suggested (Stabell and Fjellstad 1998). Value networks are including not only vendors in a value chain but also actors that are providing complementary products and services. The principle is relying on positive network externalities (Katz and Shapiro 1985; Shapiro and Varian 1999). A business model concept can include the value creating logic from both the value chain and network. Data-driven business models increase company output and productivity through increased customer insight and service improvements (Brownlow et al. 2015). Key activities are acquiring, processing/analyzing, and virtualizing data. New revenue streams stems from advertising, usage, and subscription, and barriers are big data personnel and data quality.

After a long history of doing innovations in a closed context, enterprises have learned that access to new product ideas and technologies from outside has been necessary for further growth and competitiveness. Open innovation relates to innovation processes where knowledge and innovation develop between different actors recruited from enterprises as well as publicly funded research environments (Nesse 2008). In the case of platform ecosystems, the insight from open innovation is highly applicable.

The concept of ecosystems reflects dynamics between roles and actors in the larger market. The ecosystem actors share customer and system focus and the potential technologies (Peltoniemi 2004). They both collaborate and compete in the development of a new product or service (Vargo and Lusch 2016, Moore 1993, Bouncken and Kraus 2013) and must balance the tension between common innovation development and ensuring their own financial return. The first requires openness, while the latter requires protection (Laursen and Salter 2014). Such an ecosystem can often consist of a core actor and several smaller players in the market. The core actor is often called "keystone" or platform leader (Vargo and Lusch 2016, Iansiti and Levien 2004b, Gawer and Cusumano 2014), while the smaller actors are called niche or complementary players (Hallingby and Do 2013). The keystone or the platform leader contributes to the ecosystem's health (Makinen and Dedehayir 2012) which can be measured by its degree of performance, robustness, and diversity (Iansiti and Levien 2004). Performance refers to financial performance for the ecosystems actors, e.g., return on investment capital or more subjective goals (Franco 2011). Robustness is the ecosystem's ability to survive major and unexpected changes (disruptions), while diversity refers to the ability to create new innovative niche products and services.

One important ecosystems approach that builds on the presence of one core actor is the platform ecosystem (Gawer and Cusumano 2002; Gawer 2014). Actor(s) in control of one technological platform offers the platform capabilities through open interfaces. This is the basis for innovation and delivery done by many other actors in the ecosystem. These actors integrate the platform into their software, applications, products, and services (Tiwana 2014; Gawer 2014). The platform enables innovation across the ecosystem and solutions adapt through opening their interfaces toward others (Gawer 2014). A platform with a more central role must also allow other roles to profit in order to maintain the sustainability of the ecosystem. Competition between the core platform and complementors can be mitigated with a collaborative governance model which motivates complementors to innovate to the best of the platform and the total ecosystem (Peltoniemi 2004; Gawer 2014). Thus, the evolution of an ecosystem does depend not only on easy observable business and technological relationships but also on other socioeconomic factors such as legitimation and feeling of community.

Furthermore, ecosystems are not static, but develop over time. According to Moore (1993), the ecosystem will develop through four distinct phases – birth (establishment), expansion, leadership, and self-renewal. A manager of a potential core platform who seeks to grow an ecosystem must cater to different aspects throughout these phases. The establishment phase is characterized by a lack of knowledge about the new technology and its possible applications. The focus of the platform owner is to define the value proposition for the customer and partners and find the best way to deliver the product together with the partners, e.g., by developing proof of concept/prototypes that show the technology used in different application areas, the so-called use cases. In addition, agreements with critical suppliers, customers, and distribution channels must be secured to protect the product from competing ideas. In this phase, it is more important to ensure cooperation and value co-creation and involvement among the roles and actors, rather than actively defeat competition (Bouncken and Kraus 2013). In the final phase, the self-renewal phase, the ecosystem must relate to emerging ecosystems and disruptive innovations due to changes in technology, regulation, and other macroeconomic conditions. In practice, it is challenging to carry out because they are related to processes that have to do with legitimization, institutionalization, trust building, and cooperation (Bergek et al. 2008a) (Ozcan and Santos 2015).

An ecosystem is a part of a larger context, and thus innovation and business development are interacting and dependent on factors beyond those described above (Ghanbari et al. 2017). For instance, standardization bodies, regulators, and policy makers are also included (Muegge 2011; Angraeni 2007). Concepts such as the triple helix model (Etzkowitz and Leydesdorff 2000) and technological innovation systems (Bergek et al. 2008b) describe how innovation was created in processes between three key sectors of society: business, government, and academia. The partnership creates a win-win solution for all parties – academia achieves financial support for student recruitment on new research programs, while industry secures a subsidized approach to valuable research results. In addition, the government ensures economic growth, advanced industries, and a competent workforce. According to Reve, the triple helix model is inadequate in order to foster regional innovation and economic growth (Reve 2017). He claims that there are five key stakeholder groups necessary to mobilize in such innovation ecosystems. In addition to academia, industry, and governments, there is a need for entrepreneurs starting new businesses and risky private investors who take the financial risk of the new businesses. These findings are based on a framework developed by MIT REAP program where the aim is to accelerate the number of successful start-ups by extra focus on entrepreneurs and risk capital in the different regions. In the framework, it is important that these start-ups are innovation driven and have global ambitions. This fits well with the Norwegian industrial context where studies show that during a 10-year period from 2003 to 2014, as much as 2 of 3 new full-time jobs come from new and young companies, not established companies (Reve 2017).

IoT is a complex technology and falls into the group of technologies that has been analyzed according to approaches such as platform ecosystems. The focus and challenges remain the same. Heini et al. (2018) suggest three necessary IoT ecosystem roles or archetypes: ideators, designers, and intermediators. The ideators articulate service needs, designers develop and deliver the service and the intermediators enable access to and control the platform. A similar approach is developed by Klein et al. (2017) and Saarikko et al. (2017): engagers, enablers, and enhancers. Engagers develop, integrate, and deliver IoT services; enablers develop technologies facilitating the engagers, while the enhancers utilize the service and solutions from engagers. Papers and Plfaum (Papert and Pflaum 2017) stress the importance of the solution integrators role in the ecosystem building the complete IoT service/solution and governing the relationship between the ecosystems members. The IoT platform should exhibit open interfaces in order to integrate a portfolio of smart products. This also co-aligns with the work of Leminen et al. (2018) who proposed platform business models as an emerging business model type with IoT often from dominator actors providing existing solutions from its partners to the customers through open interfaces and standards.

Obstacles for the introduction of IoT are previously identified (Markendahl 2017). Specific IoT solutions tend to be a small part of the overall solution and may be too small for a standalone business. However, if clustered together with a network of multiple devices in a connected environment that can be viewed as an entity with specific needs and tasks, the added value can differ substantially. This connected entity is most often controlled by one actor, e.g., the manufacturer or owner of a car, truck, home, or office facility. Moreover, the single IoT solutions have initially often been developed using a single firm business model, and in order to survive or grow, some kind of networked business model is needed. Dijkman et al. (2015) discuss business models specifically for IoT. The findings indicate that value proposition is the most important building block in the IoT business models, followed by customer relationships and key partnerships. Communities and co-creation are important with respect to customer relationships. Software developers, hardware partners, and data analysis partners are the most important ecosystem stakeholders to partner up with. Another study concludes that IoT research is mainly focusing on technology, that IoT business models are relatively unexplored, that data analytics may become an essential element of IoT services, and finally that open ecosystems may help companies to provide more integrated services and values to their customers (Ju et al. 2016).

Others propose an integrated 6C framework (Context, Cooperation, Construct, Configuration, Capability, and Change) to understand IoT-based business ecosystems (Rong et al. 2015). Their background is that the emergences of IoT technologies enable more and more businesses to be involved, creating a business ecosystem perspective instead of just a supply network. The authors argue that efficiency and innovation can be exploited to a higher extent in an IoT-driven ecosystem where openness of the platforms allows more and more business partners to connect with each other and create more value for end users.

In sum, it is safe to say that IoT is a technological concept that can be discussed as an ecosystem. IoT and its stakeholders are connected in both technological and social complex relationships. It is often observed and implied that one central platform will emerge in, for instance, an IoT ecosystem. However, the literature emphasizes the challenge of spurring all the other involved technologies and actors. The only way to address the value proposition of the user is to create value together. A more central actor, the platform, must cater to the other actors so that they invest their time and money both in innovation and operation. Indeed, open technological interfaces are important in this respect. Just as important are the sharing of knowledge and beliefs in business opportunities, building of trust, and legitimacy. Moreover, this is a process that happens over time going from a scarcely diffused solution to potential high, exponential growth. Finally, such evolution does not happen in isolation. From the earliest seed to the final implementation, the involvement of societal actors such as universities, regulators, and industries affects evolution.

3 Internet of Things and Artificial Intelligence

The concept of the Internet of Things arose in the late 1990s. The rapid development of communication technology, sensor technology, battery technology, and small powerful computers helped making IoT possible. The Internet of Things is about smart things and devices that automatically generate information or can be monitored and managed over the Internet. Many things can be smart when they are equipped with sensors (which measure temperature, position, pressure etc.), processes (which make calculations on the measurements from the sensors), network connection (which makes it possible to transfer data from the sensor), storage device (which stores the measurement data), and finally batteries that have the energy to carry out and send the measurements (Teknologirådet 2015).

There are various network technologies available for wireless communication from devices and sensors, e.g., Wi-Fi, Bluetooth, ZigBee, mobile 2G/3G/4G, and several different LPWAN (low-power wide-area network) technologies, using licensed or unlicensed spectrum. NB-IoT/Cat-M1 (narrow band IoT) is a mobile network technology designed to connect large amounts of sensors and items online, where the thing sends small amounts of data and has the least battery-consuming use of network connections, such as parking sensor buried in the asphalt, water measurement, mailbox notification, smart locks, and air sensors. The two technologies are complementary to each other and address different types of use cases. NB-IoT fits well for use cases that do not acquire massive data transmissions capabilities such as utility meters and smart building sensors, while typical use cases for Cat-M1 include wearable devices, trackers, and connected vehicles allowing greater data rates, lower latency, and more accurate device positioning.

With access to data from billions of physical things or devices located almost everywhere, there will be a challenge in analyzing all these data points. However, this can be remedied using techniques for artificial intelligence (AI) where computers can be trained to do complex tasks (Mc Afee and Brynjolfsson 2017). Machine learning and deep learning are building blocks in artificial intelligence that enables the computer itself to extract experience from large amounts of data and make choices based on this knowledge. In this way, the computer can independently develop analysis models and look for traces of large amounts of data, without being told exactly what to look for, such as pattern and language recognition. Since large amounts of data interact between many IoT things or devices, it can make information security vulnerable to hacking and security breaches. Data containing sensitive personal information and stored in the cloud across borders must be protected by legal restrictions. It is, therefore, necessary to develop secure mechanisms for encryption of access control for things online.

4 IoT Experimental Ecosystem in Norway

In the IoT context, the telecommunication company Telenor has taken action to spur its diffusion and growth. This has mainly been done along two paths. First, Telenor has engaged with the IoT innovation system, facilitating the development of a new ecosystem for research and experimentation. Second, Telenor has facilitated an experimental IoT ecosystem, involving commercial development within the IoT in Norway. Figure 8.1 describes actors in the experiment- and research-based IoT ecosystem that Telenor cooperates together with partners in three regions in Norway: the Trondheim region (Mid Norway), the Oslo region (South-East Norway), and the Tromsø region (Northern Norway).

The innovation system has had its center in the mid-Norway region, where two research laboratories have been established, an AI lab in the spring of 2017 and the IoT ProtoLab in the spring of 2018, both as a result of cooperation with Telenor and the Norwegian Scientific and Technical University (NTNU) in Trondheim. Telenor sponsors the open national AI lab over 5 years for research and innovation programs on artificial intelligence and advanced analysis methods. In the summer of 2018, the lab was reinforced with participation from large national enterprises such as Equinor, DNB, DNV, Kongsberg group, and Digital Norway. In the autumn of 2018, the third inspirational day at the AI lab was carried out where companies and other stakeholders “pitched” their ideas for NTNU’s academic environment and students for further analyses in master’s /doctoral theses or research projects. Telenor also participates in the newly established EU forum “AI for Europe” where the purpose is to promote Europe’s competitiveness in research and development within AI and

Fig. 8.1 Telenor experiment-based IoT ecosystem partners in Norway

its impact on business and society. NTNU currently has over 100 employees who research and teach within IoT and AI.

The experimental IoT ecosystem has centered around a IoT ProtoLab which is open to students and start-ups who want to develop and test prototypes using next-generation low-cost IoT technologies. It may apply to the communication quality of the sensors, or the actual certification of the physical product. Here, they can also connect to an LPWAN test network in Trondheim area. The lab is co-located with the incubator FAKTRY just off NTNU campus in central Trondheim. 20 IoT-based start-up companies are affiliated with FAKTRY. BRIKS is one of the start-ups helping the fertility clinic Medicus in their development of a new method of monitoring critical infrastructure during transport using IoT and sensors. Smart Cylinders is another start-up that offers an IoT-based service for gas suppliers and restaurants. Sensors measure the contents of the gas cylinders and notify them before they have to be replaced. In this way, the logistics can be much better for both customer and supplier. Wireless Trondheim is responsible for the setup and daily operation of the IoT ProtoLab. Telenor funds partly the IoT lab's equipment and activities, and in November 2018, the country's first NB-IoT hackathon was arranged. Here, the team was monitoring air quality inside and outside, and 35 students from different study programs at NTNU participated in the hackathon. Using Telenor's dedicated IoT network in Norway (NB-IoT/Cat-M1), development platform, and "state-of-the-art" development tools, the students developed various IoT solutions for better indoor and outdoor air quality. Digital Norway, which is a cross-industry initiative aiming to speed up the digitization of small- and medium-sized companies in Norway, was one of the organizers together with Telenor, NTNU, and Wireless Trondheim. Telenor is one of the 15 member companies in Digital Norway.

In the Oslo region, Telenor collaborates with the incubator StartupLab at the Research Park in Oslo (Mathisen 2017). Telenor has sponsored selected business ideas through an IoT accelerator program. In total, we find roughly 100 technology-based start-ups that are affiliated with the incubator, and in 2018, a hardware and IoT lab was established at the StartupLab. Telenor in Norway has also established a commercial IoT portfolio where they offer network and solutions in collaboration with partners from different industries to customers in corporate markets, e.g., aquaculture, transport and logistics, cities and buildings, and health and care (TelenorNorge 2018). In total, Telenor had by 2018 approximately 80% revenue market share of a total of 1.7 million M2M (Machine to Machine) subscriptions in Norway by 2018 connected to the mobile network in Norway and about 13 million globally. Recently, Telenor offered the commercial NB-IoT network providing more power efficient and better coverage than conventional 4G for buried and inaccessible sensors.

To lower the threshold for IoT innovations, Telenor is offering an IoT start-up package free of charge, including a hardware and software tool box targeting developers, students, and start-up companies (TelenorStartIoT 2018). This offering is managed from the Tromsø region. The package includes free use of Telenor's development platform MIC (Managed IoT Cloud) which is built on top of Amazon Web Service IoT capabilities. MIC handles the basic functionality that most LPWAN IoT services need and provides a dashboard editor with clicks and drags widget functionality. Moreover, the package includes a temperature sensor and a humidity sensor on a breakout board easily connected to the main device. The start-up package aims at being network connectivity agnostic within the LPWAN segment. Today, over 200 developers, students, small-, and medium-sized enterprises are registered users of the start-up package using the LoRaWAN test network facilities. When the offering is re-launched in 2019, the Start IoT start-up package will include free use of the NB-IoT/Cat-M1 network in addition to the deployed LoRaWAN networks in Tromsø, Trondheim, and Oslo regions. The start-ups can choose between three development kits, and they will receive up to four IoT on 4G-enabled SIM cards for 12 months given that they do not exceed 50 Mbyte IoT on 4G traffic. After 12 months or when the quota is reached, the start-ups may be contacted by Telenor for a commercial offering. By ordering a Start IoT devkit the start-ups become part of the Start IoT community and may benefit from knowledge and ideas shared by other IoT developers. Start IoT tutorials have been compiled and curated by our community of IoT developers into learning modules arranged by easy, medium, or advanced levels of complexity. Tutorials, discussion forum, and the possibility to publish showcases at an open website are the basis of the self-driven IoT community. As a service in return for the start-up package, Telenor gets user insights on basic IoT challenges and how initiatives like Start IoT may help start-ups and developers. Several use cases and "proof of concepts" for various areas of application have been created, e.g., monitoring of avalanche-exposed areas on Svalbard and air quality in Tromsø city, or even monitoring of plants and vegetables in greenhouses (TelenorStartIoT 2018). This is done in close collaboration with the University of Tromsø and Flow, a co-working for innovation and entrepreneurship.

5 Discussion

The innovation system for IoT that we see being established in Norway has similarities with the triple helix model (Etzkowitz and Leydesdorff 2000) in which business, academia, and the public sector cooperate in partnership. In mid-Norway region, Telenor, NTNU, and Wireless Trondheim and Trondheim municipality have entered into agreements that regulate the collaboration between these main actors. In the Oslo and Tromsø regions, cooperation with the start-up lab at the University of Oslo and the University of Tromsø is central. This initiative has been regarded as a success, mainly indicated by the recent participation by other large Norwegian enterprises. Partnering with Trondheim municipality is highly relevant since digitalization of municipalities through IoT, AI, big data, and 5G is expected to make the delivery of services and execution of tasks the coming years more efficient. According to a study by the consulting firm Menon Economics, the potential for savings from digitalization of Norwegian municipalities is estimated to 100 billion NOK from 2017 to 2028 (Mellbye and Gierløff 2018). The estimates are conservative and based on accounting data from the municipalities. The average municipality can save between 250 and 600 million NOK during the next 10 years, mostly within the health and care sector followed by education and social welfare, property management, and technical areas such as water and waste water management, etc. In the experimental IoT ecosystem, the IoT offerings in the three regions are characterized by open innovation (Nesse 2008) with experimental IoT and AI lab phases where students, entrepreneurs, start-up companies, and established businesses can openly experiment with their ideas. Furthermore, we see that IoT start-up package offering and IoT ProtoLabs in Trondheim and Oslo have many of the same characteristics that we find among global players such as Telefonica/Huawei and Ericsson. The IoT activities are largely research based, with a focus on experimenting with various solutions in different application areas, such as the free-of-charge access to development tools and IoT networks offered by the start-up package. IoT hackathons where students and start-up companies prototype various applications are also useful in increasing the pace of innovation together with UX workshops bringing together more experienced users to collect their impressions on Start IoT offerings (Raatikainen et al. 2013).

Telenor can be considered as keystone or intermediator in this experimental IoT providing the core technology (Iansiti and Levien 2004b, Gawer and Cusumano 2014, Heini et al. 2018; see Table 8.1). Telenors IoT development platform, LPWAN and NB IoT/LM-CAT 1 network together with the IoT development toolbox are key resources for linking developers, customers and other niche players in the ecosystem. The MIC development platform is cloud-based agnostic with respect to networking technologies enabling niche players or complementors to experiment with applications and service prototypes. The IoT ProtoLab offers the opportunities for such prototyping testing and debugging of these energy efficient sensor nodes free of charge and at a low risk of failure due to assistance of competent lab engineers. Here pick and place machines, battery drain and power analysis, antenna testing and electromagnetic interference, and capability testing along with 3D printing and prototype circuit board (PCB) printing facilities are available for the start-ups. Although this experimental ecosystem is mainly focused on testing and prototyping, the context of universities and a wider innovation system supports its further diffusion. This co-aligns with other findings that IoT drives for business ecosystems with openness of platforms and standards allowing more and more business partners to connect with each other and create more integrated and value-added services for customers (Rong et al. 2015) (Leminen et al. 2018). Data-driven business models enabled through analytics of data gathered from the different devices and sensors are seen as essential element of future IoT services (Ju et al. 2016). Software developers, hardware partners, and data analysis partners are here suggested as the most important ecosystem stakeholders to partner up with (Dijkman et al. 2015).

Table 8.1 Open platform IoT ecosystem elements

Elements	Platform ecosystem	Start IoT ecosystem Norway
Technology architecture	Core platform and complementing technologies	Open cloud-based IoT platform with agnostic network technologies
Roles	Core actor(s) control platform together with complementors	Telenor is keystone together with university complementors from industry actors
Business logic	Important to kick-off positive self-reinforcing effects	Low-risk IoT development on free-of-charge experimental platform
Delivery	Comprehensive solution delivered to users from interdependent actors	Solution deployed from complementors through platform and network
Innovation	Open interfaces motivate complementors to innovate on platform	Open IoT ProtoLab and AI lab and IoT start-up package/portal for academia and start-ups
Business models	Revenue sharing between actors to ensure ecosystem sustainability	Experimental proof of concepts free of charge. Platform- and data-driven business models
Competition	Competition between platform and niches hinders ecosystem growth	Low competition due to IPR to complementors. Trustful community feeling
Governance	Platform governs ecosystem innovation and reduces competition	Proof of concept developed and tested on IoT platform jointly by complementors

Considering the health of the experimental IoT ecosystem in terms of performance, robustness, and innovation, it is in an early phase and challenging to measure. However, the cooperation agreements between Telenor and the universities indicate that the trust so far between the main players is good (Bergek et al. 2008a) (Franco 2011). Regarding the ecosystem's robustness, which is linked to the ecosystem's ability to survive large and unexpected technical changes (disruptions), it seems strong. According to an overview from the GSMA, the majority of the 66 mobile commercial IoT networks launched worldwide so far is the NB-IoT network (GSMA 2017). Telefonica and Huawei established their first joint NB-IoT lab in 2017 providing access for start-ups to their R&D facilities, resources, and know-how (Telefonica 2017). Ericsson provides a similar offering for developers within the smart cities, transport, and production verticals. However, the portfolio of new commercial IoT products and services within different application areas is currently limited. Despite the low degree of engagement so far, this does not discourage the continued belief in building and spurring the focus further. Establishing ecosystems around technology-based platform innovations (Gawer and Cusumano, Industry platforms and ecosystem innovation 2014) is challenging, including the fear of "free-riding," meaning that some are disproportionately low in investment compared to what they receive (Foros et al. 2009). Therefore, it is important that the core players in the coming ecosystem phases continue to invite openness about innovation and add business models that ensure profit sharing between platform owners and the other players in order to secure a sustainable ecosystem (Hanseth and Lyytinen 2010). Today, costs for proof of concept development are free of charge for the start-ups in the experimental IoT ecosystem. However, in a commercial context, different business models should be assessed. Continuing the role as a platform leader with their managed IoT cloud (MIC) development platform, Telenor could make use of the two-sided model, facilitating interaction between complementors and customer groups. However, if the ecosystem shall continue to be healthy, legitimation and fair distribution of cost and revenues among the actors are necessary. This is challenging, but possible thanks to the trust, feeling of community among the ecosystem actors from collaboration in an experimental context (Gawer and Phillips 2013). Applying this governance structure in a networked type of business model should also be assessed going beyond the focus of the gains of the single actor (Markendahl et al. 2017).

Telenor Group is an international mobile telecommunication operator with subsidiaries in four different countries in Scandinavia and five different countries in Asia – Pakistan, Bangladesh, Malaysia, Myanmar, and Thailand. If Telenor were to transfer the Start IoT concept to the Asian markets, the objectives would be similar to the ones in the Norwegian market – to build active IoT developer communities around Telenor platforms and services and ecosystem partners, to test and demonstrate IoT technology architecture and customer journeys, and to improve IoT proof of concepts in pilots and consequently scale up and operate commercial offerings (see Fig. 8.2) (TelenorStartIoT 2018).

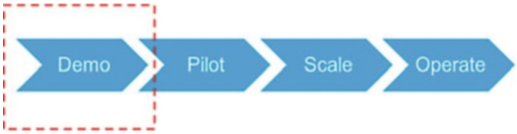

Fig. 8.2 Start IoT experimental ecosystem concept supporting commercial operations

The ways Asian business units (BUs) can demonstrate and make use of the Start IoT experimental concept are at least twofold: They can use the setup in Norway with the development portal, MIC instance, tutorials, customer journeys, and community building procedures in addition to support from Telenor Group experts. Alternatively, they can copy the concept and execute a local setup tailored to network and local market with additional support from Telenor Group.

The Start IoT concept is previously characterized as being a regional innovation system, i.e., the triple helix approach (Etzkowitz and Leydesdorff 2000). This approach refers to innovations occurring in a certain geographical context where local factors and actors such as universities, industry, and governmental policies influence the innovation ability and speed for the commercial actors (Asheim and Coenen 2005). The expanded triple helix will also include start-ups and private investors (Reve 2017). In this regional context, innovations are viewed as localized depending on the technological infrastructure, ecosystem, and market characteristics. Locally, there would be major challenges in executing the innovation system elsewhere. Transferring the Start IoT concept to Asian BUs will imply that Telenor Group should look for ways to facilitate for local needs and challenges that have to be resolved. This would most often be related to business and customer use cases; the presence of knowledge and scientific excellence; degree of co-creation between local start-ups, partners, and governmental organizations; as well digitalization, IoT, and AI maturity. Several of these factors may differ from what we find in Norway; hence, a setup flavoring the local characteristics should be analyzed going forward experimenting the Start IoT concept in the Asian BUs.

6 Conclusion

The Internet of Things and artificial intelligence are two key technologies that influence much of the way products and services are developed and business created. We raised the question of how a mobile operator acts in order to affect the evolution of a complex IoT ecosystem and provided insight from the Norwegian market. In Norway, Telenor has taken a central role in the evolution of IoT and has chosen two paths to build the future ecosystem. First, Telenor has a key role in the ecosystem in close cooperation with research and educational institutions in several regions in Norway within AI and IoT. Second, it has been a driving force in a Norwegian experimental ecosystem for the Internet of Things in an early start-up phase.

Successful transfer of the Start IoT concept to Asian BUs implies adaption to local needs, ecosystem partners, and infrastructures. Follow-up analyses will be needed to assess the implementation of the next phases of the IoT ecosystem development and the factors that enabled this development. Moreover, surveys and in-depth studies from Telenor Group's Asia BUs should be executed adding the different local needs and requirements for transferring the Norwegian regional innovations system to these markets.

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