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Using Scenario-based Business Modelling to Explore the 5G Telecommunication Market

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Abstract

Innovative technologies often alter established value chains and make traditional strategic planning methods inadequate. In this paper, we present the use of scenario-based business modelling to explore the market for the fifth generation mobile communication networks (5G). We discuss four scenarios that have been developed in a collaborative effort among different actors in the market. We then describe the approach to build business models and discuss lessons learned and benefits from the novel approach. This approach complements traditional techniques through providing a powerful platform to integrate multi-dimensional change, from technology, regulation, value-chain dynamics, and value proposition evolution. We further conclude that the approach is particularly valuable in environments that are characterized by a high level of uncertainty and complexity.

Keywords: Scenario Planning, Business Modeling, Value Networks, Anticipatory Action Learning, 5G.

Introduction

The next generation of the wireless network technologies known as 5G will be the major evolution phase in the provisioning of mobile broadband services being deployed around 2020. 5G will disrupt the mobile telecommunications industry by opening the market to new entrants that are especially expected to emerge in indoor small cells to provide mobile broadband services (Pujol, Elayoubi, Markendahl & Salahaldin, 2016). 5G networks will become a substantial part of today's mobile network operators' (MNOs) heterogeneous networks of 2G, 3G, 4G, and Wi-Fi technologies (Moore, Sanches & Boman, 2014). 5G will expand the traditional mobile business ecosystem to meet vertical sector-specific requirements in a world where everything is digital, smart, and hyper-connected (5GPPP, 2016).

As claimed in Ahokangas, Matinmikko, Yrjölä and Okkonen (2013), to capture and understand the consequences of a mobile market change for MNOs, three domains of change need to be taken into account: regulatory, technology, and business. Regulation plays a key role by defining who is allowed to enter the market through spectrum licensing and by creating conditions that directly influence the possible business opportunities. From the technology perspective, 5G promises to provide innovations that increase sharing of spectrum and network infrastructure and creating a sharing economy within wireless communications (Andrews, Buzzi, Choi, Hanly, Lozano, Soong & Zhang, 2014; Yrjölä, Matinmikko, Ahokangas & Mustonen, 2016). The business perspective is specifically related to the nature of opportunities through alternative future scenarios, value networks, and ecosystems that are strongly influenced by regulatory and technological developments. To take advantage of the business ecosystems' opportunities, a business should be able to develop an understanding of the entire system, reinvent itself, and absorb various resources for future purposes (Kandiah & Gossain, 1998). The innovative 5G business models are expected to be centred on creating and capturing value through multi-partnership within the collaborative value ecosystem (Hamari, Sjöklint & Ukkonen, 2013).

To survive in an emerging new ecosystem and market of tomorrow, companies need to constantly envision the future value and the upcoming transformations by sharing their visions with other actors and collaboratively shape the future (Moore, 1993; Rohrbeck, Battistella & Huizingh, 2015). To make sense of 5G's volatile, uncertain, complex, and ambiguous future, research on alternative 5G future scenarios becomes a necessity to form robust and agile strategies.

In this paper we apply an anticipatory action learning–based (AAL) research approach. We facilitate the creation of scenarios and moderate the subsequent development of ecosystemic business models to explore the future market that is created on the basis of 5G technologies. This research seeks to respond to two major questions:

1. How to explore future 5G business models through scenarios?
2. Why can scenario-based business modelling enhance the ability of a network of actors to jointly explore future market?

In the article, we first, in section 2, introduce the theoretical basis and rationale of applying scenarios in organizations for investigating new businesses. Moreover, we define business ecosystem and business models. In section 3, we introduce our novel approach to scenario-based business modelling. Section 4 describes the resulting scenarios and business models within the 5G ecosystem. Section 5 concludes the paper by presenting the benefits of our novel approach and its contribution to the research field.

Why Use Scenario-Based Approaches for Business Modelling?

Challenges of exploring uncertain and complex new business fields

Many industries have seen a shift from an industry-driven economy to the knowledge-based

economy, which has led to a steep increase of environmental uncertainty and complexity. In addition, science and technology have become the key drivers of rapid, complex, and pervasive change. Consequently, exploring new business fields or developing new products has become increasingly challenging and novel approaches suitable in such environments are needed for strategy formation and prospective innovation management (Ruff, 2015; Peter & Jarratt, 2015). Reduction of product-life cycles have led to the need to develop methods that permit to anticipate systematic changes and translate them into organizational responses in the field of strategic and innovation management (Hines & Gold, 2015; Rohrbeck & Gemünden, 2011).

Exploring new business fields is a challenging task because it requires the integration of various interdependent perspectives including customer satisfaction, technological potential, competitor reaction, as well as active stakeholder involvement (Heger & Rohrbeck, 2012). Additionally, development of a new business field occurs when a gap between current competencies and future competition is realized and resolved. The dynamic interrelation between technological competencies and strategy indicates that a firm's strategic vision should be dynamic as well (Vanhaverbeke & Peeters, 2005). As a result, technological discontinuity should be explored to avoid future shock, and foresighting is a way of seizing the opportunities, detecting and coping with problems, and it helps create a timely response to disruptions (Battistella, 2014). Scenario planning, in particular, enables the anticipation of less predictable future, which is a major characteristic of rare and impactful events like the swift diffusion of radical innovations (Wright & Goodwin, 2009; Ringland, 2010).

Scenario Planning and Organizational Learning

Scenario planning grew its roots in the late 1940s when Herman Kahn discussed the concept of "thinking the unthinkable". Integrating the comprehensive analyses with imagination leads to creating future-oriented stories called "scenarios" (Bradfield, Wright, Burt, Cairns & Van Der Heijden, 2005; Chermack, Lynham & Ruona, 2001). The investigation of how organizations learn penetrated into academia in the late 1950s (Huber, 1991). Organizational learning was defined as a process of altering mental models (i.e., representations and assumptions about how the world works) and processes as well as enhancing the performance of the organization (Schoemaker, Day & Snyder, 2013). It is argued that learning will emerge when knowledge is rendered into recurring behaviour and when the mental models and world experiences mutually adapt and integrate into each other (Argyris & Schön, 1974; Piaget, 1997).

The process of scenario thinking fosters the organizational learning loop where sharing ideas regarding the emerging trends, building consensus, planning, and acting take place collectively. Double-loop learning, which is the outcome of a shared organizational mental model, creates opportunities and provides potential solutions by reframing the problem faced in a discontinuous development (Godet & Roubelat, 1996; Van der Heijden, 1996). Scenario planning engages in mapping mental models, questioning mental models (i.e. norms and assumptions), and enhancing mental models (Chermack, Lynham, & van der Merwe, 2006). Through causality the old mental models and the new reality will integrate and create a new theory which can be tested and developed by reflecting on the consequences of action. Scenario planning enables re-perceiving the reality, and it leads to new and experiential learning (Wack, 1985).

Using the Futures Literacy Hybrid Strategic Scenario method, Rhisiart, Miller and Brooks (2015) identified that two types of learning will establish through the scenario thinking process: (1) sensemaking (i.e., generating shared and explicit meanings) and (2) anticipation (i.e., understanding the theory and practice of foresight). Bootz (2010) differentiated between learning at the individual level (i.e., "foresight attitudes") which is in the cognitive domain and learning at the organizational level (i.e., "foresight activity") which demonstrates the interactive and participatory type of learning within the organizations. Based on this theoretical relationship and shared characteristics and

goals we conclude that one of the fundamental values of scenario planning / thinking is generating profound and efficient organizational learning.

Business Ecosystems and Business Model Concepts

When discussing ecosystems, different types of ecosystems can be identified: biological, industrial, social, and digital business (Galateanu & Avasilcai, 2013). Moore (1993) introduced organic *business ecosystems*, focusing on business relationships and strategies. Moore (2006) stated that there are parallels with business and natural ecosystems where both are partly intentionally formed and are partly a result of accidental emergence, and they are characterized by high complexity, interdependency, cooperation, competition, and coevolution in pursuit of new innovations (Iansiti & Richards, 2006). In such environments it is key to integrate the analysis of the change drivers with mapping existing and new market participants.

As an emerging field, 5G business models have only been discussed to a limited extent in the literature. Zhang, Cheng, Gamage, Zhang, Mark and Shen (2015) discussed the cloud-assisted business model; Noll and Chowdhury (2011) introduced collaborative business models and Rasheed, Rodriguez, Kibilda, Piesiewicz, Verikoukis, Gregorio, Gregorio and Moreira (2015) applied the brokerage business model in the 5G context. However, existing studies do not specifically outline the impact of alternative future scenarios for 5G. Therefore, more research is needed regarding the possible business models in 5G as we are approaching its commercialization.

Business models are tools that are embedded in and can contextually be formed by technological innovation (Teece, 2010). A 'business model', as a mechanism for planning and implementing strategy, enables the consideration of multiple options on an uncertain and rapidly changing environment (Casadesus-Masanell & Ricart, 2010). In the discovery-driven approach to business models, which aims at detecting and exploiting new models, the role of learning and experimenting is significantly powerful. In a complex and turbulent environment, strategies require insightfulness and instant experimentation and evolutionary learning to be effective (McGrath, 2010). For example, Ahokangas and Myllykoski (2014) discussed visioning, strategizing, practicing, and assessing as parallel learning processes related to learning in business model creation and transformation. Therefore, business models that are empowered by learning can be considered to have the potential to be more sustainable and effective.

The notion of using a business model as a value creation (i.e., value proposition; e.g., product innovation) and a value capture (i.e., profit potential, revenue logic/model) construct has been addressed in the majority of related literature (Shafer, Smith, & Linder, 2005; Zott & Amit, 2011). The 4C model (i.e. connection, content, context, and commerce) (Figure 1) as a taxonomy of business models was presented by Wirtz, Schilke and Ullrich, (2010) and helps to clarify the value creation and capture processes in the Web 2.0 context. Yrjölä, Matinmikko, Ahokangas and Mustonen, (2016) extended the taxonomy to 5G context and saw the four business models as a layered construct. The upper layers are being supported and enabled by lower layers. From an individual company's perspective, the 4C model can be practiced on single or any combination of layers. From the ecosystemic perspective the four layers help form a coherent logic of how different businesses in an ecosystem are interrelated (see section 4 for a detailed explanation of the model).

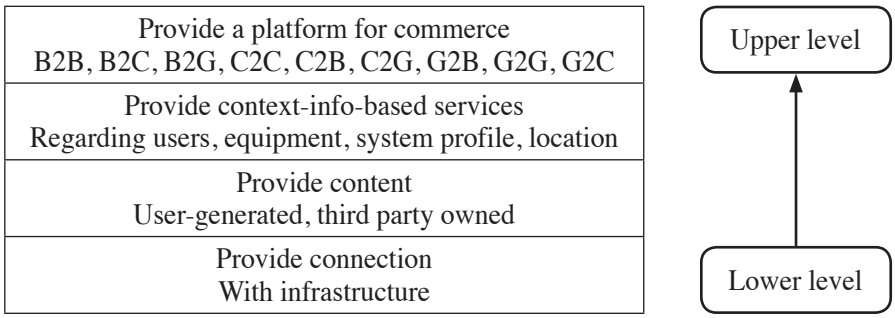

Figure 1. The 4C Business Model in 5G context (modified from Wirtz, Schilke & Ullrich, 2010 and Yrjölä, Matinmikko, Ahokangas & Mustonen, 2016)

Methodology

Research strategy: proposing and applying a new approach

In this research, we test a novel methodology for exploring new business fields that are both complex and uncertain and report on its benefits. The guiding framework for our approach is the anticipatory action learning (AAL) method which attempts to facilitate learning in a social system (Stevenson, 2006). AAL is a democratic visioning process that connects inquiry, anticipation, and learning with action, assessment, and decision-making (Inayatullah, 2005; 2006). The method aims to make multiple levels of understanding merge openly and progressively during the process. AAL underlines the pluralistic reciprocal adjustment of foresight exercises and reflects the exploration of alternative futures (Stevenson, 2002). Both action research and action learning underline the necessity of experimenting, reflecting, and learning (Roth & Bradbury, 2008). The participatory approach is beneficial for visionary workshops to create innovative ideas through conceptual models (i.e., structured intellectual procedures).

Sensemaking (Figure 2) through reflection and the analysis of the consequences of an action leads to the improvement of individual and collective learning. Concerning the action function of scenario process, scenario thinking empowers the organization to apply its understanding into practice and reduces the obstructive effect of mental fragmentation and incoherent models. Moreover, it associates the possible futures with the existing contextual environment and their subsequent impact on the organization (Van der Heijden, 1996). In consequence, we expect that the AAL method provides strategists with insights into plausible futures and is helpful in planning, decision-making, and eventually shaping the future. This exploration of the future is crucial to build a platform for anticipation (i.e., preparing one or more organizations to develop a future market). More specifically, we expect that using the scenario planning insights to trigger business model generation will trigger business model innovation and lay the foundation for new business ecosystems.

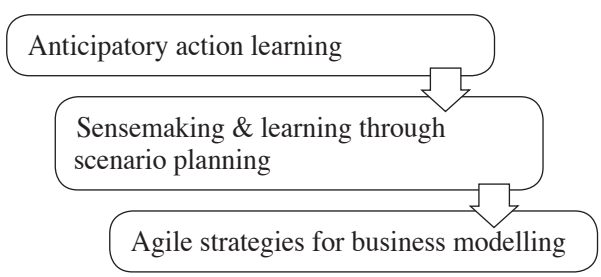

Figure 2. The research process

Research Design

Case setting

The 5G technology is expected to radically change the business landscape of the mobile communications industry, to trigger changes in the regulatory environment and alter the rules of the game in the established markets. 5G is expected to introduce elements of the sharing economy, change the roles and ways of doing business for the incumbent network operators, and open up business opportunities for new entrants. The new 5G networks will accommodate a wide range of advanced use cases with novel requirements, especially in terms of latency, resilience, coverage, and data-transfer rates (5GPPP).

For consumers, 5G promises universal availability of instantaneous communications, a high level of guaranteed quality of service (QoS) in indoor small cells environments, and at a cost levels appropriate for meeting customers' expectations. It opens up new business opportunities by providing end-to-end network slices from the cloud to fulfil specific vertical requirements and mobile broadband services in parallel (5GPPP). This is expected to result in a transition from a market that is dominated by large Telco operators / MNOs towards a market supplied by a heterogeneous set of providers with service offerings that respond to the versatile requirements arising from different verticals such as industry 4.0. Thus, 5G is an appropriate and particularly interesting environment to study business fields' exploration in complex and uncertain environments.

Research Sequence

As a first step we used the scenario planning workshop that brought different experts together to discuss different prospections related to the context of 5G from technology, business, and regulation perspectives. We selected the participants through an interview to ensure a comprehensive set of relevant knowledge and experience. Participants were recruited from different value network participants of the wireless communications ecosystem (see Table 1). The 18 participants were organized into four groups that consisted of academic organizations and firms.

Table 1. *Project participants and working group composition*

Groups	*A*	*B*	*C*	*D*
Participating companies	Huawei	CWC	OBS	Ericsson
	Ericsson	Bittium	CWC	CWC
	Nokia	OBS[2)]	CWC	BO[3)]
	CWC[1)]	Nokia	Nokia	Nokia
	CWC		Nokia	

[1)] Faculty of Information Technology and Electrical Engineering
[2)] Business School
[3)] Municipal organization

The participants were guided to build four alternative and plausible future scenarios for the development of 5G markets. The scenario process was exploratory, aiming at learning, igniting awareness, inspiring creativity, and examining the social interaction. The scenarios were set in a three to five year timeframe, which is embedded in the rapidly changing mobile telecommunications industry.

Scenario Planning Approach and Process

Our approach to scenario planning is prospective. Due to the context and principle of the problem that we are coping with, it is not possible to consider only one dimension for understanding and analysing it. Therefore, a multidisciplinary approach of systems thinking and systemic analysis is required to capture the totality of reality with all of its variables and their interrelations regardless of their type. Integrating systems thinking and scenario planning brings about plausible scenarios as the causal relationship between factors can be exhibited (De Jouvenel, 2000).

For process planning, we applied the approach that typically used by Shell (2008) and Meinert (2014) and it consists of six steps. At the starting point, the case of the scenario was created; the participants gained understanding about the objectives and the time horizon of the scenarios (step 1: approaching the topic and time horizon). The objective was to explore what kind of impact 5G might have on the wireless business ecosystem stakeholders within the next 3-5 years by creating alternative future business scenarios. Then, we started from questioning the present to identify the trends, variables, and drivers of change that will shape the future of the scenario topic. We then selected the critical variables among those that had great impact and low predictability or unknown consequences on the focal issue since they are the driving forces that lead to disruption (step 2: determining critical uncertainties). Next, the relationship and interconnectedness of the variables was analysed to formulate the possible development outcomes (step 3: creating alternatives). After that, using a cross-impact matrix, we aligned the variables and studied the existence and strength of their causal links. We identified the possible alternative ends (i.e. projection) of the created themes (i.e. drivers) to create a system for navigating the future of the scenario topic (step 4: calibrating a future compass).

Table 2 shows the four distinct scenario matrices that were built based on the identified variables and generic envisioned features of future telecommunications industry. The vertical and horizontal axes of a scenario matrix denote the dimensions and each dimension includes two ends that characterize the alternative approaches within that dimension. The dimensions were assessed to be independent of each other.

Table 2. *Four scenario matrixes and their building blocks*

Matrixes axes		End 1	Dimensions	End 2
Scenario Matrix 1	Vertical axis	Capability to create Quality of Experience (QoE)	User experience	No QoE is required/ expected
	Horizontal axis	One player defined	Distribution channel selection	All players can define
Scenario Matrix 2	Vertical axis	Horizontally defined requirements	Technology	Vertically defined requirements
	Horizontal axis	Static	Operator role	Dynamic
Scenario Matrix 3	Vertical axis	Streaming (entertainment)	Development drive	Internet of Things (IoT) (utility)
	Horizontal axis	Current operator	Operator business model	Small cell operator
Scenario Matrix 4	Vertical axis	Shared	Role of resources	Owned
	Horizontal axis	Centralised	Service provisioning	Local

The dimensions were selected based on the ecosystem logic and how the resources are offered and distributed within the mobile business ecosystem. Altogether, sixteen scenarios were created based on four scenario matrices; each with two distinct dimensions. However, in order to reduce the number of scenarios and create a generic and a more coherent scenario matrix, we merged and integrated those dimensions (i.e. the axes of the matrixes) as well as those end points of dimensions that were thematically and semantically similar to each other. For instance, the horizontal dimensions such as distribution channel selection, the operator's role, the operator's business model and service provisioning are all related to the "operator" theme; therefore, the created scenarios based on these dimensions are semantically close and have common characteristics. In the same vein, the vertical dimensions including user experience, technology, development drive and the role of resources are related to the "content, i.e. resources" theme.

In addition, having examined the features and value of all scenarios created on the vertical and horizontal axes, we realized that the horizontal axes are about dynamic and static market and vertical axes are about sharing and controlling resources. For example, creating QoE, horizontal technological solutions and streaming are not feasible without widely sharing resources within the mobile business ecosystem. In addition, having all the players democratically participate in the creation of the rules of the game, the emergence of local small cell operators and providing local services are not possible without the market being opened for acting dynamically within the ecosystem. The same justification indicates that when only one dominant player (i.e. MNO) defines the rules, if the current situation continues without change in the future and the services are just offered in a centralised fashion, the market remains static. In similar fashion, lack of required QoE by customers, vertical specific technological solutions, utilizing IoT technology and keeping the resources individually reflect the controlling attitude of the players over their resources and the fixed structures of the ecosystem. Thus, we could merge the scenarios and build one scenario matrix (Figure 3).

In the next step, the scenarios were written with the aim of being internally consistent entailing cause-effect logic, being relevant to the participant's issues of concerns and providing challenging ideas (Heijden 2005, 225). The stories of scenarios represent four alternative futures and their different outcomes (step 5: drafting scenario narratives for each quadrant). Finally, participants were asked to communicate and reflect on the developed scenarios based on their plausibility, pertinence and implication (step 6: reflecting on the end result).

As a second phase, we performed a business modelling workshop in which the aim was to explore future 5G value-based business models for key wireless business ecosystem stakeholders. To develop the business models, we used the 4C-layered internet business model typology (Figure 1).

Detailed Description Of the Approach and Results

Each of the four scenarios in Figure 3, which is compiled from the original 16 scenarios, is described in the following paragraphs. The created scenarios represent different futures regarding how the context of 5G networks and related services could unfold over time considering the regulatory changes, business opportunities and technological innovations.

Scenario Analysis

Scenario 1: Eternal Today

Despite the increase of traffic in mobile networks due to the increasing number of new devices with accelerating service demands, which is plausible to be the same in the future, the first scenario assumes the continuation of the current situation. In this scenario the business ecosystem is expected to remain as it is today with no new players, mainly due to the assumption that the regulatory framework will not change substantially. Local small cell service offerings will increase, but the

central role of the incumbent multinational operators (MNO) will not change. MNOs provide mobile broadband service by acting as traditional "default" bit pipes that extend their offerings to vertical technological solutions to specific customer segments. Existing services become locally provided but centralized by MNOs, however, with some level of service tailoring for the different verticals. Concerning technological innovation, the infrastructure manufacturers keep on pushing new technologies to the markets.

Scenario 2: Wild West

In the second scenario, regulation is expected to be flexible and the traditional long-term spectrum licensing logic will be complemented with local short-term licensing models. From the market perspective, 5G takes us to a portfolio of widely used but very fragmented services which rest on the localization of service utilization and centralization of service provisioning. However, the business environment becomes extremely competitive and safety, reliability, and security threats emerge as a strong cause for concern. A variety of content-specific services will be available and each type of content has its specific mode of monetization.

Numerous new vertical connectivity providers will emerge in the markets to compete against each other and against traditional MNOs, and each of them prefers to control (or manage) their customers' information and services. The mass market for mobile broadband is fragmented due to a wide variety of service offerings. New local operators (e.g., micro-operators) enter the market to serve different purposes and technological needs that lead to a fragmented operator market. Due to data density, intelligent traffic controlling systems as well as personalized delivery channels are needed. In the industrial sectors, local vertical-specific companies will use digital services provided through small cell networks. New vertical use cases, such as critical connectivity services in hospitals will emerge. This scenario is based on the current recognized trends and it is probable to happen in 5G era.

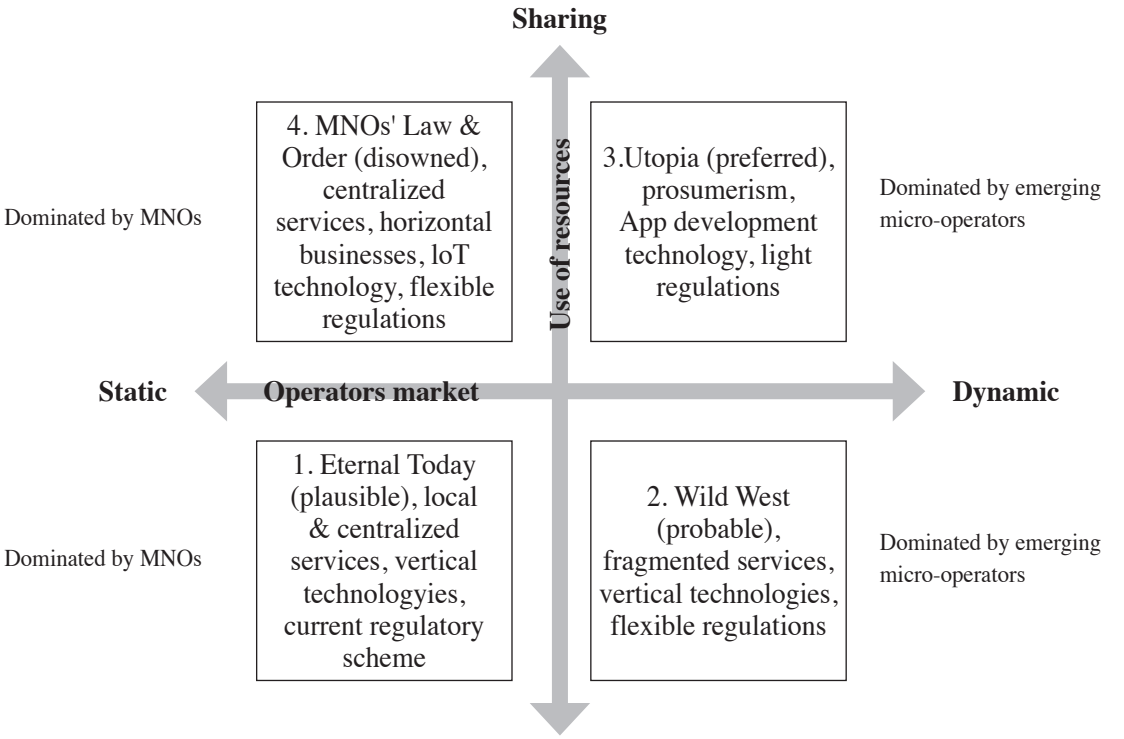

Figure 3. Scenario matrix for 5G networks

Scenario 3: Utopia

The third scenario describes the characteristics of a dynamic mobile market in a sharing economy society where various resources are shared. Regulation is assumed to become only slightly controlled and the ecosystem stakeholders can easily act within the new simplified regulatory boundaries. Businesses within the ecosystem will become service-centric and the required resources can be obtained on a shared basis through collaboration between the ecosystem stakeholders. Locally tailored content provisioning emerges and can also be distributed to different segments. Prosumerism, where the local service providers buy and sell services, will emerge. The services are mostly content-based and different infrastructures and related services are combined to work together. Having content and context awareness for local services requires a sharing attitude. This is a preferred scenario based on the workshop stakeholders' value judgments.

Scenario 4: MNOs' Law and Order

The fourth scenario is characterized by a static market situation without the appearance of new players, but necessary resources are shared between the stakeholders. Regulation promotes the sharing of various resources such as spectrum and infrastructure. This scenario consists of two sub-scenarios that describe the same world from device-centric and operator-centric perspectives. The device and content centric sub-scenario highlights the dominance of the Internet giants who own and sell content and the MNOs act as bit pipes in the shared world. The ecosystem is device- and content-driven, where IoT (Internet of Things) systems' mobile devices provide various contents. As the level of resource sharing is assumed to be high in this scenario, new roles of resource brokerages will emerge encompassing the knowledge of when and to whom they should provide resources, such as spectrum. In the operator-driven sub-scenario MNOs' platforms and interfaces control the horizontal business/services and in 5G. MNOs may share resources but only within their comfort zone. This scenario is customer-oriented since the inter-operation and interfaces call for more local services. These two sub-scenarios resemble the disowned future for the workshop stakeholders.

Business Modelling

In a complex and uncertain new business field, it is prudent to analyse unbundled (i.e. decomposed) existing business model. This is done by decomposing existing value chain positions (e.g., network operator) into its roles in the value network (e.g., connection and data transfer provider). For our purposes, we used the building blocks of the 4C business model typology and explored what kind of value can be created and captured in each of the four layers.

In this model, the *connectivity business model* is about monetizing connectivity-services related to network infrastructure and spectrum provisioning for information exchange and using high-speed online services and related needs (e.g., mobile broadband and M2M communication in IoT). The *content-oriented business model* builds on providing all types of online content-related services (audio, video, text). Such content can be owned by the service provider, by third parties, or by the user. The *context-related business model* monetizes the structured and aggregated information related to the network, application, user's profile, location, time, history data, equipment, operating systems, and required bandwidth etc. The *commerce business model* builds on a platform for buying and selling connection-, content- and context- related resources, or any combination thereof. Different types of communication including business (B), consumer (C), and public/government (G) can be identified and monetized in this layer (see Figure 1).

The 4C framework guides the inductive reasoning of the workshop participants. In the workshop, participants collaboratively specified the service components for the unbundled business model elements. The business model elements listed in Table 3, including value proposition,

differentiation, cost drivers, and ways of charging, relate to stakeholders' value creation and capture opportunities through service components within the 4C framework.

Table 3. *Unbundled service components and their business model elements*

4C mode / Business elements	Connection	Content	Contest	Commerce
Value Prop.	• Ease-of-use • More connection time for users • Efficient porcessed • Communication as a service • Inteeligent graffic control	• Absloute capacity matches with need • Customer & location data • Superior QoS • Tailored QoE • Reliable & fast local content or customized content	• Context sensitivity • Profiling of users	• Flexible deivery • Low transaction costs • Pay for what you use • Low cost connectivity anywhere
Differentlation	• User experience • Apps • Services that others do not have • Optiomized anytimes & anywhere (for end user) • Simplified & cost effective distribution (for content porviders)	• Shared investment cost including OPEX • Network extensions to MNOs • One "network" indoor coverage • Known customer-base for 5G service • Technical superiority • Local services • Communication • Personalization	• Relevance of service	• Unlimited portfolio of services • Local vs. Centralized commerce • Low transaction costs
Cost drivers	• OPEX (operating expenses) control/ reduction • Capacity & coverage	• Device (operating systems) • System complexity and infrastructure cost • Shared spectrum cost • Fewer cashpoints • Less advertising • Shortened processes	• Aggregation & organization of online information • Date security	• Big data analytics • Profiling of users • Cloud service
Ways of charging	• Monthly subscription (SIM, HW + Services) • Varies by customer	• Device • Bonus account • Free of charge	• Bonus schemes • B2B billing	• Licence price • Fixed price • Customized monetizing

In this step, we purposely avoid matching the business model elements with their role in the value network, to ensure that participants are not affected by biases. In particular it needs to be avoided that participants start focussing on protecting their current position in the value network and consequently reduce the options that are being discussed.

In the next step, we re-induce the uncertainty through bringing the four scenarios back into the process. While the scenarios are vital to prevent participants to mentally fall into established

representations and mental models, we need in this step also to drive the convergence of the market exploration insights. The rationale is that the convergence is necessary to lay the foundation for action, but that it needs to be achieved in a way that does not compromise the open exploration process of new business and market configurations.

We achieve this by identifying business model elements that are suitable to be applied in a given scenario. This process resembles analogical reasoning through which creation / mapping of knowledge (e.g. distinguishing patterns) from a familiar domain to a novel or less familiar domain takes place. This leads to choice setting and forming a new relational setting (Martins, Rindova & Greenbaum, 2015). In that way, the attention from the strategists is focussed on the cognitive task of finding an optimal business model in a given environment and hence distracted of protecting for example their own competitive position in the market. This kind of cognitive mapping (i.e. analogy) make decision-makers to be more aware of their own and other's subjective belief, therefore, it alters / facilitates the decision-making process (Swan, 1997). The results of this activity are depicted in Table 4.

Table 4. *The overview of scenarios and their 4C layers*

	5G Ecosystem				
4C MBs Scenarios	Connection	Content	Context	Commerce	Key actors in each scenario
Scenario 1: *Eternal Today* Technology-oriented MNOs dominant	• Mobile broadband as offered today		• Data & usesr density monetized	• Subscription based • Advertisements • Bonus	• Device manufacturers • Network equipment • Spectrum & infrastructure owners
Scenario 2: *Wild West* Service-oriented Micro-operators dominant	• Enabling mobile broadband offering in fragmented markets / environments	• Vertical technological solutions • Customized services			• Content owners & aggregators • Application providers • System integrators
Scenario 3: *Utopia* Service & technology oriented Micro-operators dominant	• Guaranteeing mobile broadband offering through sharing	• Multiple apps • Local content services	• Profiling of users • Context defined content services		• Combination of scenario 1 & 2 actors, i.e. professional service providers
Scenario 4: *MNOs' Law & Order* Regulatory & service oriented MNOs dominant	• Full coverage (by MNOs) throught spectrum provisioning	• IoT devices • Superior QoS • Customer specific services		• License prices • Suctioning of spectrum • Cloud-based B2B	• Government, regulation authorities & standardization groups
	5G specific value creation & capture				

The key insights are that in the technology-oriented *Eternal Today* scenario, MNOs have a dominant role and network infrastructure vendors and device vendors are expected to complement the ecosystem. Connectivity (mobile broadband), context (data and user density monetized), and commerce (with advertisements or bonus schemes) business models may provide most of the new value added in the ecosystem.

The *Wild West* scenario is more service-oriented and showed the emergence of micro-operators as new key players for providing mobile broadband as a local service. The dominating business models monetize the mobile connection locally (by micro-operators) and vertical-specific, customized technological solutions and content services. When comparing to the *Eternal Today* scenario, the role of the content owners, the content aggregators, the application providers, and the micro-operators is more pronounced.

The *Utopia* scenario is both service- and technology-oriented. It is dominated by emerging micro-operators who create and capture value through connectivity, content and context, but which are reliant on MNOs' resources. A variety of micro-operators provide services professionally for all kinds of customers locally (i.e. in selected verticals) and MNOs provide micro-operators the required connectivity to other networks and the Internet. In addition, context-defined content services for profiled users, or local content, provide the main competitive advantage. Furthermore, the sharing of infrastructure plays an important role in this scenario.

The *MNOs' Law and Order* scenario is service- and regulation-oriented; it is dominated by MNOs. Connection, content, and commerce business models are the main ways of doing business. In this scenario, the future 5G regulatory policy is concerned with improving the efficiency of spectrum use rather than opening the market to a more versatile set of players through local spectrum access rights to increase competition. As new market players are not expected to emerge, the local services market can be expected to be divided between device/content and MNO/connectivity fragments.

Overall, the scenario and business model planning exercise highlighted the key role of regulation, which is expected to be flexible in three latter scenarios whereof the third scenario goes the furthest by assuming the opening up of the market for dynamic operations as well as sharing of various resources. The second key factor is the service provisioning, which reflects on whether it is ideal to move towards sharing and dynamic activities between the operators and whether that sharing occurs between MNOs or between local operators. Technology is a substantial driver of all scenarios, but its importance does not vary between the scenarios.

Conclusion

Innovative technologies like 5G will call for novel business models for the deployment of resources and capabilities; ability to strategically adjust resources to demands and creating value proposition opportunities within a rich ecosystem of service providers. Moreover, it is crucial to be agile and resilient to environmental uncertainty and complexity. Business models demonstrate the mental models and schemas of the managers (Martins, Rindova, & Greenbaum, 2015) and they are an abstract conceptualization that pertains to sensemaking and can map and facilitate the possible or necessary changes based on the new conditions which lead to innovation and competitive advantage (Morris, Schindehutte, Richardson, & Allen, 2006).

With this paper we aimed to contribute to a better understanding and ultimately better execution in the development of new markets in environments that are characterized by high levels of volatility, uncertainty, complexity, and ambiguity known as VUCA. Entering such environments as a firm holds the promise for superior profitability and growth. Entering such environments as

societies is necessary to overcome grand challenges such as climate change, water scarcity, and limited natural resources.

Delivering on the promise of superior profitability and growth and answering successfully to societal challenges require overcoming bounded rationality. The ability of the managers is limited in anticipating and responding to changing environment; they are unable to re-think before the strategic change happens and re-perceive the environment in a novel and different way (Patel, 2016). Solving this requires that decision-makers, to which we also refer to as strategists, identify superior courses of action by altering mental models, creating new shared and powerful representations (Gavetti & Menon, 2016). We expected that this can be supported by methods and approaches of strategic foresight (Rohrbeck & Kallehave, 2012) like scenario planning that enables reducing cognitive distance that can be the consequence of lack of previous knowledge; revising the taken for granted previous assumption, deepening the awareness and enhancing the attentiveness to the dynamic environment and alternative choices (Patel, 2016). Revised assumptions and updated anticipation is comparable to adjusting the cognitive scripts, i.e. logical and consistent chain of actions expected by individuals.

It is crucially important to know how the events that appear significant to us should be selected and put together as they are unfolding over time (Louis, 1980). In this research, we address this importance by designing and testing a novel approach that combines scenario planning with business modelling (i.e. strategically think through scenarios and strategically act through business models) for collaborative exploration of a future market that is significantly altered by a technological disruption. We applied our novel approach in the context of mobile telephony market, which will face an important transition, when the 5th generation standards are being introduced. We conclude that even with working with incumbent market participants, we have been able to create representations that are significantly different from the status quo (the scenarios). We further find that these representations were powerful and tangible enough to work as a platform for defining business models. Using the dynamics of the process and by forming working groups consisting of participants from different places in the value network, we were successful in preventing the participants from falling into established cognitive patterns.

To gain a better understanding of suitable method combinations in different environments, more studies are needed that apply combined approaches in different contexts. In addition, it would be beneficial to control for cognitive biases and how the approaches contribute to their reduction.

By inducing plurality through the scenarios, it permitted to trigger and host a strategic sensemaking that overcame established mental models and led to prospective and shared representations among the participants (Wack, 1985; Schoemaker, 1995). We came to the conclusion that our approach contributed to prevent frame blindness and facilitates learning from retrospection (Choo, 1996). Storytelling and theory building enhance the participants' interactions while they are sharing their perception of the environment. Stories that individuals tell about the future illustrate the individuals' worldviews and this narration results in discovering the stories (i.e. mental models) that are tailored to specific needs and accelerates the desired future. It deconstructs and reconstructs the understanding of the uncertainty and risk and challenges the underlying assumptions and ultimately fills the gap between desired future and the existing realities (Milojević & Inayatullah, 2015). This process grows the creativity and intellectual capability of the participants. Learning occurs while participants iteratively shape and define the future while considering that they would be affected by the consequences of the future that they are envisioning (Inayatullah, 2005).

Finally, we have documented that our approach led to the emergence of two kinds of outcomes: first, the creation of alternative pathways to multiple plausible futures and, second, integrating exploration-oriented foresight methods like scenario planning with planning-oriented business modelling techniques, are boosting both insight and likelihood of meaningful action. Scenario

planning and business modelling are both involved in mapping, i.e. detecting driving factors and envisioning alternative possibilities and entail cognitive, collaborative and collective processes to create and develop knowledge for the purpose of strategizing and planning. We expect that such tailored combinations of methods will play an increasingly important role in collaborative market exploration, creating value both on a firm and societal level.

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