Business Models Based on Co-opetition in a Hyper-Connected Era: The Case of 5G-Enabled Smart Grids

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Abstract. This paper aims at introducing a new perspective on devising business models based on the logic of the networked and hyperconnected technological and business environment. The empirical data combines two technological areas: 5G and smart grids. The 5G technology provides rudimentary knowledge about how to create a networked infrastructure for ubiquitous, reliable, and high-speed connectivity. The outcome will enable the utilization of innovative and hyperconnected technologies in the smart grid sector. In the context of the smart grid, we apply a 4C-layered business model that builds on the functional logic of the commercialization of technologies in the 5G era. This eco-systemic business model illustrates how different actors interact in each layer, giving the possibility to identify existing and potential smart grid applications that could be enabled by 5G. We expanded hyperconnectivity into four dimensions, including hyper-connectability, hyper-memorisability, hyper-diffusibility, and hyper-scalability, through an empirical study that can further be developed for a stronger theoretical model of hyperconnectivity.

Keywords: Hyperconnectivity, business models, co-opetition, 5G, smart grid

1 Introduction

Entering the era of information supported by big data, the Internet, digitalization, and information and communication technology (ICT) has deeply impacted human society [5], [18]. Consequently, the demand for technological advancement that can sustain all the kinds of services needed for people's lives is growing exponentially. To address this need, ICT's evolution created an integrated, fast-moving, ubiquitous, and hyperconnected world in which the temporal and spatial boundaries of doing business are vanishing through virtualization [1], [18].

Enabling ICT technologies have also facilitated many new opportunities in traditional industrial sectors [19], [22], such as utilities and energy, where smart grids have emerged as an "Energy Internet" [16], [31]. A smart grid can be defined as a two-way communication infrastructure of information and energy flows, allowing the integration of distributed energy resources, storage, consumption, and flexible demand [37]. For these industrial energy players, the upcoming fifth generation of mobile networks (5G) is becoming a pivotal enabler for hyperconnectivity, as it aims to create more intelligent technologies and integrated networks with real-time control, lower latency, and a higher data rate [4]. Future 5G networks ought to enable innovative ways of connecting, sharing, and allocating infrastructure and other resources [24] that—together with the new smart grid platform and technologies—can open a myriad of new opportunities for businesses, consumers, and decision makers [16]. This highlights business modelling as a crucial part of integrated networks such as smart grids [31].

The use of an ecosystemic business model in the smart grid domain could unlock five main types of value across the energy industry and society: 1) economic value (i.e., value through avoiding unnecessary costs and investment in constructing excess generation capacity), 2) environmental value (i.e., value created by retiring the fossil fuel power plants and integrating renewables), 3) reliability value (i.e., value created by using next-generation communication technology to improve network reliability), 4) energy security value (i.e., value created by ramping up distributed generation to reduce reliance on depleting fossil fuel resources), and 5) engagement and interaction value (i.e., value created by enabling consumers and prosumers to actively participate in the energy market) [38].

On top of that, 5G networks should bear multiple services and integrate multiple technologies to fulfill a wide variety of demands, including user experience enhancement and rapid business development. It is expected that 5G will remove the barriers related to connectivity capacity (creating a wireless connected world) and network performance (information can be accessed smoothly and constantly), as well as to resource optimization (by intelligently and dynamically allocating the scare resources such as infrastructure and spectrum) [11].

In a hyperconnected context, absorbing and integrating others' resources leads to accelerating the development of new products, easy market access, and eventually to obtaining knowledge and resources that otherwise require strenuous effort and a heavy cost in order to be achieved without collaboration and sharing [14]. Conversely, the extent to which organizations have adapted to hyperconnectivity is limited [33]. Additionally, most modern business model frameworks lack such a holistic perspective on interdependency in the industry [26]. Furthermore, within hyperconnected contexts, firms do not only cooperate and collaborate but also compete to gain advantage [7], [9], while the uncertainty, risk, and open competition that characterize the 5G business environment make sustaining competitive advantage problematic.

The advent of the smart grid can be seen as an evolutionary development from the traditional, centralized production and distribution energy system to a modern energy network that incorporates two-way, end-to-end communication and decentralized operations of generation, transmission, and distribution [40]. It is argued that when analyzing the transition of utility-led centralized energy systems to a distributed smart grid system, the traditional single-actor-focused business model conceptualizations and tools are not applicable [38]. This research gap is rarely studied in general business model literature, nor has it been addressed in hyperconnectivity studies. Based on this gap in current knowledge in empirical and theoretical studies, this study seeks to explore how hyperconnectivity within 5G-enabled smart grids affects business modelling in such a networked environment. Hence, this study specifically asks '*How can business models be applied in co-opetition-based value creation and capture in the context of a hyperconnected business ecosystem?*'

The study is organized as follows. First, the peculiarities of the hyperconnected business context are discussed. Then, the concept of a co-opetition-based business model approach is introduced. The last section presents our framework for a 5G-supported co-opetitive smart grid, with accompanying discussion and conclusions.

2 Background

2.1 The Context of Hyperconnectivity

Hyperconnectivity can be considered as the inclusion of people-to-machine and machine-to-machine communications, supporting the development of the IoT [34]. Hyperconnectivity is defined as a state of stimulus associated with the near-constant contact with others. They view the Internet, mobile technologies (such as smartphones), and increasingly ubiquitous electronic networks as the key enablers of hyperconnectivity [15]. The 5G networks aim at revolutionizing the quality and efficiency of hyperconnectivity by enabling higher frequencies, allowing greater device densities; providing greater bandwidths, and building the utmost base station and antennas which are highly integrative in comparison with the previous four generations [4].

The territory of hyper-connection expands in two dimensions: 1) hyper-memorisability, where all the information is stored in huge databases and is accessible anytime from anywhere, and 2) hyper-diffusibility, where all the thinking and thoughts can be massively reproduced, communicated and diffused in a network, without physical limits [18]. The combination of hyperconnectivity, and big data and analytics could empower economies in three key ways: through the ability to know, the ability to have dialogue, and the ability to innovate [23]. Thus, hyperconnectivity is the main factor of change [18], as it has the power to profoundly modify the network of interindividual relations and society as a whole [33].

2.2 Co-opetition-based Business Models

Business models covey the logic and architecture of how economic value is created and captured [13]. As emphasized by [17], a business model entails the value proposition (i.e., products and services), customer relationship, and the network of partners as well as cost and revenue structure. Exploiting the business potential of created innovations requires new organizational activities through which the resources are selected and arranged [29]. Indeed, firms should identify the ways of managing their resources beyond their current business model in order to respond to the challenges of today's turbulent business environment [12].

Therefore, firms should build up different and actually more complex but beneficial relationships where they simultaneously cooperate and compete with each other (i.e., create a co-opetitive business design). According to [7], as the need for acquiring external resources increases, those companies that hold a strong position in the industry will likely cooperate with their competitors and as a result will adopt a co-opetition strategy. This strategy leads to enhancing the dynamic development and competitive advantage of the firm since it can cooperate with one competitor while competing with another, or simultaneously cooperate and compete with the same partner [8, 9], [20].

A digital, hyperconnected economy creates a specific and unique form of value creation wherein the firm and its partners generate value for various users in the networked market [41]. The value proposition offered by companies in the era of 5G and hyperconnectivity is accessibility-based business models for peer-to-peer (P2P) markets. In virtual markets, value can be created through the novel integration of information, products, and services; an innovative transaction mechanism; and the recombination of resources, capabilities, and reshaping of the relationships among the partners, suppliers, and customers [2] within the value network regarding the focus, locus, and modus of activities [30]. This P2P collaboration results in sustainability and economic benefit since the resources can be obtained easily and cheaply.

The focus of innovative 5G business models, for instance, is to create and capture value and new pricing models through multi-partnerships [24]. Hence, the business model describes how a focal firm may tap into its value network or ecosystem in order to perform the activities that are necessary to fulfill the perceived customer needs as the business model focuses on the activities performed by the subset of actors within the focal firm's collaborative network [3]. This builds the theoretical foundations of business models for a hyperconnected 5G-enabled smart grid. Building on this theoretical understanding, the next section presents our research design and methodology.

3 Research Design and Methodology

This study adopts an action-based research methodology for data collection within two techno-social collective innovation projects: one studies the P2P technical and market design of smart grids as part of European Union–level energy innovation research, and the other one is a Finnish-American research cooperation on 5G networks and how they enables key sectors such as smart grids.

Referring to [6], an action research methodology in management science leads to producing scientific knowledge that can serve the action; it enables the formalization and contextualization of models and tools, leading to the production of new knowledge capable of facilitating organizational change. The action research approach was supported by stakeholder consultation, embodied through an ecosystem actor workshop organized in Finland in 2015. A stakeholder workshop can facilitate the process of identifying the underlying connections and tensions by creating conditions in which the participants can "*co-creatively meet their individual and collective needs*" [25]. This approach has been employed in a number of techno-economic researches, especially as described in energy and smart grid literature [21].

To analyze the smart grid business context, we apply a 4C-layered business model typology (which is appropriate for a 5G business environment) presented by [36]. The 4C typology classifies Internet age businesses through four basic prototypical business models, each with varying value propositions and revenue models [36]: connection, content, context, and commerce. The 4C framework was applied by [39] for spectrum sharing in the telecom industry. Due to having an ecosystemic feature, the 4C framework is suitable for the context of a smart grid and 5G. The underlying logic of this model suggests that the upper layers can be supported and enabled by lower layers, that value can be offered in multiple layers, and that different combinations of layers can be utilized for creating value propositions. In other words, the 4C model describes the structure of the ecosystem and how different layers and models can interact [39].

In the 5G-enabled smart grid context, the use of a 4C ecosystemic model gives a comprehensive view on how the value of smart grids and hyperconnectivity is created through collaborative, competitive, and co-opetitive activities. The layers are organized into four horizontals and four verticals. The horizontals start from the connection layer on the left and end in the commerce layer on the right. The connection layer, for instance, is described as the infrastructure of the business. The verticals cover four technological layers including infrastructure and hardware, platforms and data, equipment and devices (plus user interface), and applications and services, as proposed by [40]. This framework, shown in Figure 1, is elaborated in the following section.

4 Results

4.1 The Context of 5G and Smart Grid Projects

The aim of the 5G project is twofold: technology-wise it aims at investigating and improving the technologies related to spectrum and content sharing; and economics-wise it aims at creating transformative business models and regenerating the future market for mobile operators. Therefore, we attempt to design creative models that encapsulate both technology and business/economic performance. The assumption is that the success of 5G technological applications rests on the economic value that it brings for a wide variety of stakeholders—including content providers, regulatory agencies, service providers, and users—by enhancing the interaction among them. The experimental data has been collected from an ongoing joint Finnish-American project (JointMacs). In this paper, we applied the theoretical basis of the 5G networks derived from the literature, as well as the business model that we designed for the 5G ecosystem. Future smart grids require 5G-based infrastructure design to perform safely and efficiently; therefore, the same business model design that is applicable to 5G ecosystem is needed for the smart grids to create economic value.

For the smart grid context, this study utilizes data collected from 'P2P SmarTest', a European Horizon 2020 project researching a smarter P2P-based energy system integrated with 5G communication, regional markets, and innovative business models. This project builds upon an ecosystemic perspective, incorporating the technological and social-economic components of smart grids such as ICT for the energy sector, micro grids, and power system economics. The P2P concept proposed by this research project can find its applications in both large-scale distributed energy generation and smaller energy systems, such as micro grids. To develop a holistic view on the potential business models, services, and applications that can be supported by a 5G-enabled P2P smart grid, the ecosystemic business model was adopted.

A smart grid is one of the 5G-enabled energy use cases. Information brokerage for the content, context, and connection layers can be affected by 5G; besides, it provides continuous connectivity and lower latency. Smart generation and the application of a large amount of data are empowered by 5G; it builds a unified and flexible infrastructure to ensure the deployment of virtual network functions, technological performance, and a reliable communication solution for the services in smart grids. For instance, in urban areas 5G can provide dedicated communication for smart meters [35].

In spite of the value that can be created through a 5G-enabled smart grid, a number of barriers may pose challenges to the adoption of smart grids. These barriers can be classified into four groups: the lack of regulatory framework and open standards, technology and infrastructure immaturity, low public awareness and behavioral barriers, and commercial risks and market uncertainty [27].

4.2 The 4C Business Model Framework for 5G-enabled Smart Grids

The role of an infrastructure business is to build and manage facilities for high-volume operations, such as maintaining data networks, back-office transactional services, and communications through a 5G network. The requirements of an infrastructure business are about the economics of scale, reliability, and security, thus 5G plays a critical enabling role. As ascending upwards along the smart grid technical layer in Figure 1, there is a trend among the ecosystem actors to move from collaborative oriented activities to competitive activities. It is especially interesting to point out that although smart home device businesses are currently focusing on creating complementary value and service offerings, there is an emerging movement steering towards more co-opetitive and competitive directions as the market gets saturated.

The content layer presents concrete offerings provided by different parties, including power quality, renewable energy integration, grid control, and monitoring and consumption feedback, none of which would happen without a communication network with ultra-reliability and ultra-low latency to facilitate the safety, control, and monitoring aspects of wireless automation applications. Balancing energy supply and network constraints are the prime focus, and therefore the ecosystem needs to exhibit more collaborative behavior. However, as customer usage data is becoming crucial to the further development of smart grid services and applications, a high degree of competitive activities can be observed in this layer.

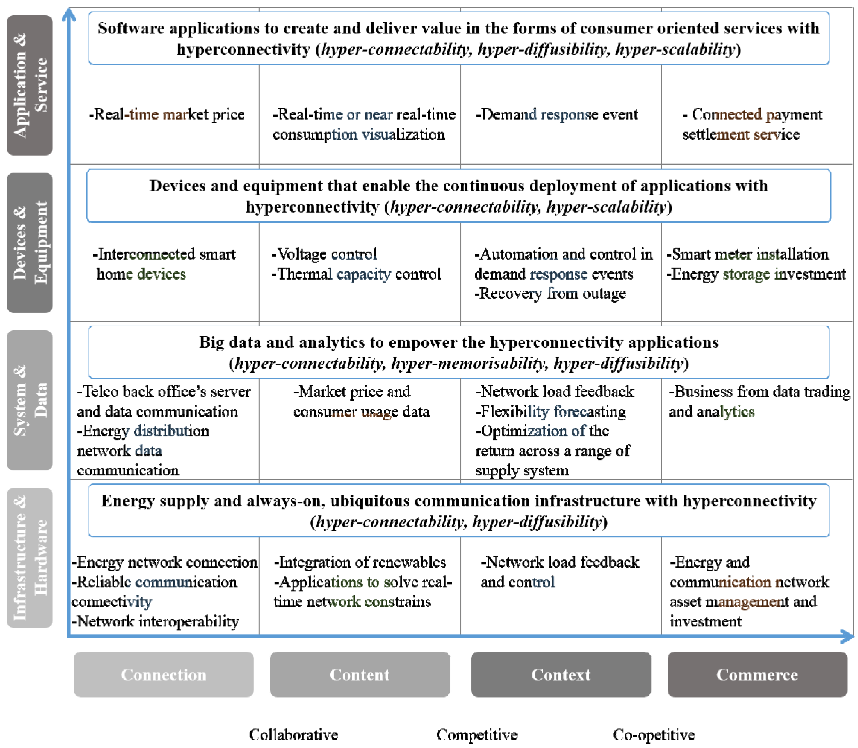

Fig. 1. The 4C ecosystemic business model for P2P smart grids.

Moving beyond the content layer, contextual value is created and captured in the context layer. Flexibility is the key concern, this requiring hyperconnected actors and coordination of activities among the ecosystem stakeholders. When reaching the commerce layer, the data from P2P smart grid project depicts a high degree of competition along all the technological layers. However, it is noteworthy that the smart meter market shows more cooperative behavior. This is largely due to the adopted policy as in many countries (especially in the EU member states) smart meter rollout is mandated and driven by policies and regulations.

By looking at the 4C model as a whole, hyperconnectivity dimensions can be observed in the technological layers or horizons of the ecosystemic model. Clearly, hyper-connetability, enabled by 5G (as one of the key components of hyperconnectivity), has presence in all four technological layers of the smart grid. Hyper-memorisability and hyper-diffusibility are highly associated with how energy information is communicated, diffused, and stored in the data infrastructure in order to improve the distribution network-balancing capability of a smart grid as opposed to the traditional grid. At the same time, hyper-scalability plays a key role in the case of

Automated Demand Response such as ‘OpenADR’, enabling highly scalable responses to network peak reduction events.

Overall, the smart grid ecosystemic model shows different dynamics across the layers, where the development of smart home devices, smart meter and storage installation, big data businesses, and renewable generation show a clear co-opetitive pattern. At a systemic level, the P2P smart grid as a whole can be seen as co-opetitive.

5 Conclusions

A critical understanding of hyperconnectivity and its implication for the new generation of business models is not possible without taking into account an ecosystemic perspective. Assuming that hyperconnectivity is a fundamental aspect for the organization of networked industries. This study conducted an empirical investigation on the 5G-enabled smart grids in hyperconnectivity contexts. One theoretical contribution of the paper lies in the discovery of four dimensions of hyperconnectivity (hyper-connectability, hyper-memorisability, hyper-diffusibility, and hyper-scalability) through an empirical study that can serve as a starting point and overarching theme when developing a stronger theoretical model of hyperconnectivity. One of the practical implications of the study relates to the typological proposition of hyperconnectivity’s four dimensions, which could support system design in various hyperconnectivity enabled domains, such as industrial internet and smart energy systems.

Hence, the research contributions of this work relate mainly to the literature on business models, smart grid innovation, and system design but they also have implications for the literature on business ecosystems and strategic management from a co-opetition perspective. One possible limitation is that the P2P SmarTest project could only evaluate 5G’s potential in existing and known smart grid applications, thus the unforeseeable applications that might emerge cannot be covered in the project’s scope.

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References

1. Amer, A., Yahya, S., Jani, S.H., Sembilan, N., Khusus, D.: Research on Hyper-Connectivity Element and Its Utilization in Electronic Channels Marketing: a Literature Analysis. In: International Symposium on Management and Social Science (ISMSS) (2014)
2. Amit, R., Zott, C.: Value Creation in E-Business. Strategic Management Journal. 22, pp. 4935–20 (2001)
3. Amit, R., Zott, C.: Crafting Business Architecture: The Antecedents of Business Model Design. Strategic Entrepreneurship Journal. pp. 1–20. Available at, http://wileyonlinelibrary.com DOI: 10.1002/sej.1200, (2015)

4. Andrews J.G, Buzzi, S., Choi, W., Hanly, H., Lozano, A., Soong, A.C.K.: What Will 5G Be? IEEE JSAC Special Issue on 5G Wireless Communication Systems (2014)
5. Atzori, L., Iera, A., Morabito, G.: The Internet of Things: A Survey. Computer Networks. 54, 2787–2805 (2010)
6. Bahari, N., Maniak, R., Fernandez, V.: Ecosystem Business Model Design. In: XXIVe Conférence Internationale de Management Stratégique, pp. 1–18. AIMS, Paris (2015)
7. Bengtsson, M., Kock, S.: Co-opetition in Business Networks: to Cooperate and Compete Simultaneously. Industrial Marketing Management. 29, pp. 411–426 (2000)
8. Bengtsson, M., Eriksson, J., Wincent, J.: Co-opetition Dynamics: an Outline for Further Inquiry. An International Business Journal. 20 (2), pp. 194–214 (2010)
9. Brandenburger, A.M., Nalebuff, B. J.: Co-opetition. New York: Currency/ Doubleday (1996)
10. Casselman, S.: Virtual Computing and the Virtual Computer. In: Proceedings of IEEE Workshop on FPGAs for Custom Computing Machines. 43–48 (1993)
11. Chen, M., Zhang, L.U., Taleb, T.: Cloud-based Wireless Network: Virtualization, Reconfigurable, Smart Wireless Network to Enable 5G Technologies. Mobile Network and Application. 20 (6), pp. 704–7012 (2015)
12. Chesbrough, H.W., Rosenbloom, R.S.: The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spinoff Companies. Industrial and Corporate Change. 11 (3), pp. 529–555 (2002)
13. Chesbrough, H.: Business Model Innovation: Opportunities and Barriers. Long Range Planning. 43 (2–3), pp. 354–363 (2010)
14. Chesbrough, H., Vanhaverbeke, W., West, J.: New Frontiers in Open Innovation. Oxford University, Oxford (2014)
15. Collins, P., Kolb, D.: Hyper-Connectivity: How Choice, Response Norms and Technology Do (and Don't) Matter. Academy Management Proceedings. 15245 (2013)
16. Cowan, K.R.: A New Roadmapping Technique for Creatively Managing the Emerging Smart Grid. Creativity and Innovation Management. 22 (1), pp. 67–83 (2013)
17. Dubosson-Torbay, M., Osterwalder, A., Pigneur, Y.: E-Business Model Design, Classification, and Measurements. Thunderbird International Business Review. 44(1), pp. 5–23 (2002)
18. Ganascia, J.-G.: The Onlife Manifesto: Being Human in a Hyperconnected Era. In: Floridi, L. (ed.), pp. 65–85. Springer Heidelberg (2015)
19. Glova, J., Sabol, T., Vajda, V.: Business Models for the Internet of Things Environment. Procedia Economics and Finance. 15, pp. 1122–1129 (2014)
20. Gnyawali, D.R., Park, B.J.: Co-opetition Between Giants: Collaboration with Competitors for Technological Innovation. Research Policy. 40, pp. 650–663 (2011)
21. Grunewald, P.H., Cockerill, T.T., Contestabile, M., Pearson, P.J.G.: The Socio-Technical Transition of Distributed Electricity Storage into Future Networks-System Value and Stakeholder Views. Energy Policy. 50, pp. 44–457 (2012)
22. Gubbi, J., Buyya, R., Marusic, S., Palaniswami, M. Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions. Future Generation Computer Systems. 29, pp. 1645–1660 (2013)
23. Hagström, M.: The Wisdom of the Cloud : Hyperconnectivity, Big Data, and Real-Time Analytics. Glob. Inf. Technol. Rep. pp. 97—103 (2012)
24. Hamari, J., Sjöklint, M., Ukkonen, A.: The Sharing Economy: Why People Participate in Collaborative Consumption. Journal of the Association for Information Science and Technology (2015)

25. Holman, P., Devane, T., Cady, S., Adams, W.A.: The Change Handbook: the Definitive Resource on Today's Best Methods for Engaging Whole System. BerrettKoehler Publishers (2007)
26. Iivari, M., Ahokangas, P., Komi, M., Tihinen, M.,Valtanen, K.: Toward Ecosystemic Business Models in the Context of Industrial Internet. Journal of Business Models. 4(2), pp. 42-59 (2016)
27. Luthra, S., Kumar, S., Kharb, R., Ansari, M.F., Shimmi, S.L.: Adoption of Smart Grid Technologies: an Analysis of Interactions Among Barriers. Renew. Sustain. Energy Rev. 33, pp. 554–565 (2014)
28. Mazhelis, O., Warma, H., Leminen, S., Ahokangas, P., Pussinen, P., Rajahonka, M., Siuruainen, R., Okkonen, H., Shveykovskiy, A., Myllykoski, J.: Internet-of-Things Market, Value Networks, and Business Models: State of the Art Report. Jyväskylä University, Jyväskylä (2013) http://internetofthings.fi/extras/IoTSOTAReport2013.pdf
29. Noda, T., Collis, D.: The Evolution of Intra-industry Firm Heterogeneity: Insight from a Process Study. Academy of Management Journal. 44, pp. 897–925 (2001)
30. Onetti, A., Zucchella, A., Jones, M.V., McDougall-Covin, P.P.: Internationalization, Innovation and Entrepreneurship: Business Models for New Technology-Based Firms. Journal of Management and Governance.16, pp. 337–368 (2010)
31. Rohrbeck, R., Konnertz, L., Knab S.: Collaborative Business Modeling for Systemic and Sustainability of Innovations. International Journal of Technology Management. 63 (1/2), pp. 4–23 (2013)
32. Sandulli, F., Chesbrough, H.: The Two Sides of Open Business Models. Available at SSRN, (2009) http://dx.doi.org/10.2139/ssrn.1325682
33. The Economist: The Hyper-connected Economy: Phase 2 Hyper-connected Organizations, How Businesses Are Adapting to the Hyper-connected Age (2015)
34. The Global Information Technology Report: Living in a Hyperconnected World. World Economic Forum, Geneva (2012)
35. Thrybom, L., Kapovits, Á., Eurescom: 5G and Energy. 5G–Infrastructure-Association. Version 1, (2015), www.5g-ppp.eu
36. Wirtz, B.W., Schilke, O., Ullrich, S.: Strategic Development of Business Models: Implications of the Web 2.0 for Creating Value on the Internet. Long Range Planning. 43, (2–3), pp. 216–226 (2010)
37. Wolsink, M.: The research agenda on social acceptance of distributed generation in smart grids: Renewable as common pool resources. Renewable and Sustainable Energy Reviews. 16, pp. 822–835 (2012)
38. Xu, Y., Kopsakangas-savolainen, M., Ahokangas, P., Li, F.: Ecosystemic Business Model and Value in the Peer-to-Peer Smart Grid. In: Global Energy Interconnection. pp. 858–871. Global Energy Interconnection, Beijing (2016)
39. Yrjölä, S., Ahokangas, P., Matinmikko, M.: Evaluation of Recent Spectrum Sharing Concepts from Business Model Scalability Point of View. In: IEEE DySPAN – Dynamic Spectrum Access Networks. Stockholm (2015)
40. Yu, Y., Yang, J., Chen, B.: The Smart Grids in China: A Review. Energies. 5, pp. 1321–1338 (2012)
41. Zott, C., Amit, R.: Business Model Design: An Activity System Perspective. Long Range Planning. 43 (2–3), pp. 216–226 (2010)
42. Zott, C., Amit, R., Massa, L.: The Business Model: Recent Developments and Future Research. Journal of Management. 37 (4), pp. 1019–1042 (2011)