

The Strategic Adoption of 5G Technology From a Business Model Perspective

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Abstract: Even if 5G is considered an enabling technology, its transformative potential and widespread adoption remain limited. This paper explores how Mobile Network Operators (MNOs) innovate their business models by leveraging 5G. Through an exploratory multiple-case study of Italian MNOs, key determinants concerning innovation in value proposition, creation, and delivery are obtained inductively from interviews and grouped into different 5G business model archetypes. These latter are "Advanced connectivity provider", "Vertical Service Provider", and "Orchestrator". The first focuses on offering 5G as an enabling technology on which end users can build their own applications. The second selects target industries and allows access to a specific service. The third doesn't own specific knowledge but it acts as the intermediary between a customer and a capable partner's network, ensuring that the project is carried out and targeting multiple verticals. The research provides both theoretical and practical contributions: from a theoretical standpoint, it contributes to the business model innovation literature by offering empirical work that investigates the strategic adoption of a new technological paradigm focusing on the architecture of the business model rather than a measurement of performance afterwards. Moreover, it contributes to the 5G literature with an empirical study that focuses on the strategic implications of the phenomenon rather than just the technical aspects, and to the enabling technology literature by offering a study that examines an enabling technology from a firm-specific perspective. From the standpoint of practitioners, it can offer managerial guidance on developing suitable 5G business models to promote technology adoption and maintain competitiveness by harnessing the potential applications envisioned with 5G.

Keywords: 5G technology, Business model innovation, Mobile Network operator, Enabling technology

1. Introduction

Advanced connectivity, especially 5G, is the pillar of digital transformation. The fifth generation of mobile networks (5G) not only offers incremental performances compared to its predecessor 4G, but also opens up possibilities for applications in the B2B market, unlocking multiple opportunities for both the offer and the demand sides. 5G has been recognized by scholars as an enabling technology (ET) (Teece, 2018; Rathje and Katila, 2021) and estimations suggest that focusing on its development in key sectors such as mobility, healthcare, manufacturing, and retail could lead to a substantial boost on the global GDP, with a potential increase up to \$2 trillion by 2030 (McKinsey & Company, 2022). Therefore, the deployment of 5G may necessitate a shift in the attitudes of telecommunications stakeholders, particularly Mobile Network Operators (MNOs) (Cave, 2018; Lehr et al, 2021; Gooderham et al, 2022), who have traditionally held pivotal roles in the telecommunications sector (Ghezzi et al, 2010; Ghezzi et al, 2015). With the advent of 5G, MNOs can change the trajectory of their business model development, especially considering the ongoing price competition in the traditional consumer market, thus unlocking a multitude of possibilities. This becomes especially pertinent considering the potential deployment of private, standalone 5G networks across various industry verticals (Lehr et al, 2021).

However, both from a theoretical and practical standpoint, the prevailing approach to understanding the multifaceted nature of 5G has primarily been technology-centric. Furthermore, only a limited number of scholars have examined Emerging Technologies (ET) from a firm-specific perspective (e.g., Gambardella et al, 2021; Teece, 2018). Therefore, through an exploratory multiple-case study approach with the key informants of Italian MNOs, this paper aims to bridge this gap, offering contributions to both theory and practice. The research provides three business model archetypes related to MNO's 5G business model innovation configurations which contribute both to the managerial literature of 5G technology, as well as the literature about ET and Business model innovation (BMI). Practically, it improves managers' awareness and understanding about 5G strategic implications on a company.

The structure of the paper is as follows: In the second section, a literature review concerning 5G technology the literature about 5G MNOs' business model innovation is presented. In the third paragraph, the methodology used to answer the research question is reported. The findings are outlined in Chapter 4, followed by the discussion driving contributions both to theory and practice and conclusions (Chapter 5, 6).

2. Literature Review

2.1 5G Technology

According to the European Commission, 5G is “*the critical new generation network technology that will enable innovation and support the digital transformation*” (European Commission, 2023). In other terms, 5G represents a new and advanced technology with high potential and a broad portfolio of applications which it could enable (5G-PPP; 2016; Cave, 2018; Ahokangas et al, 2021). Furthermore, from an academic perspective, 5G technology is widely recognized by scholars as an enabling technology (ET) (Teece, 2018; Rathje & Katila, 2021; Gambardella et al, 2021) which is missing to become a General-Purpose technology (Bresnahan and Trajtenberg, 1995) due to the lack of pervasiveness on the overall economy.

Lee and Yu (2022) outlined three key distinctions that set 5G apart from its predecessors: (i) the capacity to connect networked products and services; (ii) the promise of providing extensive, high-capacity, highly reliable, and low-latency connectivity to support diverse scenarios; and (iii) the implementation of “scenario-based” slicing. Massaro and Kim (2022) concurred, emphasizing differences such as higher data rates, traffic density, reliability, user speed, lower latency, and connectivity for numerous devices, as well as lower power consumption enabling Internet of Things (IoT) applications. According to Bauer and Bohlin (2022) and to the main 5G-enabled applications described so far, 5G primarily targets the business and industrial markets rather than the mass consumer market traditionally served by MNOs.

Knieps and Bauer (2022) described local industrial networks as “natural experiments” toward innovative solutions. Consequently, 5G-enabled networks, such as smart manufacturing, agriculture, augmented maintenance, and safety monitoring, are garnering attention from entrepreneurs and companies due to their ability to address diverse needs under specific conditions. Therefore, the deployment of local and private 5G networks presents a tangible opportunity for both MNOs and new stakeholders across various sectors (Ahokangas et al, 2021). However, despite the several opportunities they can enable, there is still uncertainty regarding the 5G business case (Blind and Niebel, 2022), and the value creation mechanism from its adoption across different applications remains unclear (Dolgui and Ivanov, 2022). Massaro and Kim (2022) noted the absence of a “killer service” or application in both B2C and B2B contexts, with many solutions still in the research and development phase (Knieps and Bauer, 2022). Only once the value generation from 5G adoption becomes apparent can the technology be scaled up across diverse sectors (Dolgui and Ivanov, 2022).

Therefore, the emergence of this technological paradigm is not solely confined to the telecommunications industry; rather, various vertical industries are poised to leverage wireless communication (Vuojala et al, 2020). In this context, it becomes imperative to pay closer attention to opportunities that extend beyond MNOs, however, they are the historical focal actor supposed to drive this technology’s adoption, especially in some countries where they own the main source of value for the system (5G network frequencies’ licenses in mid-band 3.6-3.8 GHz) that they paid dearly.

2.2 5G MNOs’ Business Model Innovation

As shown by Gooderham and colleagues (2022), MNOs have faced at least three phases during their existence. The first phase took place between 1990 and 2010 with 2G and 3G, where mobile operators based their business models on voice, messaging, and elementary connectivity (Lehr et al, 2021). The second phase regards the following decade, from 2010 to 2020, with 4G as the dominant technology, where internet connectivity became the major revenue stream for MNOs, instead of the previous voice and messaging. The third phase, which is the period between the previous time windows described and nowadays, is characterized by the advent of 5G and, according to the scholars, the following question arises: “Will this phase be the rebirth phase for MNOs?” The main solution drawn by several scholars regards all the 5G-enabled services MNOs could offer to enterprises and public players; therefore, it seems that the future of 5G lies in the enterprise, not in the consumer market (Lehr et al, 2021; Gooderham et al, 2022; Matinmikko et al, 2018; Cave, 2018). MNOs must be able to develop new capabilities which allow them to co-create digital solutions with business partners to have multiple revenue models (Gooderham et al, 2022; Matinmikko et al, 2018). Otherwise, the risk is that they will end up offering an undifferentiated and price-sensitive commodity. Therefore, already with earlier technologies, MNOs have adjusted their business models (Ghezzi et al., 2009; 2013); however, with the fifth generation, it seems that the development trajectory has changed strongly (Lehr et al, 2021), and the discussion about the best 5G business model for MNOs is still ongoing.

Furthermore, through a non-systematic search regarding the literature about Business Model Innovation (BMI) and technology, the need for greater structuring to intercept a relevant phenomenon emerges. First, as

mentioned by Foss and Saebi (2017), several studies retrospectively describe BMI when considering the adoption of specific technologies; however, it is not common to find predictive and theoretical perspectives. Such a gap addressed by the authors is also outlined by Tongur and Engwall (2014, p.534) when they explicitly affirm that “*further research is needed addressing the interrelationship between technology and business model innovation before, during, and after a technology shift occurs*”. Accordingly, Baden-Fuller and Heaflinger (2013) introduce a similar concept from a more technological perspective, addressing the fact that often the impact of technology adoption is restricted to performance measurements; however, such a link with technology requires further investigation at a BM architecture level by understanding the mechanism to innovate BM through its components to create value.

Considering the gap emerged in the managerial literature where the need to investigate MNOs’ business model innovation mechanisms becomes evident (Ghezzi et al., 2012; 2015; Knieps and Bauer, 2022; Teece, 2018; Rathje and Katila, 2021), and considering the fact that being still a junior GPT (Teece, 2018), 5G constitutes a promising case for exploring business model innovation during a technology shift, the research aims to shed light on the different strategies MNOs can adopt to successfully commercialize 5G by answering the following research question: How can MNOs innovate their business model by leveraging 5G technology?

3. Methodology

The research adopts an exploratory multiple-case study approach due to a clear literature lack. The research process starts with a state-of-the-art literature review and a research question design. Consequently, data collection was performed (Table 1).

Table 1: Data collection

Level	Data source	Origins	Data usage
Primary	4 first-round semi-structured interviews	MNOs' key Informants	Gaining an initial understanding
	4 second-round semi-structured interviews		Deepen topics
	4 "Telco per l'Italia" interviews	Youtube	Gaining initial understanding
Secondary	9 online articles	Online newspapers	Triangulation
	69 company's website pages	Company's website	

The sample was formed according to a 5G adoption/investment, market share, and segments ‘broadness. We investigated the Italian context, where frequencies for 5G service provision are exclusively held by Mobile Network Operators (MNOs) who made investments in 2018. These entities are feeling an urgent need to commercialize the technology because they were the only ones able to invest in these frequencies due to Italian regulations. It is important to note that the successful deployment of 5G depends not only on strategic decisions by such private actors but also on 'exogenous' factors such as incentives for achieving public 5G standalone coverage, which, due to the vastness of the territory, cannot be addressed by a single player. However, one of the opportunities enabled by 5G is the establishment of 5G Mobile Private Networks (5G MPNs). These networks are dedicated wireless infrastructures utilizing 5G technology to provide tailored and secure communication services for specific organizations or entities in various sectors (e.g., Manufacturing, Logistics, Healthcare). They offer rapid data transmission, minimal latency, and reliable connectivity, which cannot be achieved with other technologies. These solutions can benefit from the fact that public coverage is not strictly necessary to leverage these cutting-edge solutions. However, the commercialization of 5G MPNs is still in progress or nearly stagnant, with only proactive pioneering companies from different sectors investing and attempting to implement use cases.

Therefore, to investigate our research question, the three biggest MNOs (Telco A, B, C) and a virtual MNO (Telco D) were chosen. The study aims at reaching theoretical saturation to contribute to theory development (Eisenhardt and Graebner, 2007). The research acquired knowledge through two rounds of interviews, whose questions were adapted according to possible research opportunities, interview videos (used to gain understanding and deepen the topics), online articles, and website pages (used for triangulation). Data collection was performed in parallel with data analysis to extrapolate the highest information quality. It follows (Gioia et al, 2013) and Grounded Theory’s methods. Thus, initially, the concept was maintained adherent with the interviews and concept labelled. Then, the study groups them into second-order themes to elaborate on

similarities and differences. Lastly, the overarching dimension collects them into the highest conceptualization (Figure 1). Initially, each case has been considered singularly. Then, a cross-case analysis was performed.

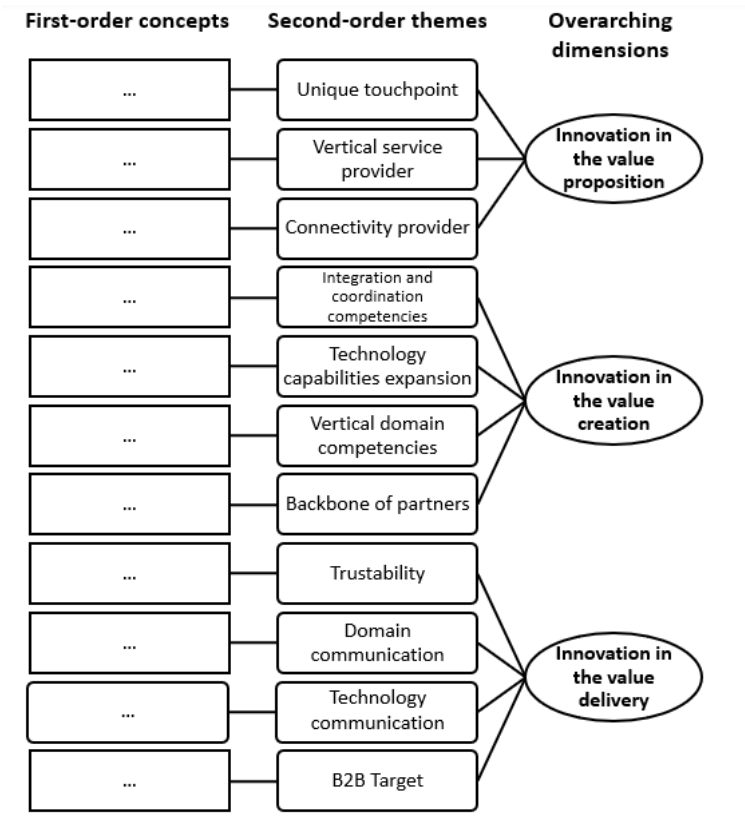


Figure 1: Coding tree

4. Findings

From the interviewees' words was possible to inductively obtain three overarching dimensions, namely the Value Proposition, Value Creation, and Value Delivery. Regarding the Value Proposition, three possibilities were obtained. The first regards a connectivity offer. *"We are telco operators, so we must bring enabling infrastructure"* (Telco A, Marketing Operative). Telco must fulfil performance requirements to make others able to develop services and products. 5G is a perfect fit due to its high performance and slicing nature. It may include a technology enlargement.

The second considers industry-specific service. *"5G enables solutions, use cases, both for consumer and business customers"* (Telco B, Head of Innovation & Vertical Solutions Business). The operator may address industry-specific needs without dismissing the connectivity business, escalating the value chain. The services may be sold *"on top of the connectivity"* (Telco D, CFO).

The last one embraces the referring point. *"We are the only one that can offer everything"* (Telco A, Marketing Manager in 5G & IoT Vertical Solutions). Telcos may position themselves as an intermediary in the service or product construction. *"It may be useful and interesting for a customer to have a unique partner"* that *"permits the customer to realize it most competitively"* (Telco B, Head of Innovation & Vertical Solutions Business).

Value Creation follows the Value Proposition needs. Given 5G applicability broadness, the MNO must establish a partnership network. Selecting a partner *"is a necessity, the innovation degree is very high, and the specialization is on the verticals"* (Telco B, Head of Innovation & Vertical Solutions Business). In particular, they may contribute to platform or application creation. Regarding the competencies, the research finds vertical domain competencies, transverse process competencies, and technology capabilities expansion. Targeting a specific industry requires *"a domain competence that is moved by the only technology components"* (Telco B, Head of Innovation & Vertical Solutions Business). Telcos can't be effective *"if you don't internally create that market knowledge"* (Telco C, Head of Innovative Concept Development & Scaling). The transverse process competencies regard more integration and coordination capabilities. *"You must act a bit as a coordinator between the competencies that are in the company rather than the ones offered by the third party"* (Telco B,

Head of Innovation & Vertical Solutions Business). The company may act as an intermediary between the client and the partners. Lastly, 5G changes the network abilities, adding elasticity, flexibility, and virtualization. 5G allows setting up "system so-called BSs (Business Support) that are sufficiently configurable to answer to more aggressive speed and customization needs" (Telco C, Head of Innovative Concept Development & Scaling). New competencies create new professional figures in MNOs, such as the specialist for the industry-specific ones, solution architect, and consultant for the transverse ones. In addition, 5G permits targeting a broad B2B segment. Even though the telcos can't turn B2C down, being their main revenue segment, "5G is born for the industrial application" (Telco C, Head of Innovative Concept Development & Scaling). Moreover, the company may require trustability building depending on the target market.

5G may profoundly change the relationship with the customers. The research identified two main approaches: passive and proactive. The Passive's mantra is "You wait for customers to ask" (Telco D, CFO). Therefore, the discussion focuses on keeping a stable relationship without investigating in-depth the real customer needs. On the other hand, "more and more companies start seeing the operator as a partner with whom they can dialogue" (Telco C, Head of Innovative Concept Development & Scaling). Thus, the Proactive requires a more complete customer engagement and dialogue.

Once the elements and current challenges related to the innovation of MNO's business models with the advent of 5G were defined, the authors attempted to aggregate the second-order themes into three different business model archetypes to outline three different directions based on what emerged from the interviews. Specifically, the three business model archetypes that were defined are: "Advanced connectivity provider", "Vertical Service Provider", and "Orchestrator". Figures 2,3,4 represent the Findings.

5. Discussion

In the first scenario, the so-called Advanced connectivity provider, the Value Proposition focuses on a connectivity offering and it may be complemented by other ICT technologies. In the Value Creation dimension, technology capabilities expansion is required without any new professional figures. Customers may be waited, given just the technology offers. Trustability can be automatically inherited from the current reputation in both market segments due to the MNO's position as a dominant player. In the second BM archetype, the "Service vertical provider", the main proposition will regard access to a service customized for specific vertical application domains. "The operator is identified as who allows access to a service" (Telco B, Head of Innovation & Vertical Solutions Business). It shifts the focus from connectivity and technological services to a service environment in which the customer may address different needs. It should require vertical domain competencies. A new professional figure may help the specialization in specific sectors. "There are commercial figures called specialists that should be specialized in the single vertical" (Telco A, Marketing Manager in 5G \& IoT Vertical Solutions). It is envisioned as a proactive relationship due to initial reputation issues and B2B customization demand.

In the final BM archetype, the touchpoint unicity is the main value proposition. Exploiting the partnership network, the telco may act as an intermediary and coordinator between the customer needs and the partners supplying. Thus, it requires strong transverse process competencies and dedicated professional roles able to judge the 5G overall solutions and it may guide the customer. Through "dialogue availability" (Telco A, Marketing Operative) and "a higher engagement with the brand" (Telco B, Head of Innovation & Vertical Solutions Business), the telco may establish a proactive relationship.

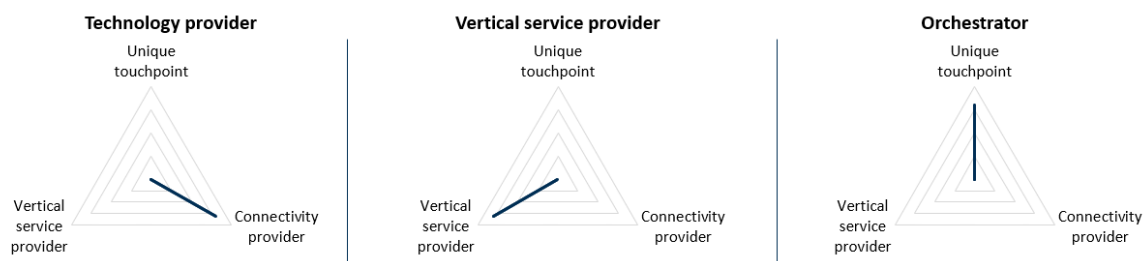


Figure 2: 5G MNOs' Business model archetypes: innovation in the value proposition

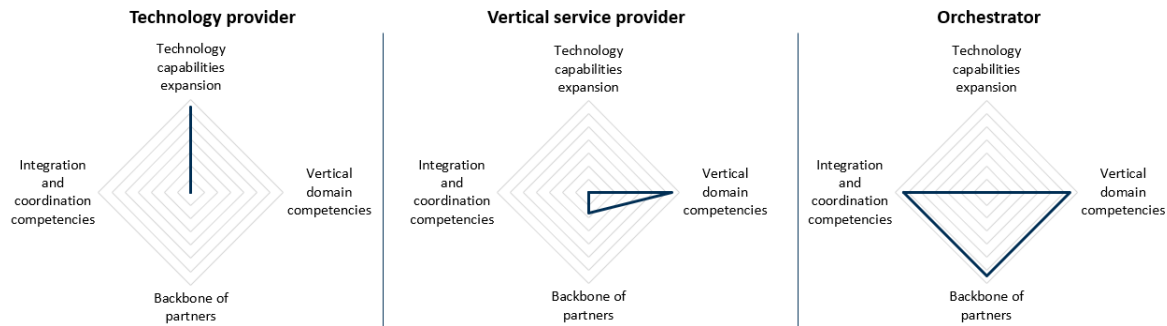


Figure 3: 5G MNOs' Business model archetypes: innovation in the value creation

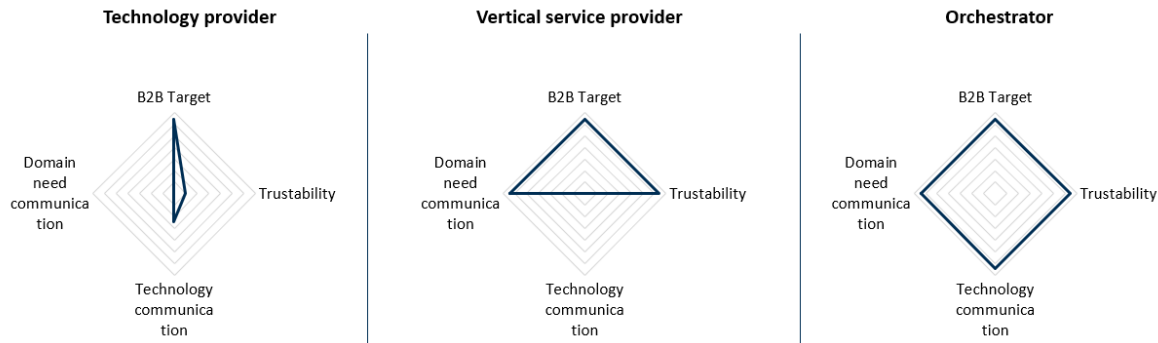


Figure 4: 5G MNOs' Business model archetypes: innovation in the value delivery

5.1 Theoretical Contributions

In opposition to the 5G technical literature in which the technologies and their impact or applications are well-defined, the 5G strategic adoption suffers from the building tools to evaluate and face decisions. If the technology research may be considered mature from different perspectives, the current 5G managerial literature appears fragmented and there is little evidence concerning the exploration of 5G strategic implications in terms of Business Model (Moqaddamerad and Tapinos, 2023). Therefore, the research contributes to the 5G literature by providing three different 5G BM archetypes based on key determinants concerning Value Proposition, Value Delivery, and Value Creation.

This research contributes to the servitization literature by presenting an empirical study on the challenges faced by technology providers in ET commercialization. In this context, the significance of the core technology diminishes due to difficulties associated with early adoption by pioneers in terms of optimal utilization. Therefore, transitioning towards Business Model (BM) servitization, as suggested by Tongur and Engwall (2014) and Sjodin and colleagues (2020), could represent a feasible option for commercializing ET already integrated into certain use cases offered to companies. In such cases, significant changes are required in the mechanisms of value creation, particularly concerning vertical domain competencies (Vertical Service Provider) or the ability to coordinate all other stakeholders (Orchestrator) in the conceptualization and development of use cases.

From a BM literature standpoint, the research contributes to the ongoing debate regarding the strategic impact of new technological paradigms from a BM perspective (Baden-Fuller and Haefliger, 2013; Foss and Saebi, 2017), particularly concerning value creation mechanisms (Teece, 2018; Sjodin et al, 2020) related to new digital technology-driven BMI archetypes (Ancillai et al, 2023). As a matter of fact, It provides an empirical study that attempts to address the interrelationship between technology BMI during a technological shift, rather than retrospectively (Foss and Saebi, 2017; Tongur and Engwall, 2014). Furthermore, due to the collected data, the impact of technology is not evaluated based on performance metrics, as is common in most studies, but rather on BM architecture (Baden-Fuller and Haefliger, 2013).

5.2 Practical Contributions

"Facing a potential technology shift, [...] they must make a difficult choice that could profoundly affect their business model" (Tongur & Engwall, 2014)". Given the choice spectrum and high investment, it is hard to coherently decide which path to follow, especially if they are just explorative attempts. The research may

guide managers' choices, depending on the selected strategy. Each archetype has distinct characteristics and addresses different visions and purposes. Model characteristics may provide a framework to assess future business models, unknown till now, and help the MNOs reposition themselves in new market positions. In the third scenario, the results highlight that continuing as a connectivity provider and even as a carrier represents the easiest path in terms of required resources and expertise. However, at the same time, MNOs may risk being "confined" to being a mere technological provider, struggling both to return on 5G investment (especially 5G licences) and to sell the technology itself. In the second scenario, there is a transition from "product," namely connectivity and SIM cards, to the "service", namely the 5G use case. In this case, the most critical choice is how to define the vertical and internally acquire new resources to gain domain expertise. The third scenario is the one that would allow maintaining one's own expertise and being able to sell the application to the end customer. However, this could also be the most "ambitious" role for other players in the value chain, who could disrupt MNOs.

5.3 Future Avenues

Being a qualitative study, interviewers and interviewees processed questions and answers through a subjective interpretation. The research considered only two interview rounds due to limited resources and time availability. Additional cycles would have increased and granularized the findings. The study doesn't include the Value Capture mechanism due to the market and technology's immaturity. As reported in the "Findings" section, technology and knowledge sophistications drive the market.

Future avenues may amplify the research context and its generalizability. The Italian context presents strict regulations regarding transmission power and investments. It may be interesting to analyse distinct contexts to assess if the same perceptions and archetypes arise. Changing the player's perspective may improve generalizability. It is unlikely that OTTs, other service providers, and the demand will remain static in the market, especially after a performance power-up. Lastly, when the market reaches sufficient maturity, quantitative examinations may confirm or re-evaluate the current literature state-of-art.

6. Conclusion

5G serves as an enabling technology within the B2B sectors, presenting an opportunity for Mobile Network Operators (MNOs), key players in the telecommunications industry, to innovate their business models and uphold a central position in the sector. Through qualitative and exploratory research involving interviews with four Italian MNOs and three pioneering companies seeking to adopt 5G, three distinct business model (BM) archetypes have been delineated prescriptively. These archetypes are characterized by various configurations of determinants derived inductively from the interviews, pertaining to innovation in value proposition, creation, and delivery. Specifically, MNOs can opt to persist as "Technology providers," offering 5G as an enabling technology while leaving the task of understanding its use cases to end-users. Alternatively, they can commercialize 5G value-added services to companies integrating the technology into specific applications, positioning themselves as "Vertical Service Providers" by integrating into downstream verticals. Another avenue for MNOs is becoming the unique touchpoint or "Orchestrator" for 5G project development facilitating interactions among all involved actors as intermediaries. This research contributes to the limited body of literature analysing the adoption of enabling technologies from a firm-specific perspective and adds to the discourse on 5G by presenting evidence of its status as an Emerging Technology (ET) and offering an analysis of its business implications rather than solely focusing on technical aspects. Moreover, it contributes to the ongoing debate on the strategic impact of new technological paradigms from a business model perspective, particularly concerning mechanisms for value creation and capture associated with new, digital technology-driven BMI archetypes. From a practitioner's standpoint, this research offers managerial guidelines on developing appropriate business models to (i) promote technology adoption and (ii) maintain competitiveness while capitalizing on the myriad potential applications promised by 5G. Furthermore, this framework could assist MNO managers in evaluating potential directions for the commercialization of the technology itself.

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