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Threading the needle of the digital divide in Africa: The barriers and mitigations of infrastructure sharing

Running title: Digital divide in Africa

Abstract

Coopetition is prevalent in today's dynamic business environment and has attracted research interests. Using coopetitive-based view, this study examines the antecedents and drivers of infrastructure sharing (IS) among local and multinational mobile network operators (MNOs) in Africa. Based on 21 interviews with different stakeholders in seven sub-Saharan African (SSA) countries, we develop an integrative framework of industry/market, technological, and institutional factors that affect IS between MNOs. We find evidence of institutional factors shaping the impact of the industry structure and technological factors on firms' propensity to engage in coopetitive strategies. There is evidence that in contexts with low-level IS, inadequate regulatory interventions mean that the existing market conditions are reproduced, leading to further competitive behaviours from MNOs. For high-level IS, MNOs tend to engage in further coopetitive strategies through strategic learning and cooperate to resolve technological incompatibilities and engage in standards settings. We extend the existing scholarly works on coopetition and IS literature by providing an in-depth understanding of the obstacles faced by MNOs in adopting IS. The study further highlights that IS requires a shift from the competitive-based logic to a dynamic, coopetitive one, which is nonetheless challenging to achieve with limited institutional capacity and support.

Keywords: Africa, coopetition, digital divide, infrastructure sharing, mobile telecoms

1. Introduction

A prevalent characteristic of today's dynamic global business environment is the coopetition among firms, which refers to the simultaneous cooperation and competition between rival firms in certain domains (Amankwah-Amoah, 2020; Bengtson & Raza-Ullah, 2016; Brandenburger & Nalebuff, 1996; Luo, 2007). Specifically, around half of inter-firm relationships are between competing firms (Padulo & Dagnino, 2007; Rai, 2016). Coopetition involves competing firms committing to common goals and sharing complementary resources to create value, while also competing for value appropriation and through independent actions in various domains to improve performance (Bouncken et al., 2020; Estrada et al., 2016; Luo, 2007). In coopetitive

relationships, competing firms work together to collectively enhance their efficiency, access and create new knowledge, access new markets, and increase market power (Ritala, 2012).

As an emerging research field, several articles on coopetition have been published over the past two decades, marking a considerable advancement in the body of knowledge on this topic (Lascaux, 2020). This research stream suggests that the disposition to engage in coopetition varies across firms, industries, and contexts (Czakoń et al., 2020). Recent reviews further highlight the focus on manufacturing firms of most coopetition studies in the context of research and development (R&D) collaboration and the limited attention paid to coopetition among service firms (Dorn et al., 2016). Moreover, the existing coopetition studies neglect the role of external institutions and government policies for coopetition (Dorn et al., 2016). The insufficient research on external institutions' role in rivals' cooperative dynamics represents a severe shortcoming in understanding the nature of coopetition (Dorn et al., 2016; Lascaux, 2020). This is particularly the case for industries with substantial regulatory involvement, such as the telecommunications industry. Therefore, scholars have emphasised the necessity for further research on the drivers, barriers, and outcomes of coopetition to determine the nature and characteristics of the cooperative processes and improve our overall understanding of coopetition (Gnyawali et al., 2016; Lascaux, 2020).

An important question in the related literature is whether coopetition can be induced or mandated in a competitive market by regulatory bodies (Bengston & Raza-Ullah, 2016; Czakoń & Czernek, 2016; Dorn et al., 2016; Givoni & Banister, 2006; Kylanen & Rusko, 2011). Mariani (2007) notes that cooperation mandated by regulators could result in shifting managers' mental models and cognitive maps from competitive to cooperative ones. Mariani (2007) further conjectures that this shifting of mental logic could hold in highly regulated industries and calls for more studies to understand induced coopetition under different settings. In this study, we first adopt a cooperative-based view (Amankwah-Amoah, 2020) for examining

the antecedents and drivers of infrastructure sharing (IS) among local and multinational mobile network operators (MNOs) in Sub-Saharan Africa (SSA). Secondly, the study explores the roles of institutions in the coopetition dynamics among MNOs. In sum, our overarching research question therefore is: *what are the drivers and barriers to IS among the MNOs in SSA?*

The choice of the telecommunications industry in SSA as a research setting is apposite. Accordingly, coopetition among firms in the telecommunications industry is increasing due to the changing nature of technologies and products, as well as the potential to access and share partners' resources (Sanou et al., 2016). However, we know little about the nature of coopetitive networks and their performance consequences for firms (Sanou et al., 2016). The importance of understanding coopetition among MNOs in Africa is relevant, given the critical and enabling role of mobile telecommunications in helping people across the continent participate in various socio-economic activities such as agriculture, business development, civic engagement, democracy, education, financial inclusion, and job searches (Amankwah-Amoah, 2019; Asongu & Le Roux, 2017; You et al., 2019). Access to mobile telecommunications is also considered vital for the transformation and development of developing countries (Amankwah-Amoah, 2015, 2016; You et al., 2020).

To address the above research gaps, we conducted a multiple qualitative case study for seven SSA countries. Based on 21 interviews with different stakeholder groups, we developed an integrative framework of the industry/market, technological, and institutional factors that affect the IS between MNOs across the telecommunications industry in SSA. Our study thus contributes to the coopetition and IS literature by providing an in-depth understanding of the obstacles faced by MNOs in adopting IS in Africa. The study further highlights that IS requires a shift from the competitive-based logic to a dynamic, coopetitive one, which is nonetheless

challenging to achieve with limited institutional capacity and support. Finally, the findings highlight pertinent policy issues and other stakeholder considerations with regards to IS.

The rest of the paper is structured as follows. The next section reviews the coopetition literature, with a focus on the motives, drivers, and antecedents of IS in the telecommunications industry. This is followed by an overview of IS between the MNOs in Africa. The methodology employed in the study is then discussed and followed by a presentation of the findings. Finally, we discuss the findings and present the implications for research, practice, and policymakers.

2. Coopetition and infrastructure sharing

As a concept, coopetition refers to a collaborative arrangement between two or more competing firms to create value based on complementary or pooled resources (Bouncken et al., 2020). It involves simultaneous cooperation in functional areas but also rivalry between firms (Amankwah-Amoah, 2020; Lascaux, 2020; Sanou et al., 2016). A number of theoretical underpinnings, such as the resource-based view, game theory, and network theory, have been applied to explicate the nature of coopetition and the situations whereby firms might be motivated to collaborate with competitors (Ritala, 2011; Sanou et al., 2016). Accordingly, firms might be motivated to collaborate to increase the size of their existing markets or to access new ones (Ritala, 2011).

Under coopetition, firms expect to improve their performance or value creation in terms of new product development, technologies, or services compared to competition and without the relational rents (Dyer et al., 2018). The network theory further highlights that inter-firm relationships can shape firms' performances and behaviours (Sanou et al., 2016). The coopetition-based view also suggests that firms can simultaneously put their capabilities and resources together in some areas, such as R&D for the design, development, and creation of products, while intensively competing against each other in other functional areas, such as

promotion (Amankwah-Amoah, 2020). Therefore, firms may find it beneficial to collaborate with their arch-rivals even amid intense competition between them (Bouncken et al., 2020; Lascaux, 2020). Some typical coopetition examples are Ford's collaboration with General Motors, its arch-rival, in developing high-efficiency gearboxes and GM's decision to work with Toyota in designing and developing fuel-cell technology (Amankwah-Amoah, 2020; The Economist, 2015).

Recent contributions to this research stream suggest that firms show differences in their capabilities and abilities to create new products, pursue novelty, expand product range, or defend market share, but their collective collaboration processes enable them to achieve all these (Bouncken et al., 2020). Moreover, the rising costs of R&D activities and the declining product-life cycles have facilitated competing firms pulling resources together to reduce burdens and risks (Gnyawali & Park, 2009). As such, coopetition provides firms with access to partners' resources and constrains behaviours (Sanou et al., 2016). Further, it serves the best strategy for firms to meet the increasingly sophisticated consumer demands, as well as the fast changing societal and market needs (Amankwah-Amoah, 2020). Specifically, firms in coopetition share complementary resources, as well as the risks and costs associated with developing new products or process solutions to meet changing market needs (Luo, 2007). Finally, coopetition enhances firms' bargaining power and ability to influence and shape the regional and national policies (Amankwah-Amoah, 2020).

Extant studies also discuss the nature of inputs and outputs in inter-firm relationships (Bouncken et al., 2020) and demonstrate that firms may experience imbalances regarding the quality and quantity of inputs, as well as value capture, due to the differences in their capabilities, abilities, and motivation (Das & Rahman, 2010; Fonti et al., 2017). This may introduce tension between partners and serve as both a driver and barrier to value creation in a partnership. Although coopetition tension may accentuate firms' use of partners' strengths to

search for new solutions, there could be risks associated with opportunism and protection in both value creation and capture (Gnyawali & Charleton, 2018). Moreover, firms in coopetitive relationships may behave opportunistically by reducing their value creation inputs or maximising their value capture, leading to the partnership ultimately failing (Fredrich et al., 2019). In some cases, coopetition partners may contribute equally to value creation, but value capture may be different because of the different motivations and difference in capabilities and proficiencies between firms (Clauss & Bouncken, 2019; Hoffmann et al., 2018).

Coopetitive relationships can thus have positive, neutral, or even negative impacts on both participating firms and the industry (Ritala, 2011). The outcome depends on participating firms' capabilities and the external environment (Ritala & Hurmelinna-Laukkanen, 2009). For example, MNOs argue that it does not make business sense for one MNO to build networks and then share them with rivals, as this poses a large financial burden (Cohen & Southwood, 2008; van de Groenendaal, 2018). Further, the mandatory implementation of IS in Zimbabwe has led to some resistance, particularly by the incumbent (i.e. Econet), which had made a larger investment in deploying infrastructure relative to its rivals over the years (Ndlovu, 2018; Nhundu, 2015). Additionally, from a regulatory perspective, IS can have an adverse effect on competition and innovation in the industry. For example, for a multi-party alliance to work, all the parties involved must be willing to commit and pool their resources together (Fonti et al., 2017). Similarly, an IS alliance requires fair and equal investment from all participating MNOs but may be difficult to achieve due to varying abilities, capabilities and motivation (Das & Rahman, 2010; Fonti et al., 2017). Consequently, disputes and tensions may arise among MNOs and if not properly managed by the regulators, this could dissipate to adverse outcomes such as free-riding (Fonti et al., 2017). If this situation lingers, coopetition between MNOs may not emerge, creating an unhealthy environment for competition and innovation to flourish, and ultimately restrict future IS. In sum, firms' disposition to engage in coopetition and their

perceptions of its benefits will be determined by both the external environment in which they operate and their own characteristics.

The coopetition literature has identified several external and internal determinants of either cooperation or competition (Bengston & Raza-Ullah, 2016; Dorn et al., 2016). They include institutional factors, industry and market characteristics, relational characteristics, and firm- and individual-level factors. External institutions play an important role in influencing firms' coopetitive behaviours (Dorn et al., 2016). Specifically, government regulations are 'powerful' enablers in influencing a firm's behaviour in the environmental context (Angeles, 2013). However, regulatory interventions can either correct market failures or worsen the situation by creating new ones. Therefore, the institutional environment plays an important role in inducing or prohibiting coopetition. For example, anti-trust laws can formally prohibit competitors from cooperation (Burgers et al., 1998), while regulatory bodies can provide incentives or even force companies to cooperate (Mariani, 2007). Industry and market characteristics can also push or pull firms away from cooperation. Coopetition is thus likely to arise in highly concentrated and regulated industries (Dowling et al., 1996). However, highly uncertain and instable industries can also be conducive to coopetition (Padula & Dagnino, 2007). Further, industries characterised by short product life cycles and high R&D expenses can force firms to collaborate (Dorn et al., 2016).

Researchers have also investigated the relational properties of firms that induce coopetitive behaviours (Barretta, 2008). For example, resource complementarity and access to distinctive resources motivate firms to enter coopetitive relationships (Gnyawali & Park, 2011; Luo, 2007), as can technological asymmetry and goal congruity (Luo et al., 2008). Finally, mutual trust between participating firms is vital to overcome fears of opportunistic behaviours (Ngowi & Pienaar, 2005). Firm-specific endowments, strategy, and dominant logic also play important roles in determining their propensities to engage in coopetition (Gnyawali & Park,

2009). Previous experience of coopetitive relationships increase firm's openness to collaboration based on learning from prior experiences and routine development. Generally, some firms are more coopetition oriented than others, which refers to firms' behavioural disposition to engage in coopetition (Bouncken & Fredrich, 2012). We next focus on coopetition in the context of infrastructure sharing among the MNOs in Africa.

3. Background: Infrastructure sharing in Africa

In the telecommunications sector, IS refers to the practice of two or more MNOs sharing telecommunications network for transmitting services to end-users (Garcia & Kelly, 2016). The coopetition-based view in the context of IS between MNOs involves the joint deployment of new networks, while competing MNOs share existing networks and/or co-invest in the deployment of new ones. For example, sharing the costs of civil work for ducting, which accounts for over 80% of the costs of deploying optical fibre infrastructure, could result in a substantial amount of cost savings for MNOs (Deloitte, 2015). This approach has the potential of increasing the pace of network coverage and lowering the entry barrier into the industry (Kaziboni & Robb, 2015; Wymann, 2007). For instance, in Tanzania, Uganda and Zimbabwe, regulators require new entrants to share the existing infrastructure with existing MNOs to avoid the duplication of networks and lower the entry barrier (Balancing Act, 2015; TeleGeography, 2018).

Another supporting argument is that coopetition reduces the cost of network deployment and coverage expansion (Meddour et al., 2011). The sharing of infrastructure further helps lower the costs burden and its shift to end-users, especially the cost of mobile data for Internet access (CRASA & ITU, 2016; Nelwamondo, 2013). Besides affordability, end-users could also access a variety of innovative services and benefit from wider network reach as the collaboration on network coverage shifts the competition among rivals to service quality provision (IFC, 2019; ITU News Magazine, 2017). Sharing network infrastructure also reduces

the negative environmental impact of mobile towers and, hence, lowers the overall environmental footprint of individual MNOs (ITU News Magazine, 2017).

Depending on the regulatory environment in a country, the two generic forms of IS include passive IS (PIS) and active IS (AIS) (Antonopoulos et al., 2015; ITU News Magazine, 2017). While PIS involves the sharing of ‘non-electronic’ infrastructure, AIS involves sharing ‘active electronic’ equipment or core networks (ITU News Magazine, 2017). Examples of PIS are the colocation of sites, towers, buildings, power supply, battery backup, and security (CRASA & ITU, 2016). AIS includes sharing the various aspects of core networks such as frequency spectrum, antennas, fibre optics, backhaul equipment, and national roaming (Kaziboni & Robb, 2015; Meddour et al., 2011). Since AIS involves sharing core networks, it is generally more complex to implement it relative to PIS (Kaziboni & Robb, 2015). Furthermore, since core networks may include proprietary technology, the adoption of AIS among MNOs tends to be limited due to the fear of losing the competitive edge to rivals.

As previously mentioned, in Africa, mobile telecommunication services play an important role in helping people participate in various socio-economic activities such as agriculture, business development, civic engagement, democracy, education, financial inclusion, and job searches (Amankwah-Amoah et al., 2018; Asongu & Le Roux, 2017; You et al., 2019). Access to mobile telecommunication services is therefore vital for the transformation and development of African countries (Amankwah-Amoah, 2015, 2016; Makhaya & Roberts, 2003; Overa, 2006). Overall, it was found that development of telecommunication infrastructure have a strong impact on economic growth (Batuo, 2015; Donou-Adonsou et al., 2016).

Although the African mobile telecommunications market has witnessed significant growth following the liberalisation of the sector at the turn of the millennium, this continent is still the least connected worldwide (A4AI, 2016; Bell, 2017). African countries have an

Internet penetration rate of only 25%, compared to 60% in the Middle East, 88% in North America, 84% in Western Europe, and the world average of 54% (Adeniran, 2019; Shaolin, 2017). Furthermore, while countries in Europe and North America are increasingly adopting 4G technology and, more recently, 5G, many parts of Africa are still relying on 2G and 3G networks, which have lower quality of service (QoS) and network coverage levels (A4AI, 2016; Bell, 2017; Mole & Amadi-Echendu, 2018).

Accordingly, the limited telecommunications infrastructure is a main reason for the low Internet penetration rate in Africa (Mansell, 1990; Justman & Teubal, 1995), compounded by the legacy problem of limited fixed and supporting infrastructure, such as grid electricity and roads (ITU, 2016; Mtega & Malekani, 2009). Therefore, the costs burden of deploying mobile networks is significantly higher in Africa than in other parts of the world. This has led MNOs to focus on deploying networks in profitable areas leading to a disparity in network coverage between rural and urban consumers (Mureithi, 2002). IS between MNOs is therefore considered a potential solution for deploying mobile networks and services across the continent, especially to economically unviable communities (e.g. Antonopoulos et al., 2015; Garcia & Kelly, 2016; Meddour et al., 2011). Using the coopetition-based view, we thus explore the IS antecedents and drivers among local and MNOs in SSA.

4. Methodology

4.1 Sampling and case selection

Given the paucity of empirical research and lack of public data on coopetition among MNOs in SSA, we adopted an exploratory research approach (Eisenhardt, 1989), which enables us to provide theoretical insights on coopetition in the context of IS between MNOs. Accordingly, qualitative case studies are particularly suitable in addressing why and how research questions, as is the case of this study (Yin, 2014). As we are exploring *the antecedents and drivers of IS*

among MNOs in SSA, the qualitative case study approach allows a more in-depth contextual understanding of these antecedents and drivers within and across cases (Elsahn et al., 2020). We consider the telecommunications industry of a country as a case study and unit of analysis (Yin, 2014). We also complemented the empirical data with data from multiple secondary sources to identify specific cases and triangulate evidence as to mitigate the bias inherent to using a single data source (Eisenhardt & Graebner, 2007). For example, online articles from Alliance for Affordable Internet (A4AI), Balancing Act, IT News Africa, ITWeb Africa, TeleGeography and TowerXchange were useful for tracking the state of IS activities across Africa, getting updated information and data on IS transactions, and identifying interviewees. Further, social media and webpages of telecom regulators and the International Telecommunication Union provided information on relevant regulatory frameworks, archival data on IS, mandated and non-mandated countries as well as the identification of those responsible for IS regulation, some of whom were contacted for interviews.

We adopted purposeful sampling in choosing the case studies (Eisenhardt, 1989; Yin, 2014). This approach is suitable given the lack of empirical studies on IS between MNOs in SSA. To make the phenomena of interest observable (Palinkas et al., 2015; Patton, 2002; Suri, 2011), we focused on the SSA countries where any type of IS activities have occurred. Before the empirical data collection, we first explored industry reports, regulatory websites, corporate websites, specialist magazines, and newspapers to create a list of IS agreements in the telecommunications industry in Africa. We identified the major IS deals in 15 African countries between 2010–2019 in Table 1. To reduce the sample to a manageable level and effectively draw meaningful comparisons across cases, we subsequently decided to focus on seven out of the 15 SSA countries (Ghana, Kenya, Nigeria, Rwanda, South Africa, Uganda, and Tanzania) as our empirical setting. Another criterion for selecting our sample was to include cases where

IS is formally mandated or non-mandated but informally practiced by MNOs. Following these criteria, we contacted MNOs and regulators to request their participation in our study.

[Insert Table 1 here]

4.2 Data collection

The empirical data were collected through semi-structured interviews. In total, we conducted 21 interviews with different stakeholders, such as MNOs managers, regulators, and the civil society, across the selected seven SSA countries. These stakeholders were identified based on existing research, reports from the ITU and TowerXchange, as well as the websites of regulators, towercos, MNOs, and online news articles. Interviewees were contacted via blogs, emails, LinkedIn, and twitter. Other participants were further contacted using snowballing based on the recommendations of interviewees and contacts at various conferences. Interviews were conducted from November 2018 to August 2019, each interview lasting between 40 and 60 minutes. The interview questions focused on the drivers and obstacles of IS, role of institutions in IS, and how firms could mitigate existing obstacles.

The respondents included four regulators from Cameroon, Egypt, Nigeria, and Rwanda; three multinational MNOs public policy directors with a footprint across 20 African countries; three academics and ICT researchers with consultancy experience and research interests in digital inclusion in Africa and other emerging economies; three civil society and international lenders that promote mobile coverage in disadvantaged locations in Africa; and eight access specialists and universal access and service (UAS) consultants that have executed UAS projects across 20 African countries. It is important to note that the four regulatory respondents are somewhat inconsistent with our sample cases of seven countries. The reason for this is due to the refusal of some of the regulators to respond to our interview request. For example, despite several email requests and the lead author engaging with key regulatory figures across Africa

at the Commonwealth Telecommunications Organisation workshop in London and the first and second International Telecommunications Society African Regional Conferences in Accra and Lusaka respectively, many regulators still did not respond to our interview request.

That said, all interviewees had experience and played key roles in shaping the telecommunications industry in Africa and other emerging economies. These respondents were thus knowledgeable enough to provide quality and accurate information on the sampled cases. Secondary sources, such as journal articles, the websites of towercos, MNOs, regulators, and online news articles, were further utilised to triangulate the primary data from the interviews (Eisenhardt, 1989). The authors' interactions with a wider group of stakeholders at the Commonwealth Telecommunications Organisation in London, virtual conversation with members of the Internet Society, and participation to conference presentations and data collection in Ghana, Nigeria, Zambia, and Zimbabwe, yielded complementary data for the triangulation (Pandit et al., 2018). This triangulation allowed for a more refined perspective and was necessary to help mitigate single source or single respondent bias.

4.3 Data analysis

We adopted an iterative approach by moving back and forth between the theory and data to code the 21 interviews using open codes (Gioia et al., 2013; Hahn, 2008; Miles et al., 2014). We began the open coding after the second reading of the interview transcripts as to allow the authors not involved in the data collection to familiarise themselves with the data (Ryan & Bernard, 2003). Therefore, open coding allowed the authors to participate in making sense of the data actively and independently and collectively comparing, adding, deleting, and amending the codes (Saldana, 2016). Descriptive codes were first developed, which reflected the interviewees' language (Gioia et al., 2013). Subsequently, we iterated between the coopetition literature on the antecedents and drivers of coopetition (Dorn et al., 2016) and our data to group similar codes into second-order themes. Finally, the second-order themes were

grouped into aggregate themes. The data structure is presented in Figure 1. In line with our research question, Figure 1 divides the data into two dimensions – the barrier dimension, highlighting IS challenges, and the mitigation dimension, with suggestions on how to improve institutional capacity/incentives and promote co-opetition for IS. Figure 1 was instrumental in helping the authors monitor and achieve theoretical saturation (Eisenhardt, 1989).

[Insert Figure 1 here]

5. Findings

Consistent with the literature review and secondary data evidence on IS in SSA, we found that IS remains a relatively limited practice among the MNOs in SSA, despite the strong policy support. Furthermore, we observed significant differences in the IS level and intensity across the countries in our sample. Through in-depth within and cross-case study analyses, we identified several factors that affect MNOs' coopetitive orientation, that is, the extent to which MNOs are behaviourally disposed towards coopetition (Bouncken & Fredrich, 2016), and their disposition to engage in IS. These factors are related to industry/market characteristics and technological and institutional forces, which together affect MNOs competitive strategies, practices and their inclination to engage in IS.

Our findings are presented in Figure 2. Specifically, the institutional environment shapes the impact of industry/market characteristics and of technological factors on MNOs' coopetitive orientation. The outcome, that is, the level and intensity of IS in a certain sector, recursively impacts the market characteristics and technological factors. Contexts with low IS levels and without efficient regulatory interventions have led to the reproduction of the market conditions that initially inhibited IS. Conversely, contexts with high IS levels have led to a change in market conditions, teaching MNOs how to coopete and further increase their IS

levels. In the following, we outline our findings based on the dimensions in our theoretical model and their underlying relationships.

[Insert Figure 2 here]

5.1 Industry and market characteristics

Our findings indicate that the industry and market characteristics play important roles in determining MNOs' disposition to cooperate through IS. Depending on market size and demand level, competition dynamics, and the level of maturity in the industry in a specific country, MNOs have different perceptions of IS and its benefits. While the interviewees broadly agreed that IS could result in pooling of resources and a reduction in the overall costs of network deployment and maintenance, particularly through the co-location of servers and sharing towers and generator sets, there was a lack of consensus on whether IS would translate into coverage improvement in disadvantaged areas. Interviewees 7 and 12 asserted, respectively:

I actually don't think infrastructure sharing has a big part to play here because of the way in which rural villages work.

Network and infrastructure sharing can stop the ridiculous duplication of infrastructure – but it just can't change the fundamental economics because if you halve the costs, you halve the revenues, and it is still the same equation.

The interviewees argued that, while sharing, in general, could lower costs so that it becomes economically feasible to provide services, it does not change prevailing circumstances such as a sparse population density, low ICT usage, and low-income levels in disadvantaged areas. Hence, there may not be enough customers to compete for or their ability to afford telecommunication services might be restricted by their disposable incomes. Further, sharing might not necessarily work in disadvantaged areas because whoever is first to deploy a technology to a given village, for example, gets most customers. In this case, MNOs might not be interested in such a location even if there is an opportunity to share infrastructure.

Furthermore, while the interviewees agreed that more costs-savings can accrue to MNOs from sharing infrastructure with their rivals, opinions were mixed on the idea that

MNOs would then reinvest the resulting revenues in areas lacking coverage, thereby shifting the burden to other parties. The literature refers to this as the ‘transfer of risk’ to others within a sharing agreement (Bing et al., 2005; Kargol & Sokol, 2008). These issues are exacerbated in contexts where there are no institutional incentives. In such cases, incumbent MNOs tend to be reluctant to share their networks with new entrants.

The degree of network coverage symmetry was another factor mentioned by interviewees. Among the sampled countries, there exists network asymmetry among MNOs due to markets being dominated by one or two MNOs for several years before the governments allowed the entry of additional operators. Interviewees revealed that the competitive nature of MNOs is a barrier to increasing IS. This is underlined in the following interview excerpt:

The answer [the lack of IS adoption] really depends on the market. In some cases, MNOs may be reluctant to give up strategic tower positions (e.g. on hills) or share access with competitors. (Interviewee 20)

Interviewee 4 stated that, in terms of network coverage, some MNOs are ‘good’ on some markets and not so good in others. Typically, in the markets where MNO networks are widespread, they hesitate to share infrastructure to keep their market leader advantage but prefer sharing in markets where they have weak positions.

Our dataset coalesces around the view that competition further complicates IS adoption, as MNOs believe that sharing would cause them to lose their competitive (or first-mover) advantages and, by extension, their market share. This is because several MNOs in SSA compete in terms of cost and network coverage rather than service and technological innovation and, thus, sharing their infrastructure is perceived as eroding their competitive advantages. This is further exacerbated by the issue of on-and-off net tariffs – considering that MNOs who rollout first often capture the market and maintain their market share through on-net tariffs. On-net tariffs refer to MNOs offering low tariffs to users within the same network and higher off-net tariffs to users on rivals’ networks. In this scenario, apart from the

unwillingness of incumbents to share their networks, MNOs with low numbers of subscribers may not benefit much from IS because of the high margins between on-and-off net tariffs. This suggests that network externality tends to favour the incumbents, while its negative impact on small players may altogether lead to a lack of IS.

5.2 Technological factors

Our findings further illustrate that technology-related factors are important antecedents of MNOs' disposition to engage in IS. Network and technology compatibility, complementarity, and interoperability are important determinants of MNOs' assessment of IS perceived benefits. Accordingly, network compatibility has held back IS adoption. The interviewees argued that, for smooth IS operation, the networks of different MNOs need to be compatible to enable interoperability. Interviewee 16 revealed that:

*From the *** [an international lending organisation] side, what we are trying to push is cross-sector infrastructure sharing in East Africa but complexities in technology such as network compatibility are restricting progress.*

Interviewee 2 was particularly vocal on cross-sector IS, arguing that since the most expensive part of infrastructure deployment are civil works, namely the digging and paving of roads for laying cables, cross-sector collaboration between sectors could help reduce costs. For example, the ministry of works can collaborate with the ministry of telecommunication by inviting MNOs to lay their cables during road construction. This will reduce infrastructure deployment costs for all the parties involved and, since such activity may require permission and/or rights of way, these could be negotiated and obtained jointly. However, recounting the experience of Eastern African countries, interviewee 16 stated that the implementation of cross-sector IS can be problematic, owing to the complexity that arises from the lack of network compatibility – as the networks of different MNOs are built-out using equipment from different vendors such as Ericsson, Huawei, and Nokia. While some equipment is standardised, others may be proprietary technology unique to individual vendors/MNOs. This suggests that, in the

event of IS, the compatibility of networks may be difficult and, by extension, so would their interoperability.

Concerns over intellectual property protection (IPP) is another issue impacting MNOs' disposition to cooperate. Apart from standardised technology, core networks contain proprietary technology may be patented and exclusive to a particular MNO (D'Este & Patel, 2007; Fatehi & Choi, 2019). Respondents noted that the lack of trust among MNOs due to weak institutions could exacerbate the fear of losing such patent technology to rivals. SSA countries suffer from institutional voids (see Table 2 for selected SSA rankings), which materialise in the form of weak IPP laws and inefficient dispute resolution mechanisms, which amplify MNOs' concerns over IPP and knowledge sharing, which are integral part of IS agreements.

Apart from the fear of losing proprietary technology, interviewees argued that the concerns over QoS are another technological issue that limits IS adoption in Africa. For example, Interviewee 1 stated that:

In Nigeria, the colocation of infrastructure is entrenched in the industry, and active infrastructure sharing is what is now being developed for the industry by the regulator. However, the operators have mixed views about the introduction and acceptability of active infrastructure sharing due to [...] quality of service concerns.

Interviewee 1 further asserted that the threat of diminished QoS owing to IS might undermine revenue. This is because coverage and service reliability are among the critical factors that influence the choice of mobile users. Interviewee 19 added that MNOs, particularly incumbents, sometimes accuse other MNOs of disrupting the performance of their networks due to increases in mobile users and traffic. Our dataset suggests that an increase in the number of mobile users without a corresponding increase in network capacity tends to reduce QoS. As such, MNOs are reluctant to participate in IS to maintain their QoS and customer experience. Regardless of IS, poor QoS is prevalent in Africa (Onyeajuwa, 2017; TeleGeography, 2018).

5.3 Institutional environment

As highlighted in the previous sections, our dataset highlighted that the weak institutional environments in the analysed countries exacerbate the issues related to market and technological factors. Our findings further show that a country's institutional capacity – in terms of robust legal and regulatory framework – and the capacity to enforce it, as well as institutional incentives, can act as drivers or prohibitors of IS for MNOs. This is reinforced by interviewee 11:

We have also tried to push this through regulatory infrastructure, but the regulator is not very effective in helping to drive decisions with the needed framework [...].

IS arrangements involve several complex issues, which in the absence of a clear regulatory framework, can discourage MNOs from collaborating. Interviewees highlighted that, whilst regulators are quick to mandate IS, there is little to no provision within IS frameworks on how to deal with, for example, cost issues. This has created frictions among MNOs in countries such as Zimbabwe, where Econet has refused to share its infrastructure until a 'fair' costing structure is put in place, since Econet has invested more in deploying infrastructure over time compared to its rivals (Mhlanga, 2017). Interviewee 5 further asserted that, without a robust IS regulatory framework, it becomes difficult to structure the rules of engagement to prevent infrastructure owners from exploiting that ownership unfairly, engaging in collusive behaviour with other large players, and using their market power to make excess profits. The lack of a clear regulatory framework also has implications for how MNOs address issues of infrastructure maintenance and upgrade. Interviewee 5 commented that:

The second issue [with infrastructure sharing] is ensuring that networks are upgraded as required and I think that can be more difficult to do if you have a single network. This makes it difficult to ascertain, for example, who is to be responsible for network maintenance, when is the right time to carry out an upgrade, who pays for it [...], and how to calculate what each MNO needs to contribute?

Since telecommunication networks are affected by obsolescence and changes in technology, interviewees noted the need to make provisions for periodic network maintenance

and eventual upgrades. Zimbabwe is one example where the incumbent, Econet, has resisted sharing its infrastructure with Telecel and NetOne on the grounds that all MNOs have to equally contribute to network maintenance. Since this issue is not currently covered within the IS framework, IS has become problematic in Zimbabwe (Mhlanga, 2017).

A reason for this lack of a robust legal and regulatory framework is the general lack of regulatory capacity. This capacity includes the level of relevant skills and funds available to enable regulators to discharge their duties. Interviewees argued that, although regulatory capacity is critical to the successful use of IS in advancing mobile coverage, regulatory bodies across Africa are generally faced with skill and funding shortages. For example, interviewee 18 asserted that:

Then, you may also think of mandating it [infrastructure sharing] but then you may need to force them, you need to monitor it, you need to come up with a fair price etc., and all these further lead to complications given the general lack of regulatory capacity in most countries.

There exists consensus among interviewees that, to create a robust legal and regulatory framework, regulatory authorities need to be able to rely on people that have the relevant skills and on funds to enforce implementation, especially when considering the growing number of countries, including Uganda and Zimbabwe, that are beginning to mandate IS (Arakpogun et al., 2017). The lack of incentives from governments to encourage MNOs towards IS was also highlighted by the interviewees. Accordingly, regulators need to offer policies that include better incentives to those who can deploy, for example, more towers. For example,

Deployment of infrastructure together is actually a great idea. The problem for the government is to make it happen. The basic task for the government, in this case, is to provide incentives for operators to collaborate; where this is lacking, infrastructure sharing becomes problematic. (Interviewee 2)

Trust is a critical success factor for the multilateral cooperation on infrastructure (Warsen et al., 2018). However, interviewees revealed that the lack of trust among competing MNOs undermines the quality of services. Moreover, there appear to be trust-related issues

between MNOs and policymakers due to concerns that the regulatory and legal framework needed for an effective IS implementation in Africa may be lacking. This is evident from the following responses:

But we know that [infrastructure sharing] works in certain type of countries, but do we know if it works in an African country? The regulators and the operators recommend it [...] but if you want to share things, then it needs some level of trust. Do I trust the operator? Do I trust the regulator to oversee it? [...] So, you have the legal regime in most countries to enforce a sharing agreement? Or do the operators trust each other enough to avoid going to court? [...] So when you say let's share things, we can potentially run into quite serious problems. (Interviewee 6)¹

Think about the pros and cons of getting married! And then translate that into sharing a bed with someone you don't love (trust). (Interviewee 3)²

Interviewee 19 further corroborated this by recounting a recent experience from Liberia, where the three major MNOs attempted several times to engage in IS for a few months before the arrangements fell apart due to the lack of trust among operators. It is good practice for the IS regulatory and legal framework to include some level of regulatory governance, which translates into enforcing guidelines for smooth implementation and a speedy dispute settlement mechanism (Fedorowicz et al., 2018; Mkhomazi & Iyamu, 2011). Our dataset revealed that, in countries where effective governance mechanisms are lacking, trust is eroded, and it becomes difficult for MNOs to support or take up IS. Overall, the interviewees suggested that a lack of trust limits cooperation and the adoption of IS among MNOs.

5.4 MNOs coopetitive orientation

Industry/market characteristics, technological factors, and the institutional environment shape firms' coopetitive orientation. The external environment affects MNO managers' assessment of the perceived benefits of IS. This also shapes their mental models that determine the way they perceive competitive environments. Some possess a coopetitive mindset, being 'people

¹ An independent telecommunications policy analyst.

² A long-term UAS consultant and independent researcher.

who have the cognitive frames and cognitive processes to understand and handle the paradox' of cooperating and competing simultaneously (Gnyawali et al., 2016, p. 13), while others possess a competitive mindset which emphasises maximising firm benefits without collective action. A key attribute that enables the successful adoption of technology is the support of top-level management through a firm's business strategy (Angeles, 2013; Awa et al., 2016).

Our analysis further emphasises the importance of MNOs to develop a coopetitive orientation as to scale up IS in Africa. MNOs' coopetitive orientation is the extent to which they are behaviourally disposed to cooperate with their competitors. This orientation materialises in a firm's dominant logic, being reflected in its routinised ways of doing things and embedded in its organisational strategies and processes. If they have a coopetitive orientation, MNOs view IS as part of their business models and look for ways to mitigate existing and potential challenges. Conversely, if MNOs do not see IS as part of their business strategy, its adoption becomes a problem from the outset, such as in the case of South Africa, where MNOs such as MTN have been criticised for not implementing IS despite the directives of the Electronic Communications Act (van de Groenendaal, 2018). This helps explain why the independent ownership of the 30,000+ towers in South Africa is below 10%, despite being one of the leading mobile markets in Africa. Interviewee 11 affirmed that:

We have very strong views in order to provide proper broadband, especially like LTE, that the only model to go is to build a shared broadband network in which we all become wholesalers (tenants).

Another MNO that has embraced IS as a business strategy is Bharti Airtel of India, with a mobile footprint across 14 African countries (Arakpogun et al., 2017), as confirmed by Interviewee 4:

I think, as operators we have increased our level of engagement because we feel that we would provide more value to the sector by looking at efficiency and one of the ways of doing it is by sharing infrastructure. This is [...] something that we align with.

To reduce duplication and operation costs, Airtel made a top management decision to outsource their passive infrastructure to a dependent firm – Indus Towers – via JV ownership with rivals such as Vodafone (Palepu & Bijlani, 2012). These answers also highlight the need for MNOs to shift from a competition-based dominant logic to a coopetitive one to be able to embrace IS. Since IS is rooted in the business and operation strategy of Airtel, Airtel has offloaded 10,000+ towers, becoming the leading adopters of PIS in Africa (TowerXchange, 2016). As MNOs start to engage in IS, the related learning process shapes their perceptions of how to work coopetitively. Increasing the IS level in turn changes the market characteristics and the level of trust among collaborating MNOs starts to increase. However as previously highlighted, for trust to emerge among MNOs, there is a need for an efficient regulatory environment.

5.5 Mandating versus non-mandating IS

Our findings point out that, for IS to be successful, governments need to create an enabling environment that encourages MNOs to participate in this process (Garcia & Kelly, 2016). Interviewees argued that the emerging trend of mandating IS in African countries can discourage MNOs to cooperate with the regulators and participate in IS. Interviewee 14 illustrated this thought as:

The government of Uganda has an agreement with Korea Telecom to build one of these networks [...] but if this network is built but none of the existing Ugandan operators want to use it, then it's a disaster. So, for sharing to work, the government needs to find a way to do it in a cooperative way with the industry. I don't think you can force operators or should force operators to share where they don't want to.

Evidence of the difficulty of mandating IS can be observed in South Africa, Tanzania, Uganda, and Zimbabwe. Consequently, following criticism, South Africa recently withdrew its proposed Electronic Communication Amendment Bill, which, among other things, mandated MNOs to provide wholesale access to infrastructure on an open-access basis. In

acknowledging this problem, Interviewee 9³ suggested that it would be initially preferable to encourage MNOs to discuss IS amongst themselves, while also defining the general framework and maximum lead times for the realisation of the relevant practical modalities. Failing this, the regulator can then intervene to establish the rules applicable to all MNOs for IS implementation. Moreover, other interviewees argued that, if regulators want to mandate IS, they need the capacity to monitor and enforce it, which has proven to be lacking.

The comments of the interviewees validated the suggestion that, instead of mandating IS, policymakers should create favourable conditions and incentives to encourage MNOs to embrace IS (Malungu & Moturi, 2015; Schorr, 2008). The implementation of IS has been successful in India, relative to African countries, due to a strategy of incentives to encourage IS in a manner that does not undermine competition (Cohen & Southwood, 2008). For example, MNOs that participate in PIS benefit from the financial subventions for rural locations; earnings from IS could be subject to tax exemptions, the terms of IS are based on commercial agreements between MNOs; licence conditions have been amended to allow for AIS albeit restricted to antennas, feeder cables, radio access network, and transmission systems; and MNOs can explore alternative sources of energy to tackle the lack of electricity (TRAI, 2007). ITU News Magazine (2017) concludes that, although many factors contributed to the growth of mobile telecommunications in India, PIS played an important part. Table 2 provides a summary of our findings and highlights the main similarities and differences across the sampled cases in relation to their stance on IS mandates.

[Insert Table 2 here]

³ The UAS director of a regulatory authority in Africa.

6. Discussion and Conclusions

Theory strongly suggests the practice of rival firms pooling resources together to cooperate in one domain, while competing in other functional areas. However, the empirical literature on the drivers and barriers of coopetition is limited and shows mixed results. Moreover, this research stream has neglected the role of institutions in fostering coopetition (Dorn et al., 2016; Lascaux, 2020). Using a sample of MNOs across seven SSA countries and based on the coopetition-based view (Amankwah-Amoah, 2020), we found evidence of the limited coopetition among MNOs. The limited uptake of the important coopetition practice of IS is caused by a number of factors. Our study reveals that the institutional environment, market/industry structures, and technological factors impact MNOs' orientation towards cooperative strategies. We also found that institutional factors shape the impact of the industry structure and technological factors on firms' propensity to engage in cooperative strategies. Regulators and institutional environment characteristics play important roles in incentivising or disincentivising firms to cooperate, even if the market conditions are not necessarily conducive for cooperative behaviours. Regulators in the telecommunications sector can, through their interventions, correct market failures or create additional ones.

Together, the institutional, market, and technological factors shape MNOs' cooperative orientation (Bouncken & Fredrich, 2016). Additionally, the managers of such MNOs can perceive the benefits of cooperative strategies and trust their partners and the regulators. There is evidence that MNOs' cooperative orientation determines their participation in IS and their level of engagement in active versus passive sharing. Finally, the level of IS practices in certain contexts influences the industry, market structure, and technological factors. In contexts with low-level IS, inadequate regulatory interventions mean that the existing market conditions are reproduced, leading to further competitive behaviours from MNOs. Whereas in for high-level

IS, MNOs tend to engage in further coopetitive strategies through strategic learning, as well as cooperate to resolve technological incompatibilities and engage in standards settings.

Similar to the coopetition literature, we find coopetition is likely to occur under specific market and industry conditions (Dorn et al., 2016; Dowling et al., 1996; Padula & Dagnino, 2007). We find that demand, market size, and the saturation level impact MNOs propensity to engage in IS. In several SSA countries, the rural areas with low-income levels and low population density are not economically attractive for MNOs due to their high sunk costs even when jointly deploying networks. The incumbents who might already have created networks in such areas can be reluctant to share their networks with new entrants. Furthermore, the mobile technology level is still lagging in several SSA countries, with some areas still operating on 2G networks. In these markets, MNOs compete based on network coverage rather than service differentiation or introducing new technological innovations. As such, incumbents are reluctant to engage in IS, as this would erode the competitive advantage on which they depend.

Finally, in SSA countries, the industry has likely been dominated by one or two MNOs for a number of years before the entry of additional MNOs. This has led to asymmetric networks, whereby the incumbents have wider and greater network capacities. The incumbents thus tend to prefer avoiding IS to preserve their competitive advantage. These issues are exacerbated in countries with weak institutional environments that lack the institutional capacity to provide a clear regulatory framework for defining and managing IS. Moreover, the lack of institutional incentives, in the form of efficient universal service funds or tax incentives to encourage the sharing or joint deployment of networks among MNOs, lead MNOs to adopt a competitive rather than a cooperative orientation.

Our findings also show the importance of technological factors in influencing MNOs coopetitive orientation. The coopetition literature points to the importance of technological complementarity and resource endowment similarity for inducing coopetition between

competitors (Dorn et al., 2016; Gnyawali & Park, 2009). Firms might collaborate in the context of R&D to acquire knowledge that is otherwise inaccessible. In the context of IS, this translates to network coverage and locations, which might motivate MNOs to engage in IS if their network coverage is complementary. However, the compatibility of the technologies used by MNOs to enable IS is equally important. Differences in capabilities can also be a barrier to IS, as some MNOs express concerns about QoS issues due to IS on networks with limited capacity. Finally, concerns on information and knowledge sharing and IPP also inhibit MNOs from IS. This is particularly prominent in the absence of a robust and transparent regulatory framework that clearly defines IS. The lack of institutional capacity results in limited trust among MNOs, leading to a reduction in the perceived benefits of IS and the adoption of a more competitive orientation. Strong institutional environments are thus vital for facilitating MNOs' engagement in IS through effective regulatory interventions.

Our findings further suggest induced and mandated coopetition practices among the sample MNOs. However, in the telecommunications industry, the distinction between forced (mandated) and induced (non-mandated) IS is too simplistic and its impact contingent on several factors. There are variations among countries regarding the way IS is mandated. This includes strict rules in requiring IS, approaches requiring PIS, and approaches which encourage but does not mandate it. Where IS was mandated, the incumbent MNOs engaged in passive collaboration (Czakoń & Rogalski, 2014), which entails following the minimum legal requirements. This practice has led some MNOs to be reluctant to invest in new networks or engage in network upgrades and technology development due to the lack of a clear regulatory framework and institutional incentives. However, in contexts where a 'softer' approach was adopted or where IS was not mandated at all, IS sharing practices emerged over time with encouragement from regulators.

6.1 Theoretical contributions

Overall, our study contributes to the coopetition and IS sharing literature by pointing out and specifying how the institutional environment can induce or hinder coopetitive behaviours among firms. Although the impact of external institutions on coopetitive behaviours is well recognised, our understanding of institutional influence is not sufficiently developed (Dorn et al., 2016). Our study adds to this body of knowledge by highlighting the essential role of strong and efficient institutions in scaling up IS among MNOs. Moreover, it underscores that mandated and non-mandated regulatory environments trigger different cooperative or competitive logics among managers and firms.

Additionally, the significant role of trust in developing coopetitive behaviours and fostering coopetitive practices has been highlighted, thus enriching the coopetitive perspective scholarship and enhancing our understanding of the phenomenon. However, our context is important in further enriching our understanding of coopetition dynamics (Bengston & Raza-Ullah, 2016; Dorn et al., 2016). The telecommunications industry as a highly regulated and high-tech industry is important in determining the different dynamics of coopetition across industries. Finally, the research focus on SSA countries, given their unique characteristics, has enhanced our understanding of coopetition dynamics.

Our paper further draws attention to the socio-environmental benefits of coopetition (Blanco et al., 2009; De Marchi, 2012). The literature on coopetition has mostly focused on situations where firms engage in coopetition to derive private benefits (Volschenk et al., 2016). However, as Volschenk et al. (2016) argue, coopetitive relationships can have societal and environmental benefits beyond individual firms' benefits, which accrue to a wider set of stakeholders. Our paper draws attention to the context of IS between MNOs, which in addition to reducing MNOs costs, also has important environmental implications and the potential to expand telecommunication and mobile network services to underserved areas.

6.2 Policy recommendations and contribution to practice

There are number policy implications stemming from our findings. First, to mitigate the lack of trust, policymakers could facilitate an environment where MNOs are obliged to each other by creating a JV model of IS as open access that is managed by the government. This would mean rival firms all have a stake in the successful outcome of IS and could be even managed by the private sector, which is better skilled and equipped to execute IS, and regulated by policymakers to prevent rent-seeking MNOs from exploiting the situation. Second, to address the issue of risk-shifting, where some MNOs are accused of not re-investing the cost-savings from IS in areas lacking coverage, policymakers could ensure public disclosure, so that stakeholders such as the civil society could use the information to demand accountability from the various parties involved. Third, to address the concern that IS on its own cannot provide a mechanism to change the prevailing circumstances in non-commercially viable areas, the case for a natural monopoly was made. Interviewees argued that, for a country with geographical challenges such as large distances and isolated areas, limited competition that guarantees increasing returns to scale may be a better choice.

Isolated areas could be allocated among MNOs, which could then be issued a ‘non-competing licence’ to be the sole providers of their allotted locations. This would enable MNOs to serve isolated areas without competition. Additionally, policymakers should consider mandating the elimination of mobile termination rates (MTR) between MNOs for serving isolated areas, so that all players can connect customers across such areas to the national network. Mandating MTR for isolated areas would allow the various MNOs national roaming and connectivity with rival networks in areas they lack footprint and vice versa. This would not only contribute to addressing affordability, but also encourage wider IS participation. This approach would also prevent incumbents from charging high off-net tariffs that could hinder

the expansion and operation of small players and limit them from benefiting from network externality.

6.3 Limitations and scope for future research

Although this study has yielded insightful outcomes and enriched the coopetition literature, it is not without limitations. Despite the several attempts of contacting more participants to balance the spread of stakeholder groups, our efforts have only limited success. This is particularly notable among regulators; whose websites were either not accessible and/or contacts were difficult to make. Most regulators whose contact details were available were not willing to participate; it also took over 6 months to conclude the interview process with the consenting regulators compared to the 1 month for multinational MNOs and UAS consultants. Furthermore, while this research was conducted from the supply-side perspective of improving physical infrastructure, the digital divide in Africa can also be explained from a demand-side standpoint, which is not covered in this paper. Therefore, future research could investigate IS from a demand-side perspective to uncover how barriers such as affordability, digital awareness and literacy, lack of local content, and digital gender divide could limit IS adoption.

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Table 1: Examples of major infrastructure sharing deals across Africa during 2010–2019

Date	Deal	Value	Outcome	Country
2019	SBA Communications acquired 900 towers from Atlas Towers SA via JV	USD 140 M	Deal completed	South Africa
	American Tower acquired 5,510 towers from Eaton Towers via outright acquisition	USD 1.85 B	Deal announced, yet to be completed	Burkina Faso, Ghana, Kenya; Niger, Uganda
2018	American Tower acquired 723 towers from Telkom Kenya via SLB	Undisclosed	Deal announced, yet to be completed	Kenya
2016	American Tower acquired 300 towers from Eaton Towers	Undisclosed	Deal announced, yet to be completed	South Africa
	Helios Towers acquired 967 towers from Airtel via SLB	USD 165 M	Deal completed	DRC
	IHS Africa acquired 160 towers from Hotspot	Undisclosed	Deal announced, yet to be completed	Nigeria
	American Tower acquired 1,350 towers from Airtel via SLB	USD 179 M	Deal announced, yet to be completed	Tanzania
	Helios Towers acquired 185 towers from Zantel via SLB	USD 6.7 M	Deal partly completed	Tanzania
	IHS Africa acquired 1,211 towers from Helios Towers	Undisclosed	Deal completed	Nigeria
2015	IHS Africa acquired 555 towers from Etisalat Nigeria (now 9Mobile) via SLB	Undisclosed	Deal completed	Nigeria
	Eaton Towers acquired 2,000 towers from Mobinil via SLB	USD 131.15 M	Deal subsequently cancelled	Egypt
2014	IHS Africa acquired 1,269 towers from MTN via SLB	Undisclosed	Deal completed	Rwanda
	IHS Africa acquired 550 towers from MTN via SLB	USD 48 M	Deal completed	Rwanda
	Helios Towers acquired 394 towers from Airtel via SLB	Undisclosed	Deal completed	Congo B.
	IHS Africa acquired 2,136 towers from Etisalat Nigeria via SLB	USD 485 M	Deal completed	Nigeria
	IHS Africa acquired 9,151 towers from MTN via JV of 51:49 in favour of MTN	USD 882 M	Deal completed	Nigeria
	Eaton Towers acquired 2,500 towers from Airtel via SLB	Undisclosed	Deal partly completed	Burkina Faso, Ghana, Kenya, Niger, Uganda
	American Tower acquired 4,717 towers from Airtel via SLB	USD 1.06 B	Deal completed	Nigeria
	IHS Africa acquired 1,113 towers from Airtel via SLB	USD 181 M	Deal completed	Rwanda, Zambia
	IHS Africa acquired 949 towers from Airtel via SLB	USD 150 M	Deal completed	
2013	IHS Africa acquired 2,000 towers from Orange	Undisclosed	Deal completed	Cameroon, Cote d'Ivoire, Zambia
	Eaton Towers acquired 1,000 towers from Telkom Kenya	Undisclosed	Deal subsequently cancelled	Kenya
	Helios Towers acquired 1,149 towers from Vodacom via SLB	USD 75 M	Deal completed	Tanzania
2012	Eaton Towers acquired 300 towers from Orange via SLB	Undisclosed	Deal completed	Uganda
	Eaton Towers acquired 400 towers from Warid via SLB	Undisclosed	Deal completed	Uganda
	IHS Africa acquired 820 towers from MTN via SLB	USD 143 M	Deal completed	Cameroon
	IHS Africa acquired 931 towers from MTN via SLB	USD 141 M	Deal completed	Cote d'Ivoire
2011	American Tower acquired 1,000 towers from MTN via JV of 51:49 in favour of American Tower	USD 89 M	Deal completed	Uganda
2010	Helios Towers acquired 750 towers from Tigo via JV of 60:40 in favour of Helios Towers	USD 54 M	Deal completed	Ghana
	Helios Towers acquired 400 towers from Multilinks	Undisclosed	Deal completed	Nigeria
	IHS Africa acquired 800 towers from Visafone via SLB	USD 67 M	Deal completed	Nigeria
	Eaton Towers acquired 750 towers from Vodafone	Undisclosed	Deal completed	Ghana
	SWAP acquired 407 towers from Starcomms via SLB	USD 81 M	Deal completed	Nigeria
	American Tower acquired 1,400 towers from Cell C via SLB	USD 200 M	Deal completed	South Africa
	American Tower acquired 1,876 towers from MTN via JV of 51:49 in favour of American Tower	USD 21.85 M	Deal completed	Ghana
	Helios Towers acquired 729 towers from Tigo via JV of 60:40 in favour of Helios	USD 45 M	Deal completed	DRC
	Helios Towers acquired 1,020 towers from Tigo via JV of 60:40 in favour of Helios	USD 80 M	Deal completed	Tanzania

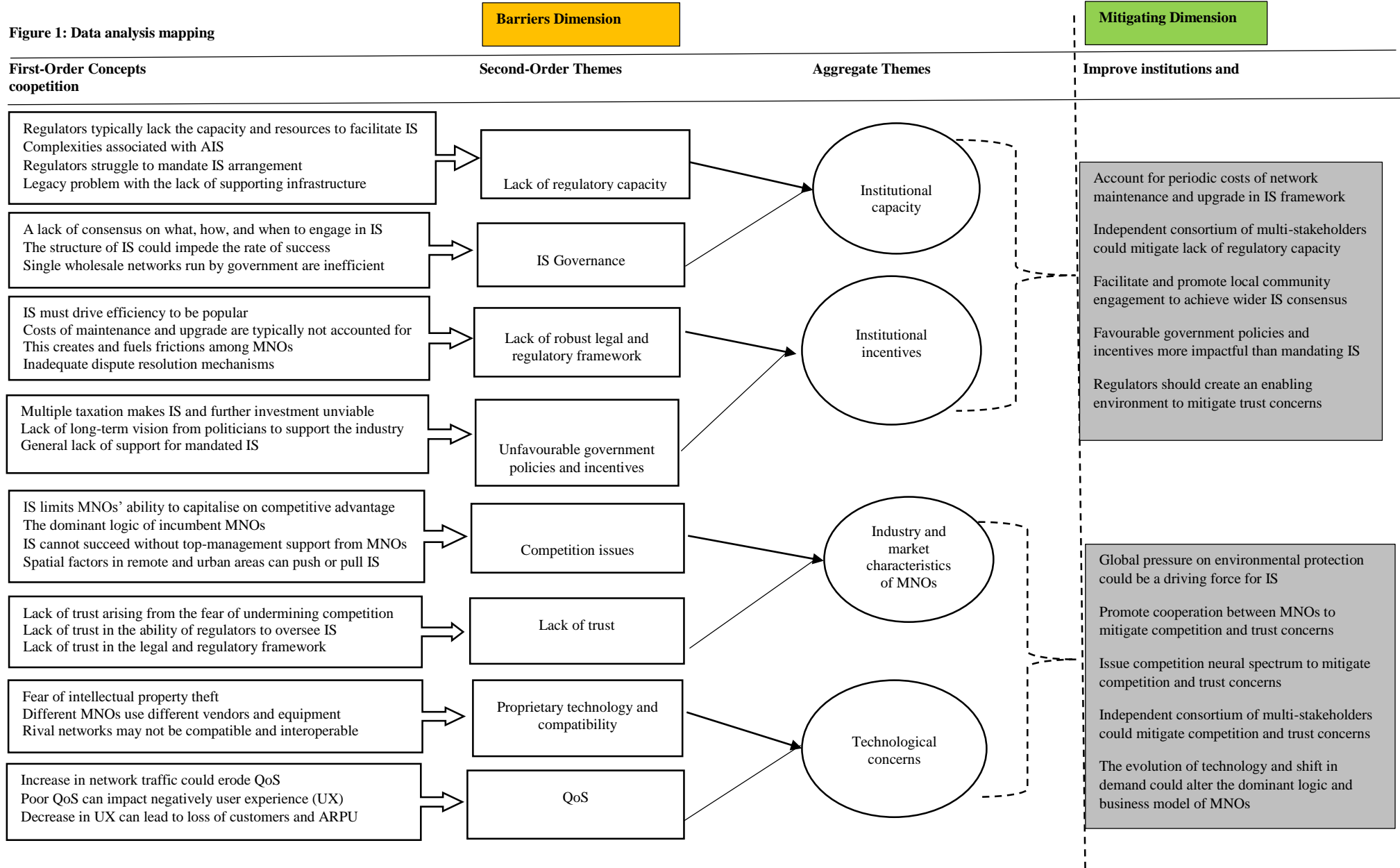
Sources: Compiled by the authors from various online sources, such as MyBroadband, TechCentral, The EastAfrican, and TowerXchange.

Table 2: Summary of findings across cases

Countries	Mandated versus non-mandated IS regulations	Telecom industry structure	Existing IS agreements	Incentives to engage in IS	Perceived Barriers by MNOs to engage in IS – Differences	Similarities
Ghana	Mandated	3 MNOs	5	Waiver of regulatory fees and tax exemptions for MNOs have been proposed by the regulator but there is no evidence of implementation	Lack of institutional incentives Finding the right balance between competition and cooperation Risk of reduced infrastructure investment	Difficulties of obtaining relevant clearance from inter-governmental agencies and local communities when it comes to, for example, rights of way and environmental approvals
Kenya	Mandated	3 MNOs	4	License fees and taxation concessions proposed but not implemented	The complexity of managing stakeholders	
Nigeria		4 MNOs	9	Regulator acting as a mediator in the event of a dispute	Incompatibility of technology and networks	
Rwanda	Mandated	3 MNOs	3	Strong ICT leadership from government, which is driving the overall digital inclusion agenda MNOs can apply to the regulator to share the existing tower site of another operator	Adapting existing tower sites to accommodate multiple MNOs could be costly and problematic to allocate between MNOs Accessing connecting points for shared fibre-optics is problematic due to complications from extra negotiations with operators, for example, Tanzania given that Rwanda is landlocked	Trust issues between MNOs
South Africa	Mandated	4 MNOs	3	A ‘proportional’ reduction in licence fees for MNOs building a single network Offsetting such cost against universal service contribution No evidence to suggest the implementation of these incentives	The lack of a clear definition of ‘infrastructure’ results in confusion and disagreement from MNOs and other stakeholders A lack of wider stakeholder consultation in infrastructure sharing policies The lack of cooperation in areas with poor infrastructure and local loop unbundling	Insufficient network capacity and poor QoS risk The unwillingness of incumbent MNOs to share due to dominant logic and investment protection
Uganda	Mandated	7 MNOs	5	Financial incentives were proposed by the regulator but there is no evidence to suggest implementation	MNOs perceive the Ugandan government’s direct deployment of broadband infrastructure as problematic in a liberalised market. MNOs argue that this would create a state monopoly that could hinder innovation and future industry development	General lack of IS-enabling policies
Tanzania	Mandated	7 MNOs	4	While IS is mandatory, MNOs are free to negotiate a ‘standard’ sharing agreement underpinned by a cost-price model. The possibility of sharing fibre optics for more revenues with neighbouring landlocked countries like Rwanda makes IS attractive to MNOs in Tanzania	The lack of supporting infrastructure, such as roads and electricity, in disadvantaged areas makes IS less attractive to MNOs The lack of a comprehensive regulatory framework for fair competition between the incumbent and new entrants	

Sources: Compiled by the authors from interacting with key interviewees, regulatory websites and other secondary sources such as Arakpogun et al. (2017), GSMA Intelligence, ITU News Magazine and TowerXchange

Figure 1: Data analysis mapping




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graph LR; IC[Institutional capacity] --> MCO[MNOs cooperative orientation]; II[Institutional incentives] --> MCO; IMS[Industry and market structure] --> MCO; TF[Technological factors] --> MCO; MCO --> ISP[IS sharing practices];
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The diagram illustrates a conceptual model of IS sharing practices. It features six main components in grey boxes: **Institutional capacity**, **Institutional incentives**, **Industry and market structure**, **Technological factors**, **MNOs cooperative orientation**, and **IS sharing practices**. Arrows indicate the following relationships: **Institutional capacity** and **Institutional incentives** point to **MNOs cooperative orientation**. **Industry and market structure** and **Technological factors** point to the arrow connecting **MNOs cooperative orientation** to **IS sharing practices**. **MNOs cooperative orientation** points directly to **IS sharing practices**. The content of the boxes is as follows:

- Industry and market structure**
 - Market conditions (size and demand)
 - Competition intensity
 - Technological stage
 - Network asymmetry
- Technological factors**
 - Technological compatibility and network interoperability
 - Quality of service
 - Intellectual property protection
- MNOs cooperative orientation**
 - Dominant logic and managerial mental models
 - Past experience in cooperation
 - Perceived benefits
 - Trust in partners