R&D MANAGEMENT

Grand challenges, corporate legitimacy, and community integration: an integrative smart technology model

Rama Krishna Reddy Kummitha[1,2,*]

[1]Newcastle Business School, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK.
[2]School of Liberal Arts & Humanities, Woxsen University, Kamkole, Sadasivpet, Sangareddy District, Hyderabad, Telangana 502 345, India. mailtokrkr@gmail.com

By referring to the smart city industry, this research studies how commercial firms gain legitimacy when their products aim to address grand challenges. Despite the reputation of giant technology companies and the overall legitimacy they enjoy in technology markets, exploiting opportunities in social contexts connected to grand challenges requires a societal-oriented approach. Firms that engaged in smart cities initially approached cities with a business-as-usual approach, to be met with sharp criticism from local communities and pressure groups. In response, firms had to redraw their strategies to include communities in the process to stay close to local reality. This paper theorizes the process and highlights an Integrative Smart Technology Model (ISTM) to narrate how firms strategically include communities in the planning process and gain legitimacy for the technologies.

1. Introduction

In his book on Technology and Social Inclusion, Mark Warschauer (2003) discussed how Ireland's national telecommunications company through a national competition in 1997 offered a $22 million cash prize to a small town called "Ennis," which had about 15,000 people residing in the town, to advance its technological visibility. The award amount was equal to a whopping $1200 per resident. Quick implementation of a plan that was envisaged in a top-down orientation followed. Every family was given an internet-ready personal computer, personal websites were made available for businesses that needed one, and smart cards for every family and smart-card reader for every business were offered to promote cashless payments. On the other hand, three runner-up towns – Castlebar, Kilkenny, and Killarney – were given $1.5 million each and were allowed to take as much time as needed to plan for the utilization of cash prizes. Three years down the line researchers found that the winning town Ennis had little progress to show although technology devices were given to residents, the problem was that people hardly had any clue about how to utilize them. Training programs were conducted, but there was no follow-up awareness building. This resulted in people not showing interest in using the technology equipment and rather choose to sell them on the black market. Whereas the remaining three towns with limited resources and much-needed time in hand, organized communities, local businesses, and labor unions together to plan the utilization of resources to build a technological vision, which helped them to make use of the resources effectively. In the end, these three towns had a significant technological impact to showcase

than the winning town. The difference between the winning town and the remaining towns that achieved significant impact despite the low resources awarded was that the latter had taken the consensus from the key local constituencies while building the technological vision. The local vision and the community interactions helped the towns to achieve a great visible impact.

Addressing the grand challenges of our times requires interactive partnerships among key actors in a society coming together to share their concerns, knowledge, expertise, and resources. Grand Challenges also known as societal challenges are those that are persistent and require enormous efforts from all sectors of society (George et al., 2016; Hamann et al., 2020). Grand challenges not only affect societies negatively but create a ripple effect and cause other associated societal problems. Failing to address these challenges would result in a significant proportion of people end up being disadvantaged, poor, and deprived. For example, climate change, poverty, inequality, terrorism, etc. all create additional social problems, which would have a massive impact on society if not addressed. Given the potential impact these challenges may have on society, apart from the governments and civil society groups, corporate firms have started to address them, albeit often with a commercial orientation (Roulet and Bothello, 2022). While firms intend to address grand challenges is a welcome move as they hold some of the best pools of resources in the world, the problem is that the traditional knowledge that commercial firms hold is most likely not sufficient to address grand challenges given the societal implications involved (Ahn et al., 2019).

Recently, "growing urbanization" is one such grand challenge that has attracted technology firms whereby they partner with city governments to enhance urban infrastructure through enhanced adoption of Information and Communication Technologies (ICTs), to transform cities into smart cities (Kummitha and Crutzen, 2017). A smart city is defined as a city that embraces enhanced use of ICTs to advance city-level efficiency, thereby allowing its citizens to engage in urban regeneration. ICTs are expected to help city administrators to navigate through city-level problems often by creating a city-level command and control room (Goodspeed, 2015; Cowley and Caprotti, 2019). For example, IBM created a centralized data processing control center that integrates and analyses data from various places in Rio de Janeiro, Brazil to create an efficient city-level operating system (Luque-Ayala and Marvin, 2016). Further, data gathered by deploying sensors in cities are expected to help city administration to predict the changing nature of the city landscape, thereby allowing them to systematically plan to address other urban problems (Giatsoglou et al., 2016).

While the corporate big tech firms are globally reputed and enjoy legitimacy in the ICT markets, their interest to exploit opportunities related to a grand challenge and capture economic value represents a significant jump, from known to unknown as their expertise in commercial space may not suffice to deal with social space. Suchman (1995, p. 574) defined legitimacy as a "generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions." The legitimacy they enjoy in the ICT market space is not just sufficient for them to engage in the social space. Social space does not offer a readymade market for firms to embrace as it is often represented by different sections of communities and interest groups. Despite their legitimacy in the commercial market space and the same technological expertise that may be used in the social space, firms need to draw specific knowledge from the societal contexts where grand challenges reside and bring about different actors together to find an optimum solution as highlighted above in the case of the three runner-up towns in Ireland. Because the institutional environment that guards the social space significantly differs from the one that these firms enjoy in the market space, which warrants a different line of legitimation strategies.

Despite this generic understanding, firms casually entered the smart city market with a commercial-driven market approach (Datta and Odendaal, 2019). Initially, firms were able to gain legitimacy by selling ICTs to city administrators as they were in desperate need to find ways in which the problems associated with the growing urbanized trends can be addressed (Paroutis et al., 2014). However, the initial legitimacy that firms enjoyed did not last long as the pressure groups raised objections about the market-driven technology push (Kummitha, 2018). Pressure groups are social groups of individuals that have the potential to question firm practices, raise awareness about unsustainable and unethical practices in both immediate and extended environments, bring legitimacy questions, and ultimately influence their potential to capture economic value (Henreuqiues and Sadorsky, 1996). The pressure created and the legitimate concerns raised forced tech firms to transform their strategies and help include communities in the process.

The paper aimed to theorize the process and makes four contributions to the literature. First, it proposes an Integrative Smart Technology Model (ISTM) where key actors are emphasised to play three unique roles

– facilitating, creating, and enabling, that would help achieve legitimacy for smart technologies. The model spans across two different approaches – firm-driven and entrepreneur-driven, highlights that as part of the firm-driven approach, corporate firms act as a creator of smart technologies, whereas the local entrepreneurs create the technologies as part of the entrepreneur-driven smart technology development. Both the approaches see government as an enabling actor, whereas communities enable local entrepreneurs and facilitate firms. Second, we emphasize the importance of firms engaging in "familiar practices" while exploiting grand challenges, this would then help them attain legitimacy. Third, our model emphasizes the importance of combining the firm-level structures and ambitions in the local context, which would help technology appropriation and achieve the intended benefits. Fourth, this research allowed us to respond to research calls by combining both multinational corporations representing the international business domain and local entrepreneurs representing the entrepreneurship domain to show how they both come together to address grand challenges (Fernhaber and Zou, 2022).

The remainder of the paper is divided into five sections. The second section below briefly highlights smart cities, their significance and the problem with the existing paradigm, and how they raised legitimacy questions for firms. The third section narrates the pressure being created by pressure groups that raise legitimacy questions. Whereas the fourth section proposes an ISTM that narrates how firm-level attributes have transformed, and the fifth section highlights the discussion, and theoretical and practical contributions and offers future directions for research.

2. Smart city

More than half of the total global population now lives in urban areas. It is expected that this trend will continue to grow and by 2050 around 84% of the global population will live in cities (United Nations, 2010). Rapid urbanization necessitates the need to upgrade city-level systems to help address problems resulting from growing urbanization. If sufficient planning is not undertaken to address the global "urban crisis" (Luque-Ayala and Neves Maia, 2019), cities will end up being centers for human and environmental catastrophes. Cities are today for example responsible for 75% of the total energy consumption and 80% of the greenhouse gases. The growing population in cities are set to raise these numbers. Anna Kajumulo, the Executive Director of the United Nations Human Settlement Programme emphasizes that "Given the inextricable link connecting urbanization, urban poverty and climate change, the way in which the world's growing cities were planned and managed would largely determine the pace of global warming" (United Nations, 2007, p. 1). Further, citizens will end up without having access to basic needs, if cities are not prepared in line with population growth. Thus, the ICTs such as sensors, meters to collect different readings, smart appliances, personal devices, and other similar sensors in cities interconnect with each other to make sense of the city's functioning (Harrison et al., 2010). By using automated algorithms and Artificial Intelligence (AI), the data generated then offers avenues for policymakers to make necessary planning. However, installing so many devices in cities requires an enormous amount of resources and technological *know-how* which governments often fall short to provide. This is where corporate actors get a chance to join.

2.1. Corporate interest in smart cities

IBM through its smarter cities challenge motivated several cities across the globe to take part in its smart city challenge to create resilient, "technologically" advanced, and efficient cities to address problems urbanization enforces upon. Smart cities represent the usage of technologies to speed up the functioning of cities including the free flow of traffic, energy, and waste management, apart from the free flow of public services to the target population (Munoz and Cohen, 2016). The winners of IBM's smart city competition receive technical assistance, consultation, and grants to adopt solutions drawn from ICTs to solve three associated grand challenges cities face – (i) urbanization and government decentralization, (ii) climate change, and (iii) urban migration (IBM, 2013). By exploiting this opportunity, IBM increased its share value steadily throughout the 2008 recession period (Paroutis et al., 2014). One of the senior vice presidents of IBM, Jon Iwata accordingly proclaimed, "Smarter planet is a collection of markets we're making… serving new kinds of buyers" (IBM, 2012, p. 2). Overall, IBM succeeded in convincing city governments to participate in its urban visioning, which resulted in about 800 cities across the globe participating in its challenge, and 134 of them receiving consultation and grants from the corporate giant. IBM was then followed by Cisco with its Smart+Connected communities, and Accenture with its Accenture Intelligent Cities to capture smart cities market share (Buuse and Kolk, 2019).

Taking cues from this trend, as part of their postrecession strategy, other firms such as Cisco, Siemens

AG, General Electricals, Intel, HP, Google, Microsoft, Capita, Serco, Philips, Oracle, and SAP influenced city governments across the globe and propagated that ICTs would address major problems associated with the rapid urbanization trends (Batty et al., 2012; Wiig, 2015). Although several cities seek consulting services from corporate firms, their top-down nature, absence of community participation in planning and lack of localized technology development and appropriation in smart city projects have raised severe concerns from pressure groups (Komminos et al., 2013; Kummitha, 2018).

The ways in which technologies are developed and appropriated by organizations in the ever-changing and polarized social world continue to dominate the debate (Leonardi and Barley, 2010; Barley, 2016). Especially the rise of corporate firms and their aim to develop and deploy technologies to address grand challenges have led to a critical discussion among sociologists, geographers, and urban planners (Hollands, 2008; Datta, 2015). The early phase of smart city development has proven that firms quite often take local realities for granted and impose their "expertise" on the local context. For instance, Kummitha and Crutzen (2017) argued in their 3RC framework that smart city debates are initially driven by technology push paradigme, where the adoption of technology itself is projected as a remedy for pressing social problems.

Accordingly, technology development and its adoption in smart city projects are reduced to corporate visioning. They leave communities, which are part of the urban fabric aside in their planning, thereby raising insider-outsider dilemma (Giorgi, 2017). As a result, smart city planning is seen as a conflict between corporate firms that are considered outsiders and the inside community members who reside in urban areas, where mostly the former benefits financially and the latter lose their right to the city when the ICTs are force-fitted. Especially, ignoring the mental frames from the local context and social construction of local reality while developing technologies raise affordance questions (Mills, 2003). Orlikowski (2000) highlights that interaction with new technologies leads to uncertainty among users, as a result, they are likely to construct their mental frames to drive the action. Despite this reality, policymakers pushed these technologies as they were clueless about the growing urban population and the growing pressures they leave on urban systems, leaving the users to follow the dominant frames that corporate firms envisaged.

Leonardi and Barley (2008) earlier argued that when users and developers are separated, then the potential effect of the technology is significantly reduced, as technologies may be unable to chip into the social fabric. Orlikowski (2007) accordingly articulates that the biggest challenge is to understand how to take serious note of intertwining human and technology interaction. This frustration is especially visible in the emergent smart cities literature (Kummitha, 2018).

3RC framework further highlights that firms initially ignored local realities to push the technologies that they produced. Although corporate firms typically engage users in product development, often voluntarily (Chatterji and Fabrizio, 2012) or by crowdsourcing ideas from users (Afuah and Tucci, 2012), the intention behind such engagement is to advance firm innovativeness and gain new knowledge from users. However, smart cities altogether represent a different reality. Because smart city projects intend to create efficiency in city-wide service delivery and address a grand challenge, thereby having wider social implications, which warrants greater social participation. Given the social implications, the failure of the firms to ensure local community participation in the technology development stage resulted in pressure groups objecting the motives of the firms to transfer technology from one city to another without local development of technologies.

2.2. *Threat to legitimacy*

In the case of smart city technological innovations, corporate technology firms use their in-house resources and knowledge to produce innovations that are then pushed into cities. Generally, there is hardly anything wrong with this type of innovation development process as firms are known for their expertise in producing innovations by legitimating the innovation development internally and then selling those products to customers (Bunduchi, 2017). The economies of scale ensure profits for the firm. However, as Leonardi (2011) highlighted often firms have no clue about which resources to opt for in a given situation until the problem in the first place is well-defined and understood. Accordingly, to gain legitimacy for the innovations, firms must seek acceptance from the key stakeholders. Literature articulates that organizations generally confront institutional pressures in their thrust to gain legitimacy; failure to do so would result in innovation being rejected by the actors (Suchman, 1995). Legitimacy not only allows to gain the necessary resources to validate the innovations but also helps expand the reach.

As discussed, in the case of smart city technological innovations, firms typically followed the market-based product development approach and developed the innovations and force-fitted them in

cities across the globe (Kummitha, 2018). Although this process helped firms initially create the smart city industry, communities that reside in those cities have raised concerns about the way these innovations are pushed into the cities (Jenkins, 2022). Because the technologies including sensors capture citizen movements, which are expected to help policymakers make effective planning, on the other hand, such data may be used to rupture citizen rights (Gabrys, 2014). Privacy concerns raised by these smart city technologies are well documented in the literature (Zhang et al., 2017).

As technological innovations started to influence social living and the way people live in cities, the top-down visioning of the smart technology force-fitting has been severely criticized. Datta (2019) for instance shows how State and corporate firms use their power to dump technological vision on cities. For her, this is all about the colonization of urban geographies in the name of "smartness." This new reality mobilized pressure groups to enforce pressure on both firms and governments.

Further, the way technologies are force-fitted in the name of smart cities has received critique across the globe. For instance, Datta (2015) critiques how Indian smart cities force fit technologies. The top-down technology-driven approach neither seeks local cultural understanding, nor knowledge from communities while creating technological concepts and frames in smart cities (Orr, 1996; Powell and Snellman, 2004). McNeill (2015) further critiqued that IBM for example aimed to achieve three objectives by engaging in smart city discourse – (i) maximize its stored knowledge and generate market value, (ii) construct a new sectoral and geographical market, and (iii) standardize and simplify the notion of city and make it a scalable commodity. As discussed, the literature on smart cities has explicitly been concerned about the technology-push nature where the dominance of corporate firms is quite prevalent. Further, it is feared that such an approach would promote a "one-size-fits-all" tendency where the role of community and human agency, talent, and creativity are undermined (Wiig, 2015). For instance, McFarlane and Soderstrom (2017) argue that "the way knowledge on cities is framed cannot be left to travelling corporate consultants but should rely on processes of grounded knowledge co-production" (p. 317). Because cocreation arrangement enables firms to learn and understand problems in detail from the local context. That would also enable firms to understand the citizens' concerns and take their knowledge into context. However, the technology push and data exploitative nature has raised legitimacy questions on the firms (Rose and Willis, 2019). Further, pressure groups articulated that the aim of cities should not be determined by corporate storytelling (Söderström et al., 2014), but rather be decided by the concerned urban population itself (Meijer and Boliver, 2016).

3. Resistance against the top-down nature

The interest of the firms to maximize profits by pushing technologies in smart cities has been significantly challenged by both academic literature (Kummitha and Crutzen, 2017) and pressure groups (Almirall et al., 2016). Laartz and Lülf (2014) highlight that several city administrators have started to understand that vendor focus is heavily dominated by their product presentations, rather than showing how exactly proposed technological innovations can be integrated with the existing infrastructure in cities.

Given their potential in altering urban fabric and the lack of local-level planning in their development and adaptation of smart technologies, there has been severe criticism from various stakeholders (Datta, 2015; Kummitha, 2018). It is argued that the needs and interests of citizens should represent the ambitions put forward in technology development, rather than restricting the focus on pushing technologies (Komminos et al., 2013). It would be appropriate to see that the big tech firms take note of the local stock of knowledge while developing their technology frames (McAdams, 2013). Technology frames are the "underlying expectations, and knowledge that people have about technology" (Orlikowski and Gash, 1994, p. 174). At a more abstract level, Goffman (1974) refers to cultural resources that people use to make sense of and interpret the cognitive schemata that would eventually help generate knowledge and form the basis for the technological object.

Further, Powell and Snellman (2004) argue the need to depend upon knowledge from the local context. Because technological innovations generated using the local context have better ingredients to address local problems in efficient ways (Champenois and Etzkowitz, 2017). This conventional knowledge about technology development and adoption for optimum impact has contributed to the growing frustration in smart cities.

Various urban stakeholders including communities, research institutions, local governments, and local technology developers have joined hands to marshal pressure on their public representatives

to promote approaches that articulate community voice (Angelidou, 2014). McFarlane and Soderstrom (2017) highlight that "public intellectuals and activists…. Are trying to find ways of bending it so that it serves other interests than the ones represented by global business" (p. 313). For example, residents in Toronto created the #BlockSidewalk campaign against Quayside smart city project, with the campaign founder claiming the whole smart city building was a "corporate capture of governance". Further, a Facebook group called Young Urbanists League comprises over 6000 Toronto residents marshaled against the project (Wachter, 2019).

The pressure has cornered firms to look for alternative ways of pushing their smart city rhetoric. Although governments see active participation of the firms could ensure resource and knowledge flow to address the urban problems, the technology push nature and pressure being created made several cities to consider alternatives. For example, policymakers in Songdo and PlanIT Valley smart cities changed their smart city developmental plans several times to ensure citizen-driven approaches and reduce corporate interference (Carvalho, 2015). In addition, Barcelona has also undergone a complete transformation from its top-down to a bottom-up and citizen-centered mode (Pansera et al., 2022). Such a transformation in the perspective sidelined corporate technology firms in cities. Although firms continue to influence cities to become smart cities, the gap between the local communities and corporate firms is visible and has the potential to ruin the prospects of the corporate firms to capture value from the smart city market opportunity in the long run. Apart from the pressure being built around, the intensive competition among the corporate firms to get the city contracts has also resulted in firms looking for alternative ways of penetrating with the citizens in the cities. In a way, they started to see the need for community integration and grassroots-level technology development as an ideal approach to attain legitimacy in the field.

The quicker organizations learn and adopt the legitimate pressures from the communities, the better they attain competitive advantage (Stata, 1989). IBM responded quickly to the institutional challenges. IBM being a catalyst in the field, not only created the industry but was quick to absorb institutional pressures, thereby showing a path for other firms to follow. As Kitchin (2014, p. 3) notes "smart city vendors such as IBM and Cisco have [already] started to alter the discursive emphasis of some of their initiatives from being top-down managerially focused to stressing inclusivity and citizen empowerment." IBM is the leader in the field and has a higher lobbying breadth (Ridge et al., 2017). It has become an obligatory passage point in the field (Söderström et al., 2014). As Schumpeter (1942) pointed out, large established firms with some degree of monopoly will be instrumental in driving the technological process. Accordingly, tech firms have started to leverage their institutional strengths and external pressures to fold communities into the process. They have started to alter their strategy and operation models by elevating communities in the planning and implementation of smart city technologies, thereby ensuring their legitimacy. Because aligning their respective strategies with community needs offers a competitive advantage (Kryscyski and Ulrich, 2015). The section below drawing examples from different cities shows how firms are currently partnering with communities in the smart technology development process.

4. Integrative smart technology model

> In the past, technology and urban planning have not been the most comfortable of bedfellows and the smart city plans are often imposed on those living there with little consultation or explanation. Den Doctoroff, CEO of Sidewalk Labs

Given the pressure from communities, civil society, and other key stakeholders, smart technology vendors have started showing a greater level of reactiveness by transforming their technology development process from being a top-down to stressing community participation and inclusive planning in developing both technologies, technology vision, and technology frames (Trencher, 2019). By altering their strategy, firms have shown their interest to engage in a process-driven approach (Kitchin, 2014). For example, Weick (1995) has long emphasized the need to pay more attention to the process rather than the technologies themselves. To create a robust interaction of technology and human agency, the latter that ontologically exists needs to give shape to the former (Bakken and Hernes, 2006). When the focus is turned towards the process, then *taken-for-granted assumptions* while framing technological concepts will be suppressed for better interactive technologies (Schein, 2004). Because processes value the participation of key actors as shown in the starting argument of this article and allow each actor to benefit from the interactions. Accordingly, the initial step that firms need to make is to consider the uniqueness of each city driven by its sociodemographical dimensions and make an effective grassroots-driven technology development plan. There are two different

approaches in which communities are included in the technology development process, which form basis for the ISTM that we proposed in Figure 1 – (i) firm-driven, and (ii) entrepreneur-driven approach.

Across the two approaches, there are three different roles carried out by actors. They include *facilitating, enabling*, and *creating*. As shown in the Table 1, facilitating here refers to a process whereby the technology development is supported by the key actors. Enabling on the other hand refers to a process whereby an actor is given the authority and equipped with the necessary means to engage in technology development. Here the actor that confers the authority holds the enabling power. Authority may be both symbolic and actual. For example, while the government may hold actual and visible authority, the community on the other hand may have symbolic authority, which is morally structured. Whereas *creating* refers to a process whereby actors engage in technology development by taking cues from the other actors.

As part of the model, the roles and responsibilities are shared among key actors during the technological visioning. As shown in Table 2, different actors enter smart city space with varying expectations and intent. The firms, for example, have a strong intent to invent technologies that can generate maximum rents for their shareholders. Communities, on the other hand, include different social groups that reside in cities, civil society, social organizations, universities, and other key actors who all participate in the process to promote livability in cities. Their interest is largely driven by advancing societal wellbeing. Enterprising individuals on the other hand represent the community and take initiative and engage in technology development and implementation, thereby benefiting from the process, all the while creating an inclusive social context. Here, the community as such participate in technological visioning and share their concerns, wants, and desires. Whereas the government plays a level playing role by making necessary regulations and policies and offering initial investments to enable an active interconnected environment in cities.

Combining Tables 1 and 2 allow us to show the role each actor plays in the process. In the conventional market-driven approach, typically firms play a *creating* role whereby they create technologies. Often, they use their in-house expertise, knowledge, and schemas in the creation process. As part of renewed smart technology development process, firms continue to play this role but are facilitated and enabled by the local communities and the government, respectively. As part of the *firm-driven approach*, as shown in Figure 1, firms approach communities, who then help firms with their ideas and to cocreate technologies. Communities here play a *facilitating role* by offering cues from the local context. This approach relies on the basic premise that acquiring new ideas and knowledge would

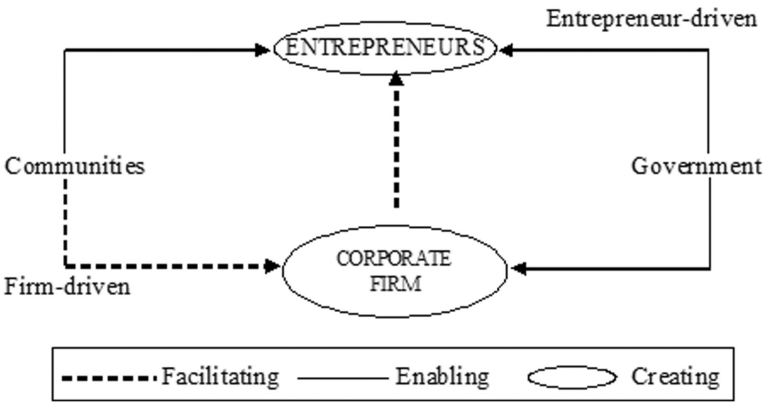

Figure 1. Integrative smart technology model.

Table 1. The three acts played during smart technology development

Role	Definition
Facilitating	A process whereby the technology development is supported by the key actors
Enabling	A process whereby an actor is given the authority and equipped with the necessary means to engage in technology development
Creating	A process whereby actors engage in technology development by taking cues from the other actors

Table 2. The roles different actors play in smart cities

Actor	The intent
Firms	Technology firms that operate with a clear motive of profit generation
Communities	Local actors in cities include social groups, civil society, social organizations, and universities, who all come to participate in technological visioning to promote livability in cities
Enterprising individuals	Those individuals from the local community that take the initiative and engage in technology development and implementation
Government	Sets the rules and regulations and provides an opportunity for actors to interact

require organizations to bring local communities on board to accomplish specific tasks in the technology development process (Brown and Duguid, 2001). This approach supports an overall interest to build a knowledge-based smart city, where planning benefits from local knowledge, and human and intellectual capital (Ardito et al., 2019). As discussed earlier, communities comprised of different actors with varying backgrounds. Snow et al. (2016) highlight that in Aarhus, Denmark, managers from corporate firms met with the Aarhus university and other nonprofit organizations to create partnerships that would enable creation of technologies. Communities bring wisdom and knowledge into the technology development phase. The firm-driven approach will have a spillover effect as the technological visioning comes from the local context, the impact can be seen in terms of enhancing local potential so that the communities present locally can come up with their own technologies to address other social problems. This is broadly discussed in the rationalistic school of the 3RC framework (Kummitha and Crutzen, 2017). But 3RC framework has explained little about how communities could be made part of the process.

When it comes to the*Entrepreneur-driven* approach, local entrepreneurs that represent local communities cocreate technological frames. Entrepreneurs, represent the local community because they are part of it. Local entrepreneurs are aware firsthand of the local problems and their daily interactions with the communities give them the advantage to understand best combinations that would solve the problems. Accordingly, community-level schemas are included to represent the group-level knowledge representation (Davidson, 2002). Here community plays an *enabling* role. As mentioned earlier, the authority that is conferred by the community here is symbolic. As local entrepreneurs often depend on resources from the government in the form of benefiting from the local entrepreneurial ecosystem, the government also plays an *enabling* role. However, corporate players as part of this approach may help the local entrepreneurs by playing a *facilitating* role by for example cocreating living labs or appointing them as their suppliers (Cohen et al., 2016).

Due to the pressure being created to support citizen-driven initiatives by the civil society as highlighted above, corporate firms in partnership with the government create ecosystems conducive to citizen-driven interventions (for further understanding about how firms may help local entrepreneurs, please refer to Kummitha, 2019). Because over the time both firms and governments started realizing that it is necessary to get communities on board to gain legitimacy for smart technologies. Firms by supporting entrepreneurial endeavors as part of this approach potentially lose a portion of their business; however, most often, it is the small-scale interventions that the communities are interested to create, leaving the larger city-wide technology development for firms to capitalise upon. For instance, in Santiago, the capital of Chile, an engineering student invented a citizen-driven project called "Stgo 2020" that enhances the cycling infrastructure in the city. He developed a self-tracking device named Rastreador Urbano de Bicicletas or Urban Bicycle Tracker, which was used by more than 100 cyclists voluntarily to test and prove the technology (Tironi and Valderrama, 2018). The entrepreneur-driven approach has the potential to chip into the local fabric and create technologies that have a significant impact.

In addition, corporate firms may also choose to open their platforms to local entrepreneurs. For example, in Hyderabad smart city in India corporate firms open their platforms for citizens to address their problems by creating smart technologies (Kummitha and Crutzen, 2019). This development is widely visible in other European smart cities where the data collected by the corporate firms through their ICT devices are shared with the communities, which enables them to identify and exploit local opportunities by using the data (Berrone et al., 2016). Barcelona for example launched a Smart City Campus. The campus aims to turn the city into a laboratory for creating new technology innovations, where the city administrators choose to promote cocreation among citizens and other interested actors (Cohen and Amoros, 2014). Corporate firms play an active role on the campus, thereby contributing to create inclusive technologies. A further narrative is offered by Simeone et

al. (2017) who studied the MIT Sensible City Lab in Cambridge MA, where various stakeholders are actively encouraged to participate in smart city technology development.

Apart from partnering with governments to promote community-driven interventions, corporate firms also encourage communities to participate in the hackathons they organize. Hackathons are generally day-long activities to produce and prototype technical solutions to address city-wide problems. For example, in Dublin smart city, IBM and Intel collaborate with Dublin's local authorities by organizing hackathons to encourage residents to create technologies for addressing their day-to-day problems (Cardullo and Kitchin, 2019). Further, in Busan, South Korea, CISCO and Korean Telecom have collaborated with the local authorities to establish Busan Mobile Applications Development Center (BMAC) to allow communities to create smart city services using a cloud-based city application development platform. In the first year itself, the initiative resulted in the creation of 13 start-ups by developing 70 applications that generated sales revenue of $42,000 (Lee et al., 2014).

Further, the entrepreneur-driven approach also includes the initiatives carried out at the community level on a voluntary or nonprofit basis. This could be initiating social enterprises to help deprived and excluded population (Kummitha, 2017; Marti, 2018) or university researchers commercializing the technologies they develop in their labs and starting small-scale ventures to address city-level problems. Such an enhanced interest from local entrepreneurs for example helped Medellin, a Colombian city to transform from being notorious for crime and violence in the late 1980s to the world's most innovative city by the year 2012 and they attribute this change to the way how citizens engaged in collaborative interventions with both the public and private sector as part of the Mi Medellin open innovation project (Almirall et al., 2016).

5. Discussion

This paper identified problems in the way corporate firms engaged in addressing a grand challenge – smart cities. The way corporates participate in smart cities raised legitimacy questions, that triggered changing firm-level priorities and strategies. In fact, control of corporate power on societal issues itself is seen as a grand challenge (Whittington and Yakis-Douglas, 2020). This research theorizes that when corporate firms engage in addressing a grand challenge, ideally, they need to consider the local contexts, apart from promoting the agentic role of the communities to gain legitimacy.

We proposed an ISTM, which forms the basis for technology development that addresses grand challenges. As part of the model, we highlight two different approaches – firm-driven and entrepreneurial-driven. Both the approaches emphasize the importance of community involvement in technological visioning. Especially we argue that the focus should revolve around problem definition (Leonardi, 2011). Our model accordingly is based on a basic premise that communities that experience problems for an extended period can better articulate their problems, with rich and inductive reasoning (Kaghan and Bowker, 2001).

The local realities, cultural factors, and socio-cognitive effects of the local actors all contribute to developing technological frames. The experience of the problem firsthand and the interactions that take place in the local context offer much-needed socio-cognitive knowledge for addressing the grand challenges (Weick, 1979). Thus, the interactions should form basis for technology development. Such integration is useful because of two specific reasons, especially for corporate firms – first, firms hardly have any firsthand experience of the problems. This leaves them to grapple with local realities. Second, insights from the local context make the appropriation of the technologies in effective way (Kummitha, 2018). For example, numerous ICT devices deployed in cities could help the government to flag and punish specific individuals, thereby raising privacy concerns (Kummitha, 2020). Before developing the technologies, firms should discuss the potential privacy concerns that the proposed technologies may bring about and then take the community's views. Communities may believe that they may not need an ICT to address a problem as they could conclude that the negative effect of such ICTs may overweight the positive ones. Alternatively, they may not want to implement a technology, however, efficient it may be, in case it is invading their privacy. Thus, the problem definition and construction should form a basis for the technology to be invented.

The paper identified three distinctive roles played by communities, government, local entrepreneurs, and corporate firms – *creating, enabling*, and *facilitating*. As part of the firm-driven approach, firms play creating roles, communities play facilitating roles by offering ideas and cocreate solutions, whereas the government plays enabling role.

The entrepreneur-driven approach ideally has more local flavor as the entrepreneurs themselves come from the local context, and possibly experience or witness the local problems firsthand. The enabling

role as part of this approach is typically played by both the government and communities together by offering the necessary support for local entrepreneurs. Local entrepreneurs themselves play creating role as part of this approach, whereas firms may play facilitating role. Overall, the model indicates that the grand challenges of our time can only be addressed by sharing resources, knowledge, and wisdom among actors with diverse interests. This requires not reinventing the wheel.

Despite the merits of community integration in the process, integrating communities in the technological concept creation has its limits, especially given the fact that the communities represent people of different backgrounds. When people from different backgrounds and cultures come together to develop technology frames, their ideas and understanding differ from each other significantly (Ettlie, 2007), where disagreements occur routinely about the features of technology and it is said that such a disagreement would impede the technology development process (Dougherty, 1992; Kornberger et al., 2017). Although some amount of disagreement is said to be good to produce a better technology, greater disagreement may cause delay, compromise, and escalate costs, thereby resulting in a failure to build a technology. Especially inventing technological solutions is often time-consuming and costly. For example, Lee et al. (2013) show how developing an integrative roadmap for Korean smart cities is far more difficult than expected because of the number of groups participating in the development process and there were individual proposals from each group. When such a technology development process is stuck with the communities, given its embeddedness in the web of complex relations and associated contradictions and politics involved, then the product cost may go up and the social problem that needs a solution with such technology may not be addressed timely.

However, on the other hand, community representation in the technological concept development would bring enormous power to the technology itself (Rosenkopf and Tushman, 1993). For example, in the case of smart cities, the need for community representation stands out as it not only brings local needs to the center of the intervention but also brings legitimacy and ownership to the technology and technology firms (Kummitha and Crutzen, 2017). In addition, ISTM highlights that the communities are not just limited to the social groups in cities but include a broader range of actors including the university, other social organizations such as nongovernment organizations, and social enterprises. As a result, the presence of these actors that represent a broader population would help achieve consensus. For example, promoting a quadruple-helix model, whereby universities, government, local community, and corporate firms may come together to achieve consensus. Kummitha and Crutzen's (2019) study highlights how a lack of consensus from these players may derail genuine attempts to promote local interests.

We are also learning that governments that are projected as an enabler in our model may in fact act as a barrier (Rana et al., 2019). This is where firms may end up using local universities and research centers as shields against the rigid bureaucratic systems (Scott et al., 2016). Overall, such partnerships with communities of different types would offer necessary legitimacy and force governments to act in line with the local need.

5.1. Theoretical contributions

This research joins growing literature that calls for business models, technologies, and approaches that enhance the participation of the stakeholders that stand at the crossroads and often are neglected and excluded in the developmental discourse in general (George et al., 2016; Marti, 2018), and grand challenges such as smart cities in particular (Kummitha and Crutzen, 2017). We make four different contributions. First, Ferraro et al. (2015) emphasized the importance of participatory architecture in addressing grand challenges, which is about setting structures and rules that would help actors with diverse interests interact constructively for extended periods to achieve mutual benefits. Further, Roulet and Bothello (2022) seek the need to define the roles and responsibilities different actors can play. In response, we emphasize three distinct and unique roles played by actors – enabling, facilitating, and creating. Overall, our ISTM advances and helps us understand how actors' participation can be achieved by adopting two optimal ways – firm-driven and entrepreneurial-driven approaches.

We also join the growing literature on corporate legitimacy. For example, earlier Scherer and Palazzo (2011) indicated that corporations under the pressure of civil society often end up regulating themselves. We are seeing the same trend in the context of smart cities that the growing pressures and unexpected backlash from the communities seek to enforce prioritization of community participation in the process to gain legitimacy.

Second, Fernhaber and Zou (2022) earlier indicated the need to combine research from international business and entrepreneurship fields to offer new insights into grand challenges. Grand

challenges are typically seen as a multinational phenomena given the fact that their impact is hardly restricted by geographical boundaries (Burkley et al., 2017), as a result, multinational firms naturally have an advantage to leverage their expertise and resources to address them. We accordingly extend how multinational firms that represent the international business domain and the local entrepreneurs that represent entrepreneurship could come together to address grand challenges. Especially when the firm legitimacy is questioned, they can potentially cocreate a vision to address grand challenges in partnership with local communities. Further, they may also help local actors to establish and expand their enterprises. Interacting with the actors in the local context is very important as grand challenges are instantiated in the local contexts (Berrone et al., 2016).

Third, when it comes to smart city literature, it is ripe with stories about how corporate firms partner with city governments across the globe and colonize urban space (Datta, 2015; Kummitha and Crutzen, 2017). In response, this research shows how corporate firms have started rather proactively to cocreate technologies. Chowdhury et al. (2022) argue that while addressing grand challenges, firms need to align their expectations with the welfare demands of the communities. We show this can be achieved by facilitating the growth of local enterprises. Further, firms in their attempt to regain legitimacy in the social space have started to elevate communities to *facilitating* roles and to cocreate technologies, and engage in joint problem-solving (Jingyao et al., 2021). Akin to Thomas Alva Edison's efforts to institutionalize electric light by mimicking the already familiar gas system (Hargadon and Douglas, 2001), corporate firms that seek legitimacy for their technologies may engage in a much familiar practice – community engagement in the planning. When firms need to engage in innovation that would address a grand challenge, they need to align their strategies with familiar societal frames that would offer legitimacy to the practices (Suddaby and Greenwod, 2005). The lack of such an attempt to connect the proposed frames with the predominant societal practices would destabilize the prominence of technological innovations.

Fourth, technological utopia projected as part of the developmental interventions raises the need for innovative methods in which knowledge can be accumulated from the local context. Especially, knowledge is sticky and most likely has local relevance with limitations on its transferability (Szulanski, 1996). Since local knowledge is considered pivotal in developing technologies, how to locate knowledge holders that spurs the technology development process is one of the questions that firms that are engaged in addressing grand challenges need to understand (Sambamurthy and Subramani, 2005; Hsiao et al., 2006). Our model helps resolve this issue. When technologies are built in close consultation with the communities, then there is a higher likelihood for their appropriation and achieving technological affordance. This process also helps firms to benefit from the community interaction and gain the legitimacy they require in appropriating technologies.

5.2. *Managerial implications*

When firms engage in addressing grand challenges, which have greater social relevance, then they better initially draw signals from the local context not only to capture entrepreneurial opportunities such challenges open up but also to understand the local context and the key actors part of it before proposing or appropriating solutions. While the absence of such an inclusive approach may offer rents to firms initially, as time progresses and societies become conscious, firms most likely face legitimacy questions, when local communities resist and seek their representation in the planning of such approaches. Although firm-level resources and expertise may suffice initially to gain a foothold in the market, over a period, firms need to engage in a dialog with communities to minimize legitimacy questions that may arise.

The ISTM reemphasizes that the technologies are effective, when they are produced, based on the requirements acquired from community-based descriptions (Orlikowski and Barley, 2001). Among several practices organizations could follow to acquire knowledge from communities, ethnography, system design integration, design thinking and so on may be useful (Hughes et al., 1993). Further, to better understand the problem context, Barley (1986) emphasized that the "scripts" could also play a crucial role to determine day-to-day interactions among those who participate in the concerned context. Scripts are observable in a given social context, which may be noticed empirically as they represent patterns of interaction typically characterized in a setting (Barley and Tolbert, 1997). Scripts could be cocreated with active integration of communities while framing technological concepts.

Our model apart from potentially enhancing citizen participation in smart city planning, offer ways in which corporate-driven artifacts may attain legitimacy, and addresses several other problems that emerge in the process. For example, when various corporate firms participate in a city and bring different technologies on board, then it opens a complex organizational activity that needs to be coordinated through

a meta-organizing process (Gulati et al., 2012). However, early engagement with communities opens a more effective search for better solutions to specific grand challenges in the creation phase, where different corporate firms could be brought together as early as possible in the process. Martin Curley the Director of Intel Labs Europe states that "the core idea of what by collaborating, organizations can achieve impact far beyond the scope of what any one organization can achieve on its own… In fact, if done right, the impact can be exponential, not merely additive" (Wartzman, 2013, p. 10). Community integration offers the right context for them to come together. For example, in Amsterdam smart city where IBM and Cisco have stakes, the technology-based projects are locally embedded with the help of community integration. Whereas in Helsinki, IBM promoted citizen engagement by creating an interactive city website that allows citizens to participate in frame and idea development sessions (Alizadeh, 2017). Further, Cisco's Smart+Connected Communities initiative is geared towards the use of intelligent networking capabilities to connect people, services, community assets, and information into a single pervasive solution by leveraging real-time information and applications, with the network as the underlying service delivery platform (Gabrys, 2014). Further to extend their legitimacy, firms started to make alliances with various public actors including universities, research centers, and other local actors (Sandulli et al., 2017). Because by aligning with public sector organizations, corporate firms could gain the first signs of legitimacy.

Further, ISTM may be handy for the developmental experts who have been criticized for force-fitting top-down interventions to address problems such as poverty and inequality without taking local contexts and community-based concerns seriously (George et al., 2012). We believe by adopting our model, a robust social order is created. Although social polarization exists for ages, the growth of democracies and cocreation approaches seek for larger integration of communities in the planning and execution of technologies and developmental interventions. As a result, the old theories are no longer as relevant as they once were to describe the innovative developmental methods and active community participation that exist in the current social order (Boxenbaum et al., 2015). Thus, we believe ISTM may advance our understanding of local reality in a much-nuanced way and offers a dais for exploring integrative developmental approaches.

5.3. Limitations and future research

Despite its interesting theoretical and practical contributions, the paper suffers from some limitations. First, although several examples from different smart cities are employed, the paper suffers from a lack of focus on any specific smart city. It would be interesting to study how firms gain legitimacy by conducting a longitudinal study. Further, it would also be useful to study how they help local entrepreneurs and take prescriptions from the communities by engaging in field research.

Both developed and developing countries may offer diverse perspectives. For example, Barcelona's orientation towards smart cities may align very well with our ISTM. Whereas in developing countries the situation may be different as lack of resources at the community's disposal and lack of pressure being built on corporate firms, it could be the case that firms may not have been exposed to legitimacy concerns. However, it would be necessary to study this assertion.

Different roles being assigned to actors as part of the ISTM may also need to be tested. Accordingly, it is worth studying if communities play facilitating role to support corporate firms and play an enabling role to support local entrepreneurs. Further, the same goes for the government, whether the government makes necessary arrangements to play an enabling role.

Data availability statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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Rama Krishna Reddy Kummitha is an Assistant Professor of Entrepreneurship at Newcastle Business School, Northumbria University, UK. He is also an Adjunct Professor at Woxsen School of Liberal Arts & Humanities, Woxsen University, Telangana, India. His research interests include smart cities, (social) entrepreneurship and hybrid organizations. His research has been published in *California Management Review*, *Government Information Quarterly*, *Technological Forecasting & Social Change, Information Technology & People, Creativity and Innovation Management* and *Cities*. He is the author of *Social entrepreneurship and social inclusion* (Sage), and *Social entrepreneurship: processes, practices and prospects* (Palgrave).