



# White Paper: The Importance of Social Engagement in Putting 5G Connectivity Infrastructures in Place

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This paper is written based on an independent study conducted as part of Mobile Access North Yorkshire (MANY) – part of the Department for Digital, Culture, Media and Sport (DCMS) 5G Testbed and Trials programme.



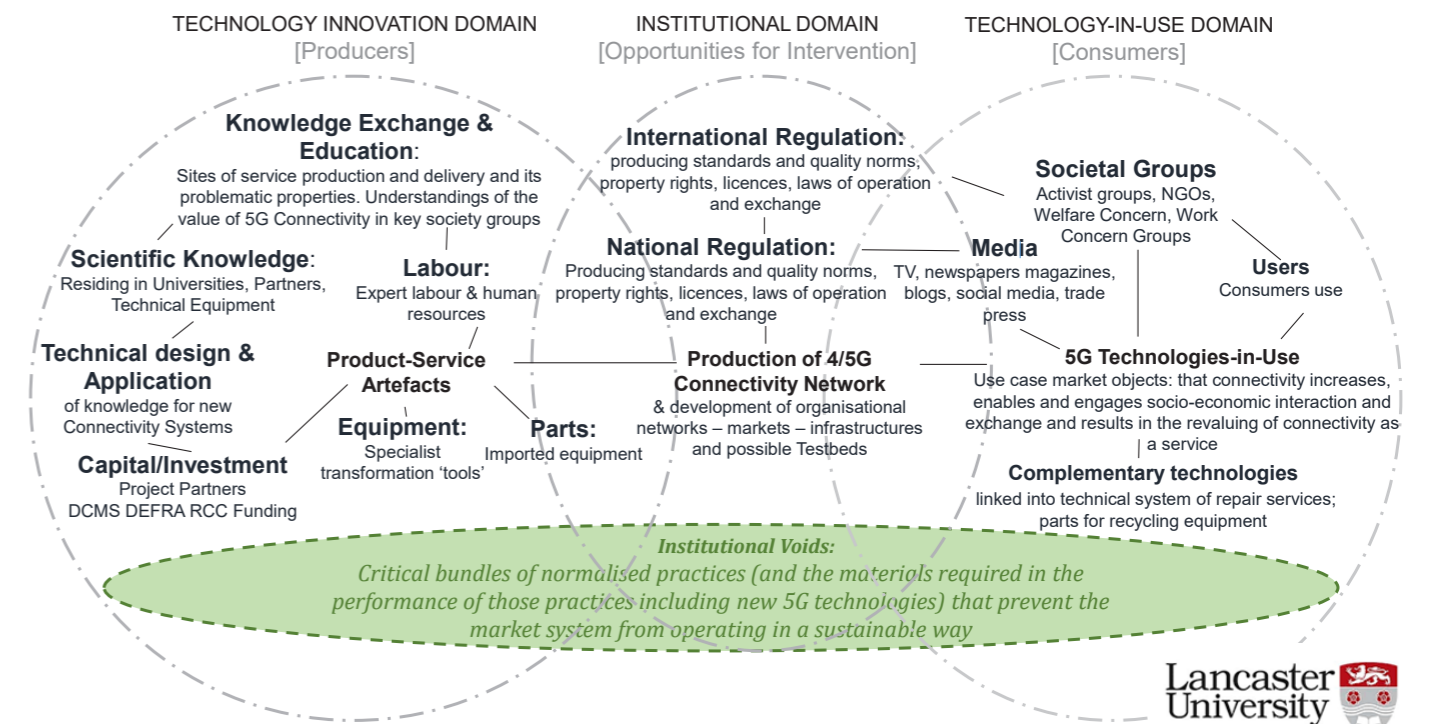


Figure 1. Connecting Activity Domains and Social Worlds through the MANY Project's Activities

The purpose of this document is to share social science research insights, generated through work with the Mobile Access North Yorkshire (MANY) project, in order to develop best practice, generate discussion for future collaborative work, and work out our collective next steps that might better achieve our aim: to help very rural communities achieve socio-economic flourishing through improved connectivity.

We define 'flourishing' as improvements in wellbeing, business innovation and the safety and resilience of connected communities and use this as our overarching aim of our work. More specifically, we define improved wellbeing as reductions in self-perceived levels of harm, loneliness, and improvements in social connections and mental health; improved business innovation as improvements in practice that contribute to the business growth and/or improvements in productivity and/or (public) service offering (i.e. using a reduced resource for the same output); and improved safety and resilience as improvements in the timeliness and quality of information provided at critical decision-making junctures.

We are working across three domains of action, the technology innovation domain, the technology-in-use domain, and in the middle, the institutional domain (Figure 1). Across these domains we are working to connect people from different social worlds (used to working with different logics, and working practices), to help them co-produce connectivity solutions that work *in place*: in a very rural community.



## The Challenge

Despite the ubiquity of digital technologies in almost every aspect of our lives, access to and the use of such technologies remains unequal and represents a *Grand Challenge* for our society. This is especially true for UK rural communities who, due to the unequal distribution of market-driven digital infrastructure, suffer from poor connectivity and ‘unfit-for-purpose’ mobile and broadband infrastructure technologies. This lack, in turn hampers a community’s capacity to exploit digital technologies and innovate (Philips and Williams, 2019). Brought into sharp relief by COVID-19 restrictions as people became reliant on connectivity technologies in order to work, socialise and learn from home, the 5G Rural Connected Communities Testbed and Trial initiative set out to support interventions to drive change.

The complex of factors which contribute to digitally marginalized communities, particularly in very rural areas, is multifaceted making the task of implementing workable digital inclusion initiatives challenging (Wagg and Simeonova, 2021). While governments have put in place policies to enable interventions that create digitally connected communities, the realities and demands of implementing such initiatives in practice are fraught with difficulties; policies are often outpaced by technological development, and the institutionalised organisational practices of Mobile Network Operators (MNOs) and other commercial digital infrastructure organisations can hamper progress in putting much needed digital infrastructures in place. At the same time, rural communities do not speak with one voice, with some citizens actively resisting changes while others welcome it. The “social worlds” of communities, commercial companies and policymakers clash as the interests and actions of each world differs (Clarke & Star, 2008: 113).

### This report reveals early findings from Lancaster University Management’s school of Mobile Access North Yorkshire (MANY).

The study is underpinned by the Responsible Research and Innovation (RRI) framework (Figure 2), an evaluative framework widely adopted in complex problem settings, including most European-wide Horizon 2020 research programmes (Owen, Macnaghten, & Stilgoe, 2012), and seeks to inform the MANY project’s actions as they work to put in the right digital ‘future proof’ infrastructures for a very rural community.

The RRI framework is constituted through four core principles: **inclusion** of the “right” forms of knowledge and expertise – such as scientists, business practitioners, policy-makers and community groups – and their **anticipation, responsiveness** and **reflexivity** throughout the innovation process. Used to organise the co-development and implementation of a practical, Grand Challenge problem-solution (George et al., 2016), we used the RRI framework in the production, circulation and consumption of multiple forms of distributed knowledge in the research and innovation process (cf. Stilgoe, Owen, & Macnaghten, 2013). In other words, we are using the RRI framework to govern how the MANY project is performed in practice (Kuhlmann & Rip, 2018).



Figure 2: The Responsible Research and Innovation Framework



MANY is developing a 5G digital infrastructure in North Yorkshire by bringing together a consortium of partner organisations: Quickline Communications Ltd, North Yorkshire County Council, University of York, Lancaster University, aql ltd, Flo-culture, Cybermoor, Safenetics, Wireless Coverage – and working with Community First Yorkshire – to enable mobile access in a rural area with little or no current connectivity. Three key research findings revealed through the first phase of the study are; **working with the community; generating joined-up thinking; and setting up for knowledge exchange.**

## Working with the Community

The MANY project works with community members in two ways. First, it develops use cases for new technology that will sit on the new connectivity infrastructure. Specific use cases currently under development include Tourism, Environmental Monitoring, Wellbeing and Mental Health, and Mission-Critical Communications.

**Tourism** is exploring how the use of an advanced mobile access network and 5G communications can support and drive the growth of the tourist economy, and enhance visitor experiences. For example, one business is being provided the opportunity to test a 5G enabled solution to provide a virtual wedding guest package. Another tourism business is testing 5G solutions through the use of AR to bring characters to life through an onsite digital quest.

The **Wellbeing and Mental Health** use case is exploring how the use of 5G can mitigate feelings of loneliness and social isolation in rural communities whilst giving the opportunity to provide health and wellbeing services remotely supporting independence and cost savings. The project is working with a rural medical GP practice, a Mental Health practitioner and adult social care teams to develop new connected services, remote video consultation and wellbeing support services that exploit 5G communications to enhance end-user experience, and support service provision effectiveness and productivity

The **Mission-Critical Communications for Emergency Services** use case is working to develop secure, extended coverage and greater resilience to the existing Mountain Rescue radio system that exploits 5G communications. Operating as a proxy demonstrator for other emergency services, the aim of this use case is to enhance search and rescue capability using 5G communications and save lives.

The **Environmental Monitoring** use case is focusing on monitoring water and flooding by engaging with three principal infrastructures in monitoring activities: vulnerable bridges, roads, and ancillary infrastructures. The goal is to be able to intervene earlier to prevent expensive damage, either through bridge collapse or total road closures through remote monitoring 5G enabled equipment. Several bridges have been identified together with a local water treatment plant that supplies water to a local village.

Second, MANY works with community members more broadly to understand community connectivity experiences, aspirations and concerns. Putting the first RRI principle – **inclusivity** – into practice, the study puts the community and the need to capture multiple voices of citizens at the heart of the MANY project. Fundamental to the study, this approach has enabled the research team to build an understanding of the everyday rural community life in Coverdale, and the entanglement of their lived experience of home, work, business, community and connectivity technologies. Rural residents and key community stakeholders (GPs, parish councilors, business owners and community custodians) have discussed their current experience of using connectivity technologies, the challenges they face, and their hopes, aspirations and concerns about using enhanced connectivity through 5G technologies. This in turn has helped develop an understanding of how this rural community value connectivity technologies both socially and economically, as individuals.

## Capturing the Plurality and Patterns of Community Experiences, Aspirations and Concerns:

MANY worked with Parish Councils and organised a number of Parish Council meetings to provide a space and place for community members to learn about the MANY project, what it was trying to achieve, how it was funded, and what the connectivity infrastructure would look like and what it would do. These meetings allowed community members to get together and hear each other's views, concerns, and provided opportunities for the project members to listen to important social aspects that needed to be taken into account.

Not everyone is confident to speak at Parish Council meetings, and some important aspects need to be explored in a more confidential setting. Working with the community, using research interviews, the research team collected additional data.

The findings presented here reveal people's experiences, hopes and concerns with connectivity technologies:

### Experiences

- Poor, **unreliable connectivity** wastes time when connections drop out when engaging with online services, completing online transactions and carrying out real-time activities for work, business or everyday life;
- Difficulties with connectivity is experienced when **using multiple devices** and when attempting live streaming and video conferencing;
- None or **poor mobile connectivity** leaves people unable to carry out specific transactions such as online-banking which require dual-factor authentication, or have operational energy provider smart meters that rely on a mobile phone signal;
- **Isolation** is heightened due to a lack of mobile phone connectivity especially when unreliable copper landlines or broadband fails, leaving individuals with no form of connectivity or communication;

- **Not all residents are unhappy with their connectivity.** Some feel their connectivity is adequate for what they use it for.
- Some residents demonstrated **resilience and innovation** in how they had investigated and installed additional technologies at extra cost in an effort to improve their connectivity.

### Hopes/Aspirations

- **Reliable, consistent connectivity can make life easier**, enable quicker completion of online tasks and activities, provide a better online experience and social interaction, and opportunities to explore technological solutions;
- **Reliable mobile connectivity can improve safety** and provide reassurance when working outside, such as in farming or equestrian activities, or when partaking in outdoor pursuits;
- Improved connectivity can **attract people to the area or keep people in the community**, avoiding the notion of 'hollowing-out' where young people feel there is no work for them or are unable to work from home and are left with no other option but to move away from the area;
- Improved connectivity and 5G could **fast-track entrepreneurial and business diversification** plans;
- 5G connectivity could **future-proof the locality** where digital infrastructure can support future technological changes such as software packages that take up more energy and data space.

### Concerns

- **What '5G' means;** there is a need to gain a more thorough understanding of the technology, its safety and regulation, how it's different and what it does that is different;
- The **visual impact of 5G equipment** on the aesthetics of the countryside and national park;
- Questions around frequencies and **health implications** surrounding 5G;
- Questions around what **technology** is required to use 5G and what happens after the project has ended;

- The impact 5G and improved connectivity will have on **community cohesion** fearing transition to an ‘eyes-down’ community where everyone is looking at their phones instead of looking up and communicating and speaking.

In sum, the community voiced a variety of connectivity experiences, aspirations and concerns. Concerns about the health and safety aspects of 5G and the benefits it might bring were most frequently voiced. Some members of the community had specialist technical knowledge that they were keen to share with the MANY project. However, interviewees generally struggled to imagine new connectivity enabled practices that differed from their existing everyday practices. More work to support the imagining of good 5G rural-connected futures would be valuable for the community and would be consistent with the Open Science and Education principles of RRI.



### Making Use of Community Insights to Shape the Project:

These research insights, questions and concerns emphasise the need to take a responsible, reflexive approach to the project’s development of innovative connectivity solutions, and for the research team to act as a conduit by ensuring questions and concerns raised by the community were taken into account when planning the next steps of the MANY project. For example, when the research team became aware of anti-5G concerns, we investigated. Findings were used to facilitate transparency and were shared with the technical team, and the wider project team. Answers to questions were sought, and the research team worked to understand the foundations for the emotive reactions from some community members towards the project.



### Best Practice Learning: Doing Community Inclusion Well

Our study revealed the importance of working with the community and in foregrounding community voices in the project. We identify four key principles that we think will help a project team do community inclusion, well:

1) **Engage early and often.** By contacting community members early on in the project (through community engagement events and Parish Council meeting, through a dedicated project website, newsletter, mailings, and social media), we raised awareness of the project within the community. We advocate the continued regular engagement throughout the life of a project to involve the community as the project evolves and develops;



2) **Be transparent.** By clearly articulating the aim of the project, sharing insights and developments across the project and with the community, we generated a mechanism for the community to raise concerns and ask questions, and have them addressed. We were transparent about the project unknowns (e.g. exactly which communities would be connected; exactly what technologies would be used), and shared our learning and progress with the community as our understandings of the technologies and the socio-political landscape grew.



3) **Be inclusive.** We used multiple engagement platforms to be inclusive. Not all our participants were comfortable enough to talk at Parish Council meetings, some felt concerned about doing a research interview, some only wanted to engage with us via email or via the project website and telephone number. Some were unable to engage in interviews or Parish Council meetings via video conferencing due to poor connectivity, but were able to engage via their landline. We also provided updates and reports to community residents via post.



4) **Be open and honest.** By working with the community and highlighting the challenges involved and typically experienced in such a project, we gradually built trust through transparency. We shared insights of the implications of working on a project during a global pandemic, working with multiple partners, finding suitable methods to communicate with the community without relying solely on digital communication. We did this through traditional mail shots and a continuous open communication channel through the project website and telephone number and acknowledging this is a testbed and trial and so mistakes will inevitably happen.



By establishing clear guiding principles of community engagement and being reflexive and responsive to the community as the project unfolds, it is possible to shape a project that is of greater value to the community, establishing a potential market of ready-to-go 5G users.

Despite carefully considered communications plans and efforts to capture community voices and provide communities with answers to their questions, projects should not expect blanket agreements. They should however gather enough evidence of a general desire for improvement and change.

Finally, projects should develop actions plans should communities overwhelmingly reject 5G infrastructure development. There are key ethical considerations at stake here on both sides and projects leads should consider their position before they begin community engagement as their position will shape their communication plans and style from the outset. We do not advocate imposing 5G infrastructures on communities that overwhelmingly demonstrate their rejection of it.



### Generating Joined-Up Thinking

A common challenge with digital inclusion initiatives such as the MANY project, is the bringing together of experts from very different social worlds (Clarke & Star, 2008; George et al. 2016). By ‘experts’ we mean community members, social scientists and technical teams, commercial and local authority experts. All these experts come together around the project, in one place. But they come from different backgrounds, bring different logical arguments for change, and have very different historical regimes of practice. In other words, they come from very different worlds and see things differently.

A key strength of our study is acknowledging, and paying particular attention to these **different social worlds**; how they collide, overlap and have tensions within and between them, have different languages, logics and meanings. Acknowledging, and foregrounding these different social worlds enables us and our project members to appreciate

how people, all working on the same project (the MANY project for example), can have different lived experiences of it, despite being joined together both by the project and the place where it is being enacted.

To illustrate, the research team might experience the project from the perspective of trying to understand people's lived experiences with connectivity technologies, with the intention of doing something *good* for the community by putting in place improved connectivity. However, community members may experience the same project completely different; they may see the project as an “unnecessary experiment” on their community, an invasion of their lives by institutions who don't understand their lives, or care about them. Both these views are valid and valuable.

Our study foregrounds and acknowledges these multiple views, logics and judgements, and used them to work out what to do next in the project. We have worked with community members both to learn about their varied lived experiences, and also to demonstrate the work required to try to connect and join-up these contrasting social world views, creating joined-up thinking in a particular place. Extant social science research shows that bringing different social worlds into dialogue with one another *can* generate expansive learning (Engeström and Sannino, 2010) and innovative solutions that neither world could have produced on their own (Mason et al. 2019; Stark 2000). We have put these ideas into practice in the MANY project.

**Tensions between the social worlds** were also clear: between the community and the project. At a Parish Council meeting it became clear that the community had, quite reasonably assumed that all of the masts in the area that they had witnessed being erected without any consultation or recourse to them, were associated with the MANY project. They were not. The MANY project team did not know about the masts. When MANY claimed to be erecting only one mast within the community, which they had not yet made a planning application for, questions about the masts, size, location and number, and planning permissions were raised, the community expressed concerns that the MANY project were not being honest or transparent. The MANY project invested in finding out the provenance of each mast in the community and reporting back to the community who had put it

there and why. This vignette evidences a significant danger with place-based projects when there is a lack of joined-up thinking. **Without joined-up thinking, communities can feel taken-for-granted, and angry.**

While the MANY project was not responsible for the other masts in the locality, the MANY project's limited knowledge of other digital infrastructure projects going in that place, created tensions within the community, and between the community and the project. Tensions were only reduced once the project took on the role of finding out information about the masts and sharing this with the local community. Communications and work with the community need to adopt a holistic, joined-up perspective on place; a place can only be made whole when local knowledge and project knowledge are joined-up, coordinated and shared.

**Tensions between the social worlds had implications for the community, the project and policymakers.**

Later in the project, further concerns emerged about the masts not put in place by the MANY project. Community members wanted to know why masts were not shared across projects, and between MNOs: all good questions for which the MANY project had to find further answers. These sensible questions highlight missed opportunities for collaboration and a lack of joined-up thinking in place from the community, project, policy *and* MNO perspective. Collaborations are always socio-political achievements. They are not always easy, but **in very rural community settings, we argue that collaboration is a necessity not a luxury** and suggest that policy incentives are put in place to help co-ordinate collaborations and hold those not prepared to, to account. Project leads can benefit from developing a peripheral vision that sensitizes the project team to relevant activities in place, and directs attention and enquiry, opening-up new conversations that begin to generate a more holistic and joined-up action plan for a place.

**Differences between social worlds can lead to assumed knowledge.** The MANY project had limited knowledge of the community's desire to understand and general level of understanding of the term '5G' and the socio-technical-political bundle of action it encompasses – the fifth-generation technology standard for broadband cellular networks.

Pushing ahead with such a project without insight from the wider community would create tension within the community, limit the success of the project, and hamper innovation. Gaining an understanding of the community's knowledge and desire or concerns towards 5G by developing our social scientific enquiry, foregrounds the need for project members to work with the community on this important area of scientific education in terms of the safety, functionality and the potential benefits of 5G for their particular community. **Benefits realisation – putting these ideas and understandings into practice – is the final step.**

Working with the community, in this instance, means helping community members understand what 5G means for them, within the specific boundaries of the MANY project, helping them also to 'imagine' how they might use the enhanced connectivity in place, to improve some aspect of their life. As one project stakeholder stated, *“people don't know what they don't know”*. By doing this idea generation and imagination work with communities, the technical team working on the project can develop an expansive understanding of the voice of the community, using it to influence how they think about the infrastructure and technological solutions they are designing and providing for each particular community, in its specific place.

Even **within a single social world** there can be complexity and tension. In the social world of the community we found just this. Our study captured a variety of community voices, but these voices were not always in unison, revealing different lived experiences even though they all lived in the same place. For example, some community residents are happy with their current connectivity, others would like to see some improvement, others want big improvements to help with business, the local economy, entrepreneurship, and retaining their community's young people (and their own children) in order to enable the community to flourish.

These differences in perspective of connectivity is influenced (at least in part) by the significant difference in the quality and speed of broadband connectivity within the rural community involved in the project. The fragmented nature of the current infrastructure in place becomes clear. Some members of the community have high speed broadband or fibre, while other properties have very poor broadband and connectivity largely due to where the property is situated and/or the quality of the copper phone line in place. This results in residents having very differing lived experiences with connectivity within a single place, leading to some members of the community reacting emotively to the potential of 5G being introduced to their locality, arguing that it is “not needed because the community already has perfectly good connectivity”.

Our study learned **how to listen** to a community in relation to the 'places' they were in. We learned to drill down with our interview questions to uncover **infrastructures in action**, and the different lived experiences that they gave multiple residents in one place. We also learned how to gather together and share these insights, presenting patterned practices with the wider community and MANY project team, to provide a wider evidence base from which to make judgements about the value of the project to a place and its community.

We want to learn how other connectivity projects have developed their peripheral vision. We want to understand if and how you have used peripheral vision to develop joined-up thinking and an improved action plan for a place.



## Best Practice Learning: Putting Joined-Up Thinking in Place

Our study revealed the value and opportunities to join-up thinking across projects and communities in a single place or site of intervention. We identify five key principles that we think will help a project team develop a joined-up thinking approach in place:

- 1) **Develop a peripheral vision.** Developing peripheral vision will help situate your project within the specific place and community you want to impact. First, identify the key people that have a potential interest in your project. These people are beyond the boundaries of the project, and often occupy key roles in your community. Next, ask them to share their local knowledge and help you develop a place centred approach to your project. Engaging with key community members, local NGOs and other organisations of interest to your community will generate new enquires and conversation that enable you to unfold new, innovative action plans. Coordinating your plans with interested external parties will open up new opportunities for collective action, further supporting socio-economic flourishing in place.
- 2) **Make transparent the different social worlds** and institutional logics that are at play in the project. By recognizing the value of each form of expertise and different interests that are brought together in a complex digital infrastructure project, expansive learning can be generated. This requires identifying the different worlds and directing project team members differences between them, the logics that operate within each, and how these logics might bring key groups to reach certain kinds of conclusion. The key idea behind this principle is that from understanding comes compromise and innovative ways forward.
- 3) **Reflect and understand tensions within a place.** Developing a more holistic understanding of place, and the tensions between the different stakeholders and actors engaged in that place, offers the foundations for reflective and reflexive conversations about the projects innovative

next steps. By building key points of reflection into your project, local, situated knowledge can be used to unfold what the project becomes, what it delivers and the benefits it realizes.

- 4) **Anticipate differences and question your assumptions.** As part of the reflexive process, projects should seek to anticipate and continuously question their assumptions about what they know, and what they think other key stakeholders in place know. This is a difficult and engaging process, but represents a key aspect of putting RRI into practice.

- 5) **Develop mechanisms to resolve tensions.** We used social science enquiry to put in place project mechanisms that would drive join-up thinking and to use this to overcome and resolve tensions in a place. Many university-based researchers are interested in supporting these kinds of projects. Include researcher time in your project proposal and enroll expert knowledge activism and intervention. Alternatively you could develop a project brief and assign responsibility to a project member to do this work and to evidence how it feeds into unfolding project plans, as the project progresses.

## Setting up for knowledge exchange

Our study generated valuable insights into the running of complex projects; the MANY project being identified as such. The complexity of the MANY project is attributed partly to multi-stakeholder involvement, the contrasting social worlds from which these stakeholders come, and the varying institutional logics and organisational cultures each brings with it to the project. When brought together in a single collaborative domain, inevitable tensions and contradictions emerge. The government encourages and values collaboration between multiple stakeholder institutions; demonstrated by their framing of funding calls, which often specify that project proposals make clear applicant intentions to incorporate collaborative activities both *within* individual projects and *across* other 5G projects that fall within the broader policy driven initiative.

**Our findings suggest that collaboration can be a blunt instrument, and that a more nuanced mechanism can be developed and put in place to deliver more effective outcomes.**

### Institutional voids can emerge as projects progress.

Tensions and contradictions typically associated with complex projects, are (of course) evident in the MANY project. We attribute this, in part at least, to the partial, distributed and multiple forms of knowledge, and differing interpretations and understandings of that knowledge and information (cf. Mason and Palo, 2019). Tensions emerge through action, e.g., when tackling policy, attempting to fulfill the aims of the project, looking for technological solutions and developing operational practices. Our research revealed the repeated emergence of gaps or holes in the project's unfolding action plan, revealing actions or thinking that was not joined-up. We refer to these holes as 'institutional voids' (Mair, Marti and Ventresca, 2012) which, if left unchecked, can manifest into irreconcilable differences, lost opportunities and/or other project activities stalling. The continual identification of gaps is a strength of the project, not a weakness. It is only by identifying these institutional voids and acting to repair them that the project can move forward. By anticipating the emergence of institutional voids and identifying them as they occur, repair work can be designed, and the project can move forward in an effective and coherent way.

### Institutional voids introduce the opportunity for boundary spanning and bridging work

for specific individuals working within the project. We found ourselves taking on such a role, becoming 'knowledge activist' by continuously and deliberately working across the institutional boundaries of the project. We worked to effectively share knowledge across boundaries. Within the project, boundaries emerged as key project groups formed to get work done. We had two key groups in the MANY project; the technical team and the social team. By gathering together, making visible and joining-up different parts of the distributed, fragmented knowledge jigsaw, we were able to steer constructive and productive conversations to generate 'small' solutions that bridged voids, connected the social and technical teams and kept the project on track.

**Identifying institutional voids within the project enabled us to anticipate tensions** and act on them in a pre-emptive way through our ongoing process of enquiry (Dewey, 1938). For example, we asked challenging questions at meetings revealing voids and asking the group to collectively imagine the precise steps and mechanisms that would need to be put in place to ensure something happened. We ensured we knew who was accountable for making that work happen, and so collectively designed activities that bridged voids. Structured knowledge sharing and collaboration events were an important part of our practice, creating insight generating mechanisms and new knowledge that could be used in specific project groups and with the wider team.

**Knowledge activism plays an important part in bridging the institutional voids** that open-up *within* and *with* communities through project activities.

Social science researchers, communication specialists and the engagement team played a crucial role in reducing tensions with the community, bridging voids in consultation and responsiveness to address important and legitimate community concerns. When research interviews revealed opportunities to support a Small and Medium sized Enterprise (SME) situated within the community, the research team connected the SME directly to the technical team after sharing the presentation of a number of business challenges that the SME faced, with suggestions for how these problems could be solved or substantially supported with the aid of 5G technologies and mobile connectivity. This resulted, in the technical team, through the process of collating, reviewing and evaluating business needs for a specific equestrian training enterprise. This work enabled the MANY team to establish health and safety, and welfare for riders and horses as a significant priority for the business. An iterative process of emergent socio-technical understanding across the project teams and the SME community member led to the crucial identification of the need to de-risk a frequently occurring situation: when a horse and rider become separated on the gallops (perhaps due to a fall). Together the team worked with the SME owner to explore how 5G technologies, GPS trackers and fixed web cameras, could be used create an improved, effective response, to routinely deescalate potential emergencies.

Similarly, research interviews revealed challenges with a number of water treatment plants, monitored manually by community volunteers. Situated within the rural community the remote monitoring of the water treatment plants became an important part of the MANY project. This unexpected discovery fell within the remit of the environmental monitoring use case. Acting on this knowledge enabled the project to look into developing a solution to provide remote monitoring of the water treatment plants and reduce the need for volunteers to physically inspect the premises.

Understanding that any very rural community involved in 5G testbed projects is likely to be small in size, means taking extra pre-emptive measures to ensure community members has every opportunity to engage with the project if they want to. All community members should have the opportunity to remain engaged as the project progresses. We used regular communications, checking-in with participants that they want to remain involved in the project rather

We want to learn about the project gaps or institution voids that emerged in your project and the repair work you had to do as a result. What were your practices (and knowledge activism) for identifying and dealing with institutional voids?

than making assumptions that they want to continue participating; providing them with updates on the progress of the building of the project network infrastructure; and guidance on the necessary technical requirements for participants to connect and operate the new connectivity technologies being installed.

In sum, complex projects require substantial **knowledge activism** to gather together and share knowledge across intra and inter-project boundaries, and across key stakeholder boundaries

(including with the community). Knowledge activism enables the continual identification and repair of institutional voids that can stop projects progressing and realising the potential benefits they have to offer for very rural communities, and for community socio-economic flourishing.

### Best Practice Learning: Running Complex Projects in Place

This study revealed the valuable role and practices of knowledge activism within the project, with key project stakeholders. We identify three key principles of knowledge activism to help project leads and project group members identify and repair institutional voids that emerge as their project unfolds:

- 1) **Allocate the role of knowledge activist and boundary spanner to one or two project members;** By identifying and making clear to all project group members who your knowledge activists are, the purpose of their role and how they will work. Knowledge activists provoke change by sharing and connecting knowledge. Having project members understand this role will help your knowledge activist do their job, and help the project to develop and prosper by providing an important mechanism for joining-up thinking and knowledge exchange. Celebrating positive outcomes that result from this role as the project unfolds can also be important to demonstrate the value of it to those you are trying to enrol in its activities.
- 2) **Be open to where the boundaries are in the project.** Boundaries usually emerge as projects progress, stopping the dynamic flow of information across different elements of a complex project. Boundaries typically emerge when different experts work together in a new setting. It is important that project members do not make assumptions about where boundaries are, but rather look out for the emergence of boundaries. Boundaries may be inter-organisational or between groups of experts that use different technical language or logics to make judgements. Project tensions tend to emerge at boundaries.

### 3) **Create knowledge sharing mechanisms within the project and lead knowledge sharing activities.**

Your project needs you to put in place knowledge sharing mechanisms and activities to support effective knowledge activism. Project meetings, smaller inter-organisational meetings, collaborative events with other projects - conferences, workshops, seminars - are all mechanisms for knowledge activism and knowledge sharing. Make sure that your knowledge sharing activities emerge from the coordinated efforts of project members: get people involved and advocate knowledge sharing through inter-organisational meetings.





## Conclusion

Based on the accepted premise and evidence that digital market infrastructures and connectivity enable economic flourishing in place, we reveal the work required to engage communities with the form and functionality of infrastructures as they are put in place, and enroll community members in its use, through the work of a complex project designed to do such.

We argue that a nuanced understanding of community engagement, study and enrolment provides the basis for understanding why communities sometimes resist some forms of infrastructure change and welcome others. The core assertion from our analysis is that complex digital infrastructure projects confront multiple engagement and enrolment thresholds as they unfold and progress. Hence, to deliver effective community engagement and enrolment, complex digital infrastructure projects must seek to capture the plurality of voices within a community and explore the underlying concerns and aspirations of individuals; identify patterned concerns and aspirations and work with the project's technical team to see how these can be taken into account in the infrastructure design and application; and select key team members to act as knowledge activists and boundary spanners within projects to mobilize knowledge in different forms, to connect with different experts so that a holistic and joined up approach to place and space can be determined through the actions of the project.

We argue that this work is essential in enabling digital infrastructure projects to repair institutional voids and make the socio-technical market system work for a very rural place. By presenting a series of principles that guide action in the development and delivery of digital infrastructure projects for very rural areas, we hope to stimulate further inquiry into the dynamic interactions among and government policymakers, communities, and digital infrastructure projects.

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