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Is Planning A Barrier To The Development Of Digital Network Infrastructure? Insights From Rural Wales

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Abstract

This paper investigates the frequent claim that planning is a ‘barrier’ to developing digital networks (mobile telephony and broadband), causing ‘delay’ and deficits in rural network coverage. It draws on planning applications data and expert interviews gathered in Wales. It found only a relatively small proportion of infrastructure applications failing to gain consent but that developers did perceive planning uncertainty and constraints to adversely affect network roll out. However, economics rather than planning has been the central factor limiting rural network coverage. More fundamentally, framing planning as a ’barrier’ to infrastructure delivery ignores how planning mediates between alternative technological pathways.

Key words: telecommunications, phone masts, delay, infrastructure, digital divide, 5G

Introduction

Many planning researchers and practitioners are familiar with narratives that cast planning as a 'barrier' to necessary development. Such discourses typically accuse the planning system of causing 'delay' and blocking projects, then proffer reducing planning control as a mechanism for expediting delivery (Clifford et al 2019; Rubin & Felsenstein 2019). Such narratives have become more intensively asserted and translated into actions since the 1980s, as a component of neo-liberal ideologies. They have become particularly prominent in relation to infrastructure, reflected in many countries through measures that seek to tackle 'planning delay' by fixing the time frames for decision-making processes and containing the scope for challenge (Marshall 2012).

Claims of planning barriers have been observed in the case of 'digital infrastructures'. We use the collective term digital infrastructures to refer principally to mobile telephony and broadband, as it is the characteristic infrastructures of these technological pathways – phone masts and associated equipment – that have dominated debates about planning. Because phone masts typically require some form of planning approval so, in many countries, one can observe difficulties in the development of digital networks being blamed on planning regulation and public opposition expressed through those regulatory processes (Lloyd et al 2004; Larsson 2014; Bröer et al 2016). Indeed, the UK Government claimed that its 2022 'barrier busting laws' – mainly measures to reduce planning controls for larger masts – will have various benefits, including 'accelerating' network development, and 'eras(ing) mobile coverage "not spots" in rural areas' (Andrew and Lopez 2022) i.e. rural areas with persistent connectivity problems.

But are these assertions well-founded? As researchers have noted, claims that planning 'delays' or impedes infrastructure development are poorly evidenced (Marshall and Cowell 2016). Although 'barrier' claims are widely repeated by governments and the mobile telephone industry, systematic academic research on the interface between planning and telecommunications infrastructure development is sparse. Most studies focus on previous eruptions of public controversy around phone masts, but few trace the substantive effects of planning regulation on network coverage in rural areas. Furthermore, as we shall argue, discourses of 'planning barriers' neglect a wider issue: planning regulations do not simply facilitate or impede development, but are implicated within and mediate between *different pathways of infrastructure development*.

The analysis presented in this paper draws its data from a research project, *5G – Wales Unlocked*, which examined potential commercial opportunities for investing in 5G networks in rural Wales.[1] As part of that study, an investigation was conducted into the planning challenges of both extending rural coverage of current major telecommunications technologies (4G), and the prospective development of 5G. This investigation addressed

three questions: has planning affected the roll out of digital infrastructure in rural areas?; how important is planning in affecting rural network coverage compared to other factors?; to what extent are any 'barrier' problems co-produced by particular development pathways? The findings of that investigation are presented here.

In the next section of the paper we review the analytical challenges affecting research on planning delay and barriers to infrastructure development, then existing research on the interface between planning and digital infrastructures. The following section explains the methodology for the study, which combined planning application analysis and interview data. The results section shows that while planning procedures can cause delays to specific projects, the effects on rural network coverage are ambiguous and, compared with wider economic factors, relatively marginal. The final, concluding section discusses key findings, policy recommendations and directions for further research.

Analytical Issues and Policy Context

Challenges in Researching Planning 'Barriers'

Claims that planning creates 'barriers' to development, by delaying or preventing it, are easier to make than to evidence. Systematic analyses are scarce (Marshall and Cowell 2016), and studies of planning delay have often produced 'weak and contradictory' results (Rubin and Felsenstein, 2018, 2180). Existing research spotlights four sets of analytical problems in assessing the 'delay' or 'barrier' effects of planning in relation to infrastructure.

Firstly, in the case of delay, emphasising procedural speed has long been recognised as a simplistic way of judging the quality of decision-making (Booth 2002). The apparently straightforward task of measuring the time taken by planning processes faces various ambiguities (Ball et al 2009). Projects may require multiple consents and a single project may be subject to successive revisions (of design or location) and planning application procedures. Moreover, defining 'delay' as 'unnecessary time' (RTPI 1978, cited in Booth 2002) raises value-laden questions about what the necessary purposes of planning processes should be; specifically, the weight to be attached to development cost and delivery of national development goals, set against careful impact assessment, meaningful opportunities for public engagement and wider democratic legitimacy.

Secondly, on the issue of causality, there are questions about the relative importance of planning processes *vis a vis* the multiple other factors shaping the delivery and performance of major infrastructural projects (Denicol et al 2020). Research in sectors like energy and transport (Marshall and Cowell 2016) has shown that time spent organising finance to make projects remunerative for private investors can be a more significant determinant of time

frames than public planning procedures. In terms of substantive barriers, where commercial businesses are involved, economics may play a critical role in determining where infrastructure is provided and which sections of society get served (Graham and Marvin 2001). Where planning has been shown to have negative effects on development rates, this arises not from longer decision-making processes per se, but from the effects of planning on time frame uncertainty, with potential stakeholder objections being a major cause (Rubin and Felsenstein 2018).

A third set of analytical problems is the tendency of most studies of planning delay to seek causes solely within decision-making procedures, whereas the quality of development proposals are rarely factored in, beyond fairly crude considerations of project size (Rubin and Felsenstein, 2018). In effect, the material form of development proposals, their design and the sites chosen by developers (e.g. whether they have sensitive qualities) are excluded from the equation. Such omissions are problematic, given that analysts of infrastructure siting conflicts have long established that how projects are perceived to fit with or threaten the qualities of place, and how those concerns are handled, can affect the emergence of conflict (Devine-Wright et al 2016).

Fourthly, conceptualising problems in planning through the lens of 'barriers' to delivery offers a particular and narrow view of the issue. As Bulkeley et al (2005, p.9) suggest, it mobilises a linear and typically techno-economic conception of the policy process, where new interventions (like new technologies, infrastructures or policy goals) are discrete, rational, immutable and unproblematic objects that 'proceed logically from formulation to delivery unless impeded by some barrier' (*op cit*. p.13). Viewed thus, problems are not located in the policy intervention but in the separate, 'irrational' social and political worlds of implementation, which could and should be adjusted to achieve the desired outcomes. Such 'barrier discourses' typically fail to recognise how problems might derive from the social, political and technological choices embodied within policy interventions themselves.

One can apply these insights to the various 'planning barrier' problems that arise in relation to infrastructure. For example, one might contrast the considerable planning and siting challenges faced by large scale new energy generation facilities, like nuclear power or on-shore wind farms, with the different set of challenges that might arise in rolling-out more decentralised energy supply pathways, making greater use of smaller-scale technologies and demand management. Simply seeking to resolve planning 'barriers' by rolling back regulation for one particular, dominant pathway ignores the multiplicity of development pathways and alternative framing of societal goals, which may not create the same planning difficulties (Marshall and Cowell 2016).

From the above, it is clear that analysts of planning 'delay' or 'barriers' need to be keenly aware of the analytical and interpretative difficulties. These insights can be applied to a rapidly evolving infrastructural sector – digital networks.

Digital Networks and Planning Policy

From the 1990s onwards, the adoption of digital technologies by society and business has expanded rapidly, to a point where they are widely considered as an essential universal requirement. The expansion of telecommunications infrastructures has enabled and encouraged this trajectory. The infrastructure for mobile telephony and broadband, with its network of masts and antennae, continues to increase in reach, capacity and capability, through successive technological shifts from 2G, to 3G, 4G and 5G. At the same time, 'fixed' infrastructures for internet provision have expanded to embrace *inter alia* faster, higher-capacity fibre networks. Fixed and mobile technologies are also increasingly interwoven, with mobile telephone infrastructure increasingly important for 'on the move' internet provision, and fibre networks supporting mobile telephony.

The roll out of digital networks has faced a number of challenges, notably the social controversy sparked by the initial waves of mobile phone mast development, a phenomenon observed in a number of countries (Foster and Carrel 2006). Health risks have been a dominant factor, interlaced with concerns about visual intrusion and landscape impacts. Researchers focused most attention on understanding public risk perceptions and evaluating government efforts to manage the controversy (e.g. Stilgoe 2007). While development interests and sections of government blamed this public opposition and the planning system for delivery problems (Drake 2011), a small number of researchers sought to quantify the overall, material effects of these factors on infrastructure deployment outcomes. Askew et al (2009), Lloyd et al (2004) and Larsson (2014) questioned the evidential basis for 'barrier' concerns, pointing to the fact that ultimately most phone mast applications were granted consent.

Planning has had a more fugitive presence in another major challenge facing digital network development - social inequality (Graham and Marvin 2001) and its important rural dimensions. While use of mobile telephony and the internet has expanded significantly, rural areas have faced persistent deficits in infrastructure coverage and connection reliability (Ofcom 2021). The depth of such 'digital divides', and the social exclusion that they cause, is especially problematic in the more remote, less densely populated 'deep rural' areas (Philip et al 2017). Significantly for the argument here, rural researchers locate the main cause of the problem in the dominant development pathways for infrastructure. Following privatisation and deregulation, most digital infrastructure has been developed by competing private sector 'mobile network operators' (MNOs) for whom the higher costs of

and lower returns from building infrastructure in more sparsely populated rural areas disincentivises investment compared to more profitable urban markets. This is coupled with a policy and regulatory environment which has emphasised speed and capacity over connectivity and universal access, leaving 'many rural areas ... continually trying to catch up' (Philip et al 2017, p.388). Although planning is part of the 'policy mix' shaping the deployment of digital infrastructure (Henderson and Roche 2020), planning 'barriers' are rarely afforded any prominence in academic explanations of rural digital divides (e.g. Philip et al 2017; Salemink et al 2017).

The evolution of planning and consenting regimes for telecommunications can be placed in this context. In the UK, planning policy towards digital infrastructure has sought to effect a pro-development stance while accommodating concerns for the proper regulation of potential environmental impacts and adequate local control. The balance between these objectives is expressed through the allocation of infrastructure to one of four categories of planning regulation, as summarised in Table 1 below. The largest forms of infrastructure – typically new masts over a certain height, deemed likeliest to generate the most impacts – are subject to full planning control, exercised by local planning authorities. Below that, categories of infrastructure can be subject to Permitted Development Rights (PDR), in which national government confers the right to develop and the scope for local planning control is reduced.

[Place Table 1 somewhere near here]

Over time, governments have adjusted the thresholds between these categories of regulation to give effect to changing priorities (see Walton 2002; Allmendinger 2007; Hutton 2021). With the UK government (which has planning responsibility for England), most post-2010 adjustments to planning control have been in a deregulatory direction: more development has been placed in regulatory categories 2 and 3 (see Table 1), with the aim of expediting network development. This trend towards deregulatory streamlining is observable in other countries (Foster and Carrel 2006; Finch et al 2015; Bröer et al 2016). In 2022, the UK Government introduced 'barrier busting' extensions to PDR in England to give mobile network operators 'more freedom to make new and existing phone masts up to five metres taller and two metres wider than current rules permit' (Andrew and Lopez 2022). National Parks and other designated landscapes have usually been exempt from these extensions of PDR, in recognition of their landscape qualities. Planning is a devolved function in the UK, allowing the governments of Northern Ireland, Scotland and Wales to make their own adjustments.

Conventional public planning regulation is not the whole picture. In the UK, governments and the mobile network operators have circumnavigated pressures for greater planning control by increasing reliance on voluntary 'third party regulation' (Allmendinger 2007), by

drawing up and agreeing a Code of Best Practice for Mobile Phone Development (e.g. Welsh Government 2021). The Code promotes many facets of good planning, including early consultation and the submission of sensitivity analyses of alternative mast sites. Limits to such voluntary regulation have also been observed. The Code encourages mast sharing, which is important because mast proliferation is a side effect of competitive market approach to network delivery and a common source of public concern (Foster and Carrel 2006; Drake 2011). However, there is little evidence that the Code *per se* does much to increase the frequency of mast sharing (Walton 2002; Allmendinger 2007).

What one can observe is the evolution of systems of planning regulation for digital infrastructures – especially mobile telephony – in which the desire to expedite network development has usually entailed the rolling back of planning control. However, whether planning causes such a 'barrier' to network development that deregulation is likely to encourage network development or close rural 'not spots' is unclear. As we noted above, researchers face numerous problems in addressing such questions: including separating any 'delay' effects of planning from the multiple factors affecting infrastructure development. The analysis that follows seeks to respond to those concerns by advancing our understanding of the effects of planning on digital network infrastructure. It gathers data from a time period (late 2021, early 2022), when concerns about the coverage of 4G technologies in under-served rural areas was coinciding with the rapid expansion of 5G technologies in urban centres, and active debate about their rural potential. Such a moment offers particular insights on the interface between planning, development 'barriers' and technological transitions. In the next section we explain our methodological approach.

Methodology

The geographical context for this research, Wales, is an apposite location for investigating the challenges of extending digital networks in rural areas. Network coverage in Wales is lower than the UK average, especially in deeper rural areas with sparser populations and more rugged terrain (Ofcom 2021). Although telecoms policy is reserved to the UK government, devolution has given the Welsh Government important powers in the telecoms field, including planning. The broad format of planning control over telecommunications infrastructure in Wales echoes the UK norms outlined above but, at various points, the Welsh Government has resisted following deregulatory moves in England, informed by research it commissioned that questioned how much difference this might make to network development (Askew et al 2009; Arcadis 2017). At the time of writing (November 2022), the Welsh Government has not followed the latest roll back of planning controls introduced in England (Andrews and Lopez 2022).

The research employed a multi-method research design combining analysis of planning applications and appeals with qualitative data, collected from semi-structured interviews with key stakeholders and documentary analysis. Data collection was focused on Wales, with a particular emphasis on the south-east of the country. The planning applications analysis drew upon the searchable online databases of planning applications held by local planning authorities, and selected all 'telecommunications' applications and prior notification cases from seven authorities (Monmouthshire, Powys, Blaenau Gwent, Torfaen, Brecon Beacons National Park, Newport and Cardiff), for the period 2010 to October 2021, yielding a dataset of 179 applications. 'Telecommunications' is the standard category of planning application used for digital infrastructure (phone masts etc). Applications were analysed for their outcomes (percentage granted, refused or withdrawn) and to discern any pattern among those applications that were not granted. Appeals data were obtained from the COMPASS database, which covers every ministerial call-in, inquiry and hearing for England and Wales since 1985, indexed *inter alia* by development type.

Although analysis of planning outcomes presents a reliable and quantifiable means of tracing what is happening in planning processes, simple quantification of outcomes does not, of itself, elucidate actors' perspectives on delay or barriers and the perceived causes. To enhance the validity of the research, twenty-three semi-structured interviews were conducted with twenty-five people, between November 2021 and April 2022, undertaken with the approval of the Research Ethics Committee of the School of Geography and Planning, Cardiff University. Interviewees were selected for their involvement in digital infrastructure planning applications in Wales, choosing actors from the public sector (the UK and Welsh Government; local planning authorities), private sector (major infrastructure builders, smaller connection providers), and environmental bodies. Actors involved in innovative rural 5G projects were also selected. The interviews used open-ended questions to obtain insights on the relative importance attributed to planning and other factors shaping rural digital networks, with an effort made to probe beyond claims about delay and barriers to explore the justifications – be they illustrations, data or other evidence – that lay behind them. Each interview lasted an average of 45 minutes, and was recorded and transcribed; quotes are referenced to basic respondent categories, to uphold anonymity commitments.

Results and analysis

What Does Planning Applications Data Tell Us About Planning 'Barriers'?

Patterns in planning outcomes for digital infrastructure

Table 2 below presents the overall frequency and outcome patterns for telecommunications applications across our sample of Welsh local planning authorities.

[Insert Table 2 somewhere near here]

A number of points can be taken from the data. Firstly, digital infrastructure does not appear to encounter an unusual level of difficulty in the planning system, insofar as most applications are approved. This deduction echoes other studies (Lloyd et al 2004; Larsson 2014; Arcadis 2017). The overall acceptance rate of 87% is comparable to the average rate for all planning applications (80-90%, 2005-2020, MHCLG 2021). Refusal may not be the end of the story either. For applications noted as 'withdrawn' in Table 2, interviewees explained that withdrawal often leads to a re-submitted application, with the design or location modified to better satisfy planning concerns.

Spatial and temporal trends in planning outcomes

Figure 1, below, shows that the number of appeals has been very low since 2008 and, across the whole period, 68.2% of appeals were ultimately successful. Indexing appeals against volume of telecommunications applications gives little evidence that the ratio of applications being appealed has increased over the period, either.

[Insert Figure 1 somewhere near here]

The data shows other important patterns. Applications for digital infrastructure in rural areas do not appear more likely to face refusal than those in urban areas. In Table 2, the predominantly urban local planning authorities of Cardiff and Newport received the most applications but also rejected the highest number. This pattern confirms the ongoing importance of proximity to sensitive receptors – homes, schools, etc - in triggering public resistance, with proximity being a bigger issue in urban than rural locations. In open countryside, concerns and objections tended to be raised by organised bodies concerned about the environmental impacts – local planning authorities (LPAs), statutory environmental bodies, landscape NGOs – more than publics. Our research did find some mast applications for particularly sensitive rural landscapes triggering opposition: Table 2 shows a cluster of withdrawn and refused applications in the Brecon Beacons National Park. However, landscape groups promoting the Pembrokeshire Coast National Park did not find any telecommunications applications in their area sufficiently problematic to warrant a response.

In interview, most rural local planning authority and NGO respondents felt that telecommunications were not an unduly problematic form of development in planning terms and, furthermore, expressed the view that telecommunications faced fewer planning

problems (i.e. objections) than in the past. This was attributed to: growing recognition of the importance of digital connectivity in rural areas, raising social acceptance among communities and landowners; the telecoms industry learning to improve the quality of their applications and siting practices (see also Allmendinger 2007; Bröer et al 2016); the broadly effective containment of objections on health grounds (see also Larsson 2014; Bröer et al 2016); and the greater scale and impact potential of wind turbines in many rural areas eclipsing the impacts created from phone masts.

How is Planning Perceived to Impede Digital Infrastructures?

Perceptions of problems

To understand whether or how planning regulation processes might be impeding development, it is necessary to look beyond the simple quantification of planning outcomes. Despite relatively high consent rates, respondents from the digital infrastructure industry and their planning agents frequently, and often firmly, articulated the view that planning was a problem for infrastructure deployment. Much of the concern focused on the uncertainty that planning processes injected into development time frames, especially for applications that required full planning consent. For example:

> All we want to do is bring certainty to our roll out plans ... having an application to submit puts uncertainty and delay into the project, and that's the fundamental problem that we have (Industry)

Blame was placed on decision-makers and consultees. Some planning officers were perceived to attach insufficient weight to the benefits of connectivity. Planners were criticised for failing to understand the diverse constraints affecting digital infrastructure siting and design, for making ill-informed design requests that impact network performance, and for unnecessarily deferring decisions on masts applications in sensitive locations. For other industry respondents, "negative" statutory conservation bodies were felt to impose excessive environmental tests on projects, and to be slow to respond. Although, as above, respondents did not believe such planning problems were worse in rural areas, aspects of infrastructure requirements in rural areas could create additional planning issues, such as the requirement for access tracks to masts.

These discourses of delay informed preferences for particular solutions. There was wide support from industry actors for extending PDR for larger masts, including for Wales to follow the 2022 deregulatory moves for England. Support for greater use of the prior notification procedure instead of full planning consent (see Table 1) reflected the desire to reduce uncertainty in the time frame for decisions, by requiring local planning authority

responses within a specified number of days. Interestingly, some planning officer respondents also supported further extensions to PDR for digital infrastructure, expressing views that 'permitted development rights are still too tight; why are we dealing with these applications?' (planning officer). They were content that the prior notification procedure could, for them, provide adequate 'safeguards' for the local authority, even though it limited the scope for consulting publics or other organisations.

Perceptions that planning is not the primary factor

If the above were pervasive themes in the responses, they were qualified and resisted in various ways, and from various directions. For some industry respondents and their agents, extending PDR for masts was not the first or main issue with planning and the regulatory environment that they raised. Some gave equal importance to difficulties in acquiring land rights. Ironically perhaps, there were claims that adjustments to PDR designed to facilitate development had themselves caused problems, because of poorly worded legislation and ensuing interpretative problems (see also Askew et al 2009). Industry views were split between those content with modest incremental extensions of PDR rather than wholesale removal, and those preferring 'absolutely massive height increases. That is really what you need in rural areas ... it makes the planning a lot easier' (Land Agent)

Other planning officers, statutory bodies and NGOs resisted the idea that planning was a 'problem'. Respondents referred to the high percentage of applications granted consent, and the need for decisions to have democratic legitimacy. They also pointed to instances where developers were complicit in the problems experienced by their application, because of their choice of location, because pre-application site analysis or consultation was lacking, or insufficient attention had been given to effects on designated features. Planners and environmental groups (as well as some development respondents) pointed to instances where developers or their agents had pursued sites that are lower cost and convenient to them (for example in highway land, which they have statutory powers to access), even though lower impact sites could be available. For such reasons, a range of respondents spanning the development and regulatory sectors were uncomfortable giving developers "carte blanche". Importantly, there was convergence across different sets of respondents about the situational nature of many 'planning problems', and agreement that siting facilities in sensitive landscapes required care, which inevitably took more time. Almost all respondents felt that protected areas like National Parks required safeguarding from any roll-back of planning controls.

Practices that help facilitate the planning process

The extent to which planning processes were problematic could also be ameliorated by organisational practices. Respondents expressed broad support for effective early

engagement between network operators, local planning authorities and other statutory bodies (see also Henderson and Roche 2019). There was also positive support for the employment of 'digital champions' within local authorities (Mobile UK 2021). Such individuals could provide a single point of contact for digital infrastructure within the authority, working across technologies and departments, helping to ensure that strategic goals of network development are recognised across the authority, including when project-specific planning decisions are made.

Such actions were seen as more helpful than measures involving strategic-scale discussions about future network development plans. Some developers and statutory conservation bodies saw merit in early information-sharing discussions around major area investment programmes to contextualise individual mast applications (e.g. for the 'Shared Rural Network' in Snowdonia, on which more below). However, most planning officers saw little value in the annual roll-out plans sent to them by the industry, which set down their forthcoming network development activities. Officers conceded that 'we don't do much with that information' (Planning Officer), partly because of staff resources - 'we haven't had the capacity to look at it in detail' (Planning officer) – but also because of a preference to concentrate attention on specific applications, rather than generalised intentions.

Does Planning Regulation Contribute to Rural 'Digital Divides'?

While it was straightforward to find discourses of delay and other problems associated with planning, it was harder to locate substantive evidence that these problems were a major factor explaining gaps in rural digital network coverage. One reason for this is the limitations of taking a planning application-centred approach (Allmendinger 2007) to the issue. While planning problems do lead to some infrastructure applications being withdrawn or refused, with consequences for costs, one cannot assume that network infrastructure did not ultimately materialise (e.g. via a revised application). The same applies to anecdotal references to villages being 'poorly served' because of NIMBYs (e.g. the comments attached to Jackson 2020); and interviewee observations that where projects encounter local resistance such schemes can drop to the end of developers' roll out programmes. The unknown here is whether such areas have since been revisited or remain unserved. Moreover, when asked, industry respondents acknowledged that, in the end, 'because planning policy is so in favour of masts' (Land Agent), most objections could be overcome. Consequently, 'we are delivering the vast, vast majority of the time' (Developer). And, as noted above, almost all categories of respondent agreed that development in sensitive landscapes like National Parks required careful planning control.

Given the above, any relationship between planning and network coverage is not a simple consequence of planning regulation (illegitimately) curtailing development. For respondents

involved in delivering mast-based infrastructures, the more important causal effects were mediated through economic costs of system development. Such actors frequently argued that developing the infrastructure in ways deemed compatible with planning regulation resulted in networks being provided in telemetrically and economically inefficient ways. For example:

> they design masts that they can get through planning rather than putting in the best mast to get the best coverage (Developer)

One effect was that navigating planning controls led to masts located in sub-optimal locations in terms of coverage. More systemically, planning constraints were a factor militating in favour of using more but smaller masts, as opposed to 'more efficient' approaches using fewer but taller masts; respondents frequently referred to Sweden and other European countries allowing masts up to 40m in height. Such views underpinned calls for extensions of PDR, for the 'flexibility' it conferred on network design. One industry respondent explained that there could be circumstances where 'it was not commercially feasible to go and build ten sites … we need to be able to build one site, which is going to have a big, massive coverage area' (Developer). However, specific evidence of the scale of prospective network coverage improvements that this 'large mast pathway' could achieve – and thus of the deficits in coverage caused by not using it - was lacking. Respondents acknowledged the 'chicken and egg' nature of evidence, in that concrete experience was shaped by the technology that they did build, governed by the availability of standardised equipment and supply chains, not what they might build.

However, *problem framing clearly matters*. When the questioning shifted from asking specifically about the effects of planning, to exploring in a more open-ended way the main factors shaping network coverage, the response was clear – economics. Respondents readily acknowledged that economics and topography were the main factors inhibiting the development of rural digital networks. As population density declines, so the likely demand and therefore return on system development falls. And as the topography gets more difficult, in terms of slope, elevation and ground conditions, so capital costs increase, and not just for building the masts. Distance from existing networks plus difficult terrain also makes it more expensive to deliver power, provide transmission connections to the core network (backhaul), and build access tracks. As one industry respondent put it:

> a remote rural site can cost at least a million pounds … that's going to take a hell of a long time to give a return on any investment (Developer)

While planning processes might affect delivery costs, and the efficiency of network development, there was no systematic evidence that this significantly tilted the economic cost/benefit gradient against closing rural 'not spots'. Arguably, the effects of planning

become purely hypothetical for those sizeable un-served rural areas where no planning application for infrastructure had ever been made.

Indeed, the UK Government itself has recognised that problems of rural network coverage arise from the political economy of the dominant development pathway. In its 'Shared Rural Network' programme, for which roll-out began in 2021, the UK Government is seeking to improve rural coverage and reduce the size of 'not spots', principally by injecting significant public funding. £500 million has been allocated for mast infrastructure in areas with no coverage from any operator, covering capital and operating expenditure. The Government's justification for this funding refers explicitly to how 'thirty-five years of commercial investment in mobile networks has left some rural areas unconnected', requiring action 'to remedy market failures and the socio-economic consequences of poor coverage' (DCMS 2021).

However, other features built into the programme may create new planning challenges. To deliver operator choice, the Shared Rural Network programme requires that the masts built are capable of being shared by the four MNOs, but this entails the construction of taller, bulkier lattice tower masts as opposed to the slim, often shorter, columnar monopoles that have been used widely to extend rural network coverage. Respondents widely observed that monopoles have often proven more acceptable in planning terms.

5G: Different Pathways, Different Planning Challenges?

One can begin to see how arguments about planning 'delay', 'barriers' and their effects on rural coverage are interconnected with different development pathways. Such interconnections are also apparent when one considers the latest wave of telecommunications technologies, 5G, which has effects on prospective development pathways that extend beyond the technological.

5G is expanding rapidly at the time of writing, mostly in urban areas, with an array of initial extensions and test beds underway in rural areas. As a technology, it is seen as offering faster connectivity speeds, greater signal robustness, and more scope for network slicing: qualities that enable innovative new applications involving *inter alia* the 'internet of things'. In infrastructural terms, it is widely stated that because 5G signals are qualitatively different to previous radio technologies – travelling for shorter distances, more sensitive to signal interruptions – such systems require network densification, with more cells and host sites, and less scope for screening techniques such as the use of trees (Welsh Government 2021). Consequently, one might expect that deploying 5G would present an intensification of familiar planning issues around digital infrastructure siting. Indeed, the UK government

included ’accelerating’ 5G roll out as part of its justification for introducing ‘barrier busting’ planning deregulation (Andrews and Lopez 2022).

However, 5G is not a singular technology but a cluster of elements, which together introduce a greater ‘tool-box of capabilities’, more stakeholders, and an array of different business models for digital network delivery (Lehr et al 2021, p.1). This enables a diversity of potential development pathways with different implications for planning. Innovative rural 5G projects supported by the Connecting Rural Communities programme (DCMS 2019) have made a positive pitch of demonstrating ‘how building mobile network infrastructure in rural areas could be done more cost effectively and at increased pace’[2], and ‘bring connectivity to challenging environments’[3]. Projects sought to achieve this by reducing the construction of new masts and instead utilising existing assets, such as buildings or extant masts as equipment hosts, along with their backhaul and power supply, as well as innovations (e.g. floating buoys to handle 5G signals in coastal locations). Delivery was facilitated by the employment of smaller companies, which ‘are skilled in that space’ (Project manager) and possess detailed knowledge of local territory. The result was ‘a more sensitive, light touch way of doing this’ (Project manager), achieved by building network from smaller scale equipment that fell within the scope of PDR, which meant that ‘planning regulations and delays were completely side-stepped’ (Project manager). Respondents contrasted their approach with the major operators, which they perceived to have ‘a very rigid delivery model – if it doesn’t fit their model, it doesn’t fit their supply chain, it just can’t happen’.

Importantly, these experiences are echoed by existing companies that already work to provide internet connections to rural customers. Some actively touted that they specialise in delivering connectivity into ‘the most challenging rural locations … to communities and business who cannot rely on mainstream solutions for connectivity’.[4] Again, planning was not an issue, because a combination of close knowledge of territory and the utilisation of existing structures to host equipment meant that most infrastructural requirements were modest in scale and fell within the scope of PDR.

For these companies, and the innovative 5G projects discussed above, the bigger ‘barriers’ were market regulatory issues that made it difficult for smaller outfits, offering bespoke solutions, to break into markets dominated by major incumbent businesses. Respondents referred to the difficulties of accessing notionally shared spectrum and the cost of sharing existing masts.

Consequently, it is unclear to what extent the future development of digital networks in rural areas will rely on conventional mast-based systems. This is partly because, as a number of our respondents observed, the dominant narrative of ‘5G = more/bigger masts’ was felt to represent an urban, capacity-driven agenda; whereas in less densely populated rural areas re-configuring existing base stations could prove adequate coverage. It is also because

mobile telephony and broadband systems both require the extension of fibre networks, for backhaul connections to the core network. Costs and practical difficulties mean that fibre is unlikely to be extended into the remotest rural areas but it is germane to our analysis here because its use, typically cabled underground following the highway, obviates many of the planning and landscape concerns of large masts. Some respondents argued that fibre should allow alternative mobile telephony development pathways for rural areas, based on smaller poles plugged into the fibre network.

> That would be a very simple, quick and cheap solution … as opposed to building massive, big macro sites (Developer)

Planning regulation is still important to these alternative pathways. Industry voices have pressed for smaller mobile phone masts to be treated as PDR (category 2 in Table 1), like the telegraph poles that they resemble, to facilitate their development. But other, non-planning areas of regulation matter, too, notably ongoing struggles to open up Openreach's telephone poles and ducts to sharing (see Hutton 2021).[5] Much also depends on how satellite-based digital infrastructures evolve as an option for delivering connectivity to hard to reach premises: these technologies side-step the need for large-scale terrestrial infrastructure entirely.

Conclusions

The research presented in this paper set out to investigate claims that planning was a 'barrier' to the deployment of digital networks in rural areas. In so doing, it helps to fill knowledge gaps that surround the 'delay' effects of planning on infrastructure development, and the interactions between planning and digital network development more widely.

A key finding is that digital infrastructure – masts etc – do not face particular difficulties negotiating planning processes compared to other categories of development, and that the problems encountered may not necessarily be more significant in rural areas than in towns and cities. Major network operators and other industry actors did blame planning processes for creating timeframe uncertainty for deployment (an effect identified for other categories of development: Rubin and Felsenstein 2018). It was also argued that negotiating planning constraints worked against the creation of networks that were more telemetrically and economically efficient in achieving coverage. However, it proved difficult to systematically evidence any claims that these effects were a significant cause of deficits in rural network coverage. In addition, it is clear that the high costs and low returns of building network in remoter rural areas are major factors causing persistent rural 'not spots'. Furthermore, many remaining 'not spots' coincide with protected landscapes, where more restrictive

planning policy is widely supported. Given all this, UK Government claims that 'barrier busting' planning deregulation will close rural not spots are difficult to sustain.

The research has also illustrated the need to take seriously the analytical problems involved in seeking to understand 'planning barriers' to infrastructure deployment. In particular, the results have shown how 'barriers' are often co-produced by facets of the development pathway, and different development pathways intersect with planning regulation in different ways. We reported on how new, innovative 5G network projects are providing rural connectivity through smaller-scale infrastructures that utilised existing structures as equipment hosts, much of which falls into categories of permitted development. These findings have wider significance. They show that planning regulation and its adjustment is not just something that affects development 'delivery' in a linear way, but needs to be seen as distributing and redistributing (economic) advantage between different development pathways. Making 'big infrastructure solutions' easier by rolling back planning control does little to help smaller-scale, tailored solutions that might better represent 'least cost planning', or to incentivise innovative responses to environmental and economic constraints. Our research also reminds planning researchers to unpack 'development interests', rather than seeing them as homogeneous. This is especially important if planning is to better engage with debates about technological transitions, including sustainability transitions, in which the interface between new 'niche' actors and incumbent socio-technical regimes (Geels 2002) is a key dynamic.

Although the points above represent more widely applicable conclusions from our research, they also points to some limitations, in that our deductions are based on empirical evidence arising from the prevailing technological pathways for digital networks in what is a rapidly changing sector. A number of important sectoral developments suggest areas requiring further research. Assessing progress with the UK Government's Shared Rural Network programme may better elucidate the effects of planning on rural network coverage, because steps have been taken to reduce the economic barriers through public funding. However, in line with our discussion of the analytical issues involved above, such research would also need to test the technical, social and economic assumptions built into this development pathway i.e. that rural citizens and stakeholders will value operator choice, facilitated by bulkier masts, sufficiently to outweigh the greater potential for visual intrusiveness, including in protected landscape areas. And while major social controversy around masts scarcely affected the development of digital networks in Wales during the period of this research, further research could usefully investigate whether this is likely to hold, especially as 5G technologies roll forward, and especially if adjustments to planning regulation diminish the scope for public oversight and control. The potential for 5G technologies to foment opposition, targeted on the planning process, has already been observed (see for example https://stop5g.co.uk/local-campaigns/[6]).

A number of practical and policy recommendations also emerge from the research. Our investigations pointed to the value of having 'digital champions' within local authorities (Mobile UK 2021) able to inject greater levels of information into planning processes, and work across departments and sectors to tackle the multiple factors involved in enhancing digital networks. Although our research encountered equivocation on the merits of focused, spatial, forward planning for digital infrastructure, the creation of better-quality and more widely shared information on remaining poorly served areas might underpin more effective conversations on how such deficits might best be filled. Indeed, closing the remaining rural 'not spots' in digital network coverage would benefit from a policy approach that focuses on these areas specifically, to develop solutions responsive to the particular causal factors, social needs and environmental sensitivities involved (Philip et al 2017). Cultivating more responsive, tailored solutions may prove more effective than perennially invoking the need for further, 'rural blind' reductions in planning control.

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Declaration of Interest Statement

The authors report that there are no competing interests to declare.

References

Allmendinger, P. (2007) Mobile phone mast development: the rise of Third Party Governance in English planning?, *Planning, Practice and Research* 22(2), 177-196.

Andrew, S. & Lopez, J. (2022) 'New laws to end mobile coverage "no bar blues"', Press Release, DCMS (Department of Culture, Media and Sport), March 2022.

Arcadis (2017) *Planning for Mobile Telecommunications: An Assessment of Permitted Development Rights in Wales*, December, Welsh Government.

Askew, J. (2006) Mobile phone masts: the role of planners in resolving conflict, *Journal of Planning and Environment Law*, July, 929-938.

Askew, J., Sheppard, A., Dalton, A., Baker, N., Appleby, T. & Peel, D. (2009) *Research Project for a Review of Mobile Phone Operators' Permitted Development Rights*, (Cardiff, Welsh Assembly Government).

Ball, M., Allmendinger, P., & Hughes, C. (2009) Housing supply and planning delay in the south of England, *Journal of European Real Estate Research*, 22(1), 151-169.

Booth, P. (2002) A desperately slow system? The origins and nature of the current discourse on development control, *Planning Perspectives,* 17, 309-323.

Bröer, C., de Graaff, B., Duyvendak, J. & Wester, R. (2016) Engaging citizens: local interactions, policy discourse and courses of protest against mobile phone cell site deployment, *European Journal of Cultural and Political Sociology* 3(4), 447-468.

Bulkeley, H., Watson, M., Hudson, R. & Weaver, P. (2005) Governing municipal waste: towards a new analytical framework, *Journal of Environmental Policy and Planning* 7(1), 1-23.

Clifford, B., Ferm, J., Livingston, N. & Canelas, P. (2019) *Understanding the Impacts of Deregulation in Planning: Turning Offices into Homes?* (Palgrave).

Denicol, J., Davies, A. & Krystallis, I. (2020) What are the causes and cures of poor megaproject performance? A systematic literature review and research agenda, *Project Management Journal* 51(3) 328-345.

Devine-Wright, P., Cowell, R. &d Devine-Wright, H. (2016) *What works for infrastructure siting in local areas: an evidence review*. DECC report, available online at http://www.placewise.org/wp-content/uploads/2016/03/DECC_Infrastructure_PlacewiseLtd.pdf

DCMS (Department for Digital, Culture, Media and Sport) (2019) *Rural Connected Communities Overview and Application Guidance*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827375/RCC_Overview_and_Application_Guidance.pdf accessed 31st March 2022

DCMS (2021) *Shared Rural Network (SRN) – Transparency Commitment Publication*, Policy Paper, 11th March 2021.

DLUHC (Department for Levelling Up, Housing and Communities) (2022) 'Planning Applications in England: October to December 2021', *Planning Applications Statistical Release* 29th March

Drake, F. (2011) Protesting mobile phone masts: risk, neoliberalism, and governmentality, *Science, Technology and Human Values* 36(4) 522-548.

Finch, K., Devereux, J., James, J. & Nott, P. (2015) The national broadband network: challenges and opportunities for telecommunications infrastructure planning, *Australian Planner* 52(1), 71-76

Foster, R. B. & Carrel, M. A. (2006) Disguised as a tree: judicial review of land use decisions on cellular telecommunications facilities under the Telecommunications Act of 1996, *The Urban Lawyer* 38(3), 657-668

Geels, F. W. (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and case-study, *Research Policy*, 31, 1257-1274.

Graham, S. & Marvin, S. (2001) *Splintering Urbanism*, (Routledge).

Henderson, D. & Roche, N. (2020) 'Examining the policy mix for broadband deployment in Wales: the role of informal coordination in the last mile', *Local Economy* 35(1), 48-67.

Hutton, G. (2021) *Building Telecommunications Infrastructure*, Briefing Paper No. CBP 9156, 30th April, House of Commons Library.

Jackson, M. (2020) 'Operators sign £1bn deal for 95% geographic UK coverage by 2026', *ISPreview*, 9th March.

Larsson, S. (2014) What type of knowledge rules where? Legally regulated participation in large-scale mobile infrastructure planning in Sweden, *Environment and Planning C: Government and Policy* 32, 163-183.

Lehr W, Queder F and Haucap J (2021) '5G: a new future for Mobile Network Operators, or not?' *Telecommunications Policy* 45, 102086

Lloyd, M. G., Peel, D., Roberts, P. & Riley, J. (2004) *Evaluation of Revised Planning Controls Over Telecommunications Development*, (Scottish Executive Social Research, Edinburgh).

Marshall, T. (2012) *Planning Major Infrastructure*, Routledge.

Marshall, T. & Cowell, R. (2016) 'Infrastructure, planning and the command of time', *Environment and Planning C: Government and Policy* 34(8), 1843-1866.

Mobile UK (2021) *Building Mobile Britain: The Case for Local Authority Digital Champions*, https://uploads-ssl.webflow.com/5b7ab54b285dec5c113ee24d/6273e1737caa08e351ba5dfe_Digital-Champions.pdf, accessed 20.08.22.

Ofcom (2021) *Connected Nations 2021: Wales Report*, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/229723/connected-nations-2021-wales.pdf, accessed 25th February 2022.

Philip, L., Cottrill, C., Farrington, J., Williams, F. & Ashmore, F. (2017) The digital divide: patterns, policy and scenarios for connecting the "final few" in rural communities across Great Britain, *Journal of Rural Studies* 54, 386-398.

Rubin, Z. & Felsenstein, D. (2019) Is planning delay really a constraint in the provision of housing? Some evidence from Israel, *Papers in Regional Science* 98(5), 2179-2200.

Salemink, K., Strijker, D. & Bosworth, G. (2017) 'Rural development in the digital age: a systematic literature review on unequal ICT availability, adoption and use in rural areas', *Journal of Rural Studies* 54, 360-371.

Stilgoe, J. (2007) The (co-)production of public uncertainty: UK scientific advice on mobile phone health risks, *Public Understanding of Science* 16, 45-61.

Walton, W. (2002) The changing regulation of mobile-phone mast development in a devolved United Kingdom, *Environment and Planning B* 29, 687-705

Welsh Government (2021) *Code of Best Practice on Mobile Phone Development in Wales*, Crown Copyright.

Table 1: Telecommunications infrastructure and planning regulation

Category of control		Requirements
1	De minimis	Item does not constitute development, and so does not require planning permission; typically very small equipment like a microcell
2	Permitted Development Rights	National government legislation confers the right to develop these categories of infrastructure development; consent of the local planning authority (LPA) is not needed, though operator must notify LPA the 28 days before works commence; typically minor equipment like additional antennae on existing masts
3	Permitted Development Rights with Prior notification	Prior notification is submitted to the LPA which has 56 days to determine whether prior approval is required, and whether to give approval; is only able to consider siting and appearance; typically available to new or extended masts up to specified height limits.
4	Full planning permission	Permission needs to be obtained from the LPA, which entails wider consultation and requests for further information, enabling other issues to be raised; typically applies to new or extended masts over specified height limits

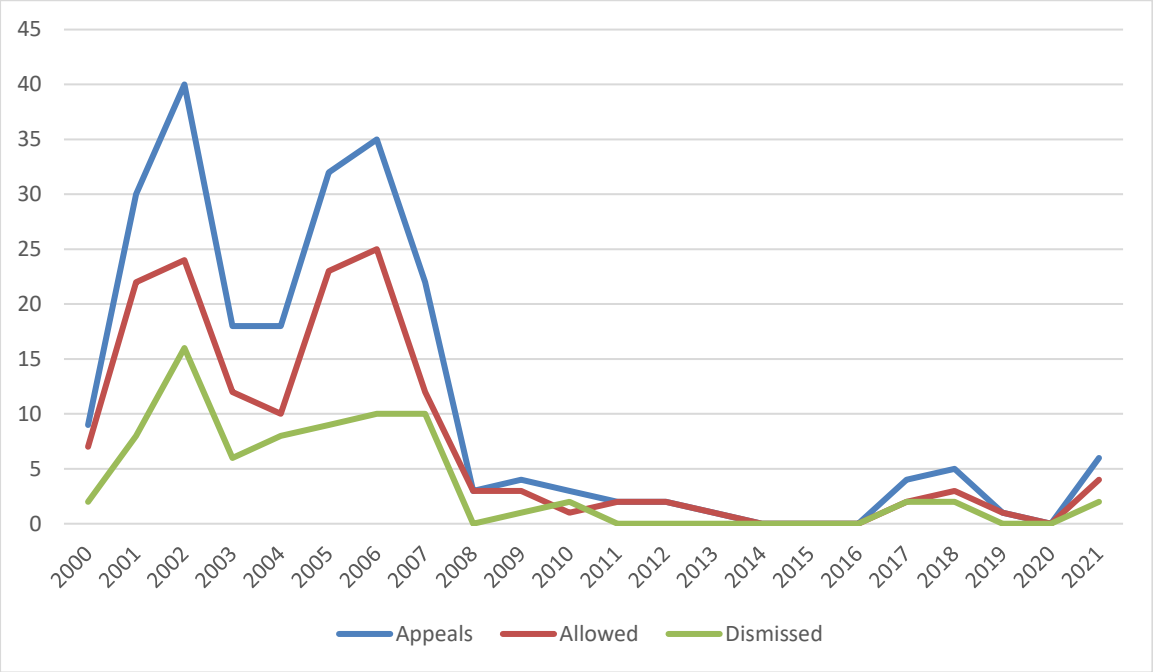
Sources: Allmendinger 2007; Welsh Government 2021

Table 2: Outcomes of telecommunications applications in selected Welsh Local Planning Authorities

LPA	No. of applications	Accepted	Rejected	Withdrawn	Prior app. required but refused
Monmouthshire	12	12			
Brecon Beacons NP	17	13		4	
Cardiff	59	51	3	4	1
Newport	56	50	3	3	
Powys	11	11			
Blaenau Gwent	13	12	1		
Torfaen	11	8	2		1
TOTAL	**179**	**157**	**9**	**11**	**2**

Notes: includes only applications that have been determined, for period 01.01.2010 to 30.09.21; includes full planning applications and prior notification applications.

Figure 1: Telecommunications planning appeals in Wales, 2000-2021



Data excluded applications for telephone boxes and other facilities not directly related to the propagation of radio/digital signals.
Source: COMPASS database, https://www.compasssearch.co.uk/compass/#/homeout, accessed 10 February 2022.

[1] See https://www.5gwalesunlocked.co.uk/, accessed 11.11.22.
[2] Wmr5G.org.uk accessed 28.07.22
[3] 5gruraldorset.org, accessed 28.07.22
[4] Country-connect.co.uk/about-us/ accessed 25.07.22
[5] Openreach is a company that maintains the telephone cables, ducts and associated equipment that connect the majority of properties in the UK.
[6] Accessed 11.11.22