Final Report for the Rees Jeffreys Road Fund

The Regulation of Disruptive Innovations: The Case of Dockless Bicycle Hire

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This Final Report provides, firstly, a brief Executive Summary, followed by responses to each of the questions addressed in the original proposal. The third section gives brief details for the outputs so far, with their references, together with information on the project interviews. The interviews were preceded by a review of the primary and secondary sources on dockless bicycle hire and the three case studies.

1. Executive Summary

The innate tensions between innovation and regulation are compounded by the equally delicate balance between national and local government, and with the users of the innovation. In UK transport in recent years, the trend has been to allow innovators the freedom to operate with a regulatory framework that is as light as possible. The principal aim is to allow them to assist in finding solutions to deep-seated and complex urban transport problems. As far as regulation is concerned, national government sets the agenda, but the responsibility for facilitating the delivery of these innovative solutions falls on local government, who can lack the expertise and economic resources to execute the task successfully. The result is that local government can place its faith in private sector innovators with their own commercial objectives and business models, which can contain weaknesses that fatally undermine the attainment of the wider social, environmental, and economic objectives of local authorities. In the case of dockless bicycle hire, these governance and innovator weaknesses have created a regulatory vacuum, where a patchwork of operational codes of conduct has sought to maintain some form of control over the innovators.

Consequently, dockless bicycle hire in the UK has been shaped strongly by its economic and political contexts, which have determined the trajectory and character of the policy and operational processes. Specifically, the business model of the original operators has placed significant constraints on the development of the technological innovation. Dockless bicycle hire has its origins in China, and the two early dominant operators, ofo and Mobike, both adopted a strategy of worldwide expansion at rapid speed, with rides subsidised from their extensive venture capital funds. However, this model proved financially unsustainable, with ofo now withdrawn from the UK and out of business, and Mobike opting to consolidate its position in its existing operational areas.

For their part, the local authorities were largely content to accept the dockless bicycle operators on the basis of being an apparently attractive technological innovation that made no demands on public funds. There were a variety of local regulatory frameworks, together with an accreditation scheme run by CoMoUK, the organisation that represents bicycle hire operators. However, none of these ad hoc frameworks was

legally enforceable, and the government has so far declined to introduce a statutory regulatory framework. Each of the project case studies reflects these economic and political contexts, and we conclude that a national legal regulatory framework is required to enable local authorities to provide greater co-ordination and leadership to the sector. Nevertheless, the constraints imposed by government policies of austerity with regard to local government may limit the resources and expertise available. One other possibility is that the emerging concept of micromobility, that includes docked and dockless bicycle hire, together with electric bicycles and scooters, may provide a fresh context that reshapes the operational and regulatory framework for dockless bicycle hire. The needs and preferences of users is another neglected area in the development of dockless bicycle hire, with little consideration given to consultation with the public, so that frameworks of participatory exchange need to be developed, particularly during the implementation of schemes.

2. Responses to the Original Study Research Questions

a. At what level, e.g. national or local, can dockless bicycle hire regulation be most effective; who should be given these responsibilities; and what detailed character should regulation take, e.g. quantitative, qualitative, environmental controls?

At the heart of the delivery of smart mobility systems, such as dockless bicycle hire, lie the innate tensions between innovation and regulation. These tensions are worked out and compounded by the equally delicate relations between governance levels, and with the users of the innovation. In the UK in recent years, the political, administrative, and regulatory trend has been to generally allow smart mobility innovations the maximum freedom to implement their systems as a means to not only promote economic growth, but also to find solutions to deep-seated and long-standing urban transport problems, such as traffic congestion, and ambient air quality.

If the political and regulatory climate has been set generally by national government, much of the responsibility for actually delivering on transport goals falls on local government. For their part, although they are under pressure to find solutions to complex problems, the urban local authorities can lack the expertise and financial resources to challenge the innovators in a manner that would enable the former to attain wider social and environmental objectives.

The result is that both central and local government place themselves in the hands of private sector innovators who have their own commercial objectives and business models, and can be susceptible to a wide range of problems, including weaknesses in the business models themselves, crises in cash flow, and safety and misuse hazards with the infrastructure. In the case of dockless bicycle hire, these governance and innovator weaknesses have created a regulatory vacuum, where a patchwork of voluntary codes developed by local authorities has sought to maintain some form of control over the innovators.

Consequently, the regulation of dockless bicycle hire has hitherto depended crucially on the economic and political contexts in which it operates. Thus, the business model adopted by the principal dockless operators has shaped the environment in which development has taken place in several important ways. From its outset in China,

dockless bike hire has been subject to intense competition. From this environment, two companies, Mobike and ofo, emerged as the principal players. Both have received substantial investment, and adopted strategies of expanding at a rapid rate by offering subsidised rides, with the result that they have been making heavy losses. This led to widespread criticisms that the companies are not operating a sustainable model, and in 2018-19 both were subject to severe financial pressure. In response, the companies sought to tighten their operational models in terms of changes to access rules, pricing, and the electronic boundaries to the schemes, but the basic strategy of subsidising rides continued to drain resources.

Ofo ceased its operations completely in the UK in 2019 and is now out of business globally, while Mobike has been placing more emphasis on the need to make a profit. It has adopted a strategy of consolidating its existing areas of operation, rather than the previous strategy of expansion at all costs. Mobike's strategy has been particularly affected by its experience of a failed scheme in Greater Manchester in 2017-18, where persistent theft and vandalism of the bikes led to the company's withdrawal from the urban area. Subsequently, new companies have entered dockless operation, including Lime, Jump, and Beryl, sometimes with an extra innovation in the form of electric bikes, but the long-term expansion of dockless bicycle hire in the UK remains problematic. Basically, the tendency for bikes not only to be stolen or vandalised, but also just abandoned, and then not collected, places demands on local authorities to clear the bikes from where they are left, while the sight of bikes littering the streets is considered to adversely affect the image of cities.

With regard to governance, the lack of any national legal regulatory framework means that the sector has relied on experimentation with self-regulation, and with non-binding policy measures and frameworks by local authorities. National government has been reluctant to legislate for a regulatory framework. In 2019, this was attributed partly to the dominance on the policy agenda of the UK's withdrawal from the European Union although, as noted above, there also appears to be a political commitment to allow innovators as much freedom to operate as possible. However, in 2018 the government suggested that local authorities could use Section 235 of the 1972 Local Government Act to create specific byelaws to prevent the nuisance caused by dockless bikes, but so far the local authorities have not taken advantage of this statute. On the other hand, in 2019 the Labour MP Daniel Zeichner introduced the Dockless Bikeshare (Regulation) Bill as a Private Member's Bill, but this Bill was not supported by the government, and failed to proceed.

In the case of the operators themselves, there is an accreditation scheme run by CoMoUK, the representative body for bicycle hire operators. The local frameworks include a voluntary Code of Conduct for dockless bicycle hire in Oxford introduced by Oxfordshire County Council, and a Code of Practice operated by Transport for London (TfL). In the case of TfL, there is currently a proposal for a byelaw for dockless bicycle hire schemes, which will apply to bikes and modes such as electric scooters if the government approves their use. This is intended to replace the current patchwork of regulation operated by the London boroughs.

To a large degree, the dockless operators have been able to act autonomously, due to the political and economic environment. For the local authorities, there was considerable attraction in allowing an innovation that offered a relatively cheap and

flexible means of transport that crucially placed no demands on the public purse. In any case, the public authorities had no legal authority to prevent dockless operation. It was only as the schemes developed that major problems began to emerge, including theft and vandalism of the bikes, and general misuse. As a result, for economic reasons caused by the operational problems, and bikes left randomly in areas of low demand, over time the operators frequently reduced their areas of operation to city centres. For their part, the local authorities can feel a sense of injustice, given that they have not been directly involved in setting up the schemes, and yet are responsible for carrying the costs of clearing up abandoned bikes.

The local authorities may not have been able to exert any authority over the original business models of the operators, but the more conciliatory approach now being offered since 2018 by Mobike (particularly after its adverse experiences in Greater Manchester) and other operators, together with lessons learned by the local authorities themselves, suggests the time could be right for the national government to assume leadership in the sector and introduce a legally enforceable regulatory framework, although this would need to allow for the operation of discretion at the local level. Nevertheless, a national regulatory framework could include quality standards for bicycles, and their conditions of operation, but also give the local authorities the legal power to control the numbers of operators and bicycles. It could also include provision for local authorities to negotiate with the operators on the geographical areas in which they operate. In essence, there is a triangle of local authorities, users, and innovators, each with separate roles and having different objectives. The need is to bring these stakeholders together to provide the best possible service, at a reasonable cost to the user, and to be inclusive.

The acquisition and exchange of data is another area that could form part of a legal framework. Hitherto, there appears to have been little public use made of the data produced by dockless bicycles. Aggregated data may only have a limited use, but the more finely grained data, such as the detailed routes taken by dockless users, could assist public authorities in planning infrastructure, and integrating transport services.

b. In the relationships between innovators and regulators, what structure should regulation take, e.g. voluntary codes of conduct, or statutory controls?

As noted above, a statutory framework can give greater structure and clarity to dockless bicycle hire, with the proviso that local authorities should have the necessary capacity and leadership to guide the sector within their own areas. Larger authorities, such as London and the Metropolitan areas, are likely to have greater capacity to operate a regulatory system compared with smaller cities and towns. It is also important to emphasise that there cannot be ‘one size fits all’ solutions to the regulatory problems, and local authorities will require the discretion to act on what can be complex problems. A particular challenge is to decide how dockless operations should be distributed across an area, and who the beneficiaries should be. For example, should greater consideration be given to those living outside the areas normally targeted by dockless operators?

In the context of local authority expertise, it is also important to note that ‘soft’ forms of regulation are likely to be required, including benefits to users who use the bikes appropriately, and also negotiating with the operators in areas such as the acquisition

of data. The holding of data exemplifies the imbalance in expertise between the innovators and the local authorities, with the latter requiring the detailed knowledge to both frame and enforce codes of conduct, and more generally to negotiate with the innovators.

c. For each of the three case studies, what are the administrative and political merits and disadvantages for managing the tensions between innovation and regulation? Can any of these approaches, or a combination of them, be 'scaled up' for best practice regulation more generally? What are the implications for other UK cities and towns where dockless bicycle hire may be introduced?

With regard to the three case studies, it is again important to emphasise that each was subject, either directly or indirectly, to the economic and political contexts and associated processes noted above. In the case of Greater Manchester, the Combined Authority and the executive body Transport for Greater Manchester (TfGM) were attracted by the novelty of dockless operation, and the lack of public funding required. Although TfGM stipulated a six-month trial of 1,000 bikes for the operator Mobike, the company was left to act autonomously, and as a result of persistent theft and vandalism of the bikes, eventually restricted its area of operation to the city centre. This was done without consulting TfGM and caused considerable antagonism from users. Despite restricting its operation, Mobike continued to suffer theft and vandalism, and in 2018 terminated the scheme after fifteen months of operation. Mobike has acknowledged that it made mistakes in Manchester, and in future would place greater emphasis on working with the local authority. For its part, TfGM is now seeking to introduce a cycle hire scheme where the terms of the contract set out more clearly the responsibilities of operator and public authority.

In the case of dockless bicycle hire, the lack of planning controls means that the operator is able to flood the market with bikes, and then just as easily withdraw. This leaves short-term consequences for the local authorities in clearing up the mess, and in the longer-term to compensate for the loss of bicycle hire in the city.

In Oxford, the transport authority Oxfordshire County Council adopted a more facilitating role than Greater Manchester did, allowing four main dockless operators to enter the city in 2017, and each opted for a strategy of rapid expansion. This helped to create a demand for dockless use, but as in Manchester (although on a lesser scale) there was some misuse of the bikes. At their peak, the four operators were running around 1500 bikes, but by January 2019 Obike and ofo had withdrawn altogether, and the other two companies, Mobike and Pony Bikes, had reduced their size and areas of operation. In 2019, Pony withdrew, leaving Mobike as the sole Oxford dockless operator. In addition, a docked bicycle hire company, Oxonbike, ceased to operate in 2018 blaming, at least partly, the numbers of dockless bikes (although in 2019 Oxonbike resumed its service with a new operator).

Oxford's Code of Conduct for the dockless operators included provision for the numbers of bikes, bicycle safety and maintenance, avoidance of obstruction, data, and a stipulation that the operator should pay staff at least the Oxford Living Wage (which is approximately £1 above the Living Wage for areas outside London, currently £10.02 vs £9.00). Enforcing the Code was always challenging because of its voluntary character, but the Code was generally adhered to, although it became more difficult

over time, when the operators reduced the numbers of staff available to collect and maintain the bikes. In this situation, Oxford City Council was compelled to pick up abandoned bikes through its parks and refuse teams. The County Council has also been disappointed that the dockless operators have not fulfilled their Code of Conduct obligations with regard to the supply of data. As in Manchester, this illustrates the relative lack of power on the part of the local authorities in being left with the responsibility of clearing up, while lacking the powers to enforce compliance on the part of the operators.

In Oxford, actual levels of demand reduced the numbers of operators to a single one, but this experience in itself illustrates the continuing fragility of dockless bicycle hire as a business. A statutory regulatory framework can hope to manage the system, but the operators themselves need more resilient and financially sound business models, together with the flexibility to adjust to local conditions, and a greater understanding of the needs of users.

In contrast to Greater Manchester and Oxford, the West Midlands Combined Authority resisted the introduction of dockless bikes when framing its major Bikeshare scheme for a minimum of 3000 bikes across the region. Instead, the scheme was intended to consist entirely of docked bikes. Significantly, the executive body Transport for the West Midlands (TfWM) acknowledges that the adverse experience in Manchester was a key contributory factor to their decision to exclude dockless bikes.

In 2018, the Combined Authority awarded the contract for the scheme to the bike hire operator Nextbike. However, from the outset there were formidable problems in scheme implementation. A fundamental difficulty here was the lack of finance for the scheme. The Combined Authority had stipulated that there would be no public funding, and had relied on Nextbike to find a sponsor, but Nextbike could not fulfil this task. The contract had also required that Nextbike would integrate the scheme with TfWM's SWIFT integrated public transport ticketing system, but basic technical difficulties arose in making the systems compatible. In addition, Nextbike had an ambitious target of 5000 bikes, rather than the Combined Authority's aim for 3000 bikes. Complications arose in obtaining planning permission and the finance for the required docking stations, and in the event the only element of the scheme to be delivered by Nextbike was a 25 bike pilot with just 5 docking stations. In 2019, the Combined Authority ended its agreement with Nextbike, and claimed that the company lacked the expertise and resources to deliver the scheme. For its part, Nextbike claimed that the scheme chronically lacked funding, and that there had been unrealistic expectations on the part of the Combined Authority.

Although the West Midlands Bikeshare scheme excluded any dockless element, other problems (including the installation of docking stations, which are not required for dockless systems) hindered implementation. As in the cases of Greater Manchester and Oxford, the Combined Authority relied on private sector operators to deliver the scheme, but as with Mobike in Greater Manchester, the problems proved insurmountable. Significantly, for the re-tendered scheme the West Midlands Combined Authority is taking responsibility for delivery more into its own hands, and it will supply and own the bikes and docking stations, together with taking on the task of finding a sponsor. Crucially, there will also be public funding for the scheme.

Rather than the concession handed to Nextbike, the new operator will be paid a monthly fee to manage the scheme. The new scheme will also be less ambitious, with 1500 bikes, of which 10 per cent will be electric. However, the Combined Authority continues to reject any dockless element. The local authority is therefore choosing to take a higher degree of direct control, but in turn this means greater internalisation of risks and emphasis on its own expertise and financial resources to deliver the scheme successfully. It could be said that, in general, local authorities will seek to maximise value for money, and at the same time minimise the risk element. By taking more direct control, the West Midlands Combined Authority avoids the risk of relying on a private sector operator to deliver the scheme, and can hope to obtain better value for money. At the same time, from a political perspective the Combined Authority cannot offload responsibility for any weaknesses in the scheme.

It cannot be said that any one of the case studies, or a combination of them, in themselves offers an obvious case for the 'scaling up' of dockless bike sharing. More significantly, for each of the case studies, the economic and political contexts have played a crucial role in framing decisions and influencing implementation. Although, as we have discussed, lessons can clearly be learned from the processes adopted in each case study area, addressing the problems caused by contexts and the associated processes are more likely to be important for other cities and towns seeking to introduce dockless operation, rather than copying other local authorities.

In summary, a national statutory framework could provide the local authorities with the means to impose quality and quantity controls on the operators. From there, the local authority needs to carefully monitor implementation of the scheme to ensure that day-to-day management, operation, and maintenance are effective, and that the operators are adhering to the conditions laid down. It is also important to not only ensure users understand the scheme, and have a reward system for using the bikes appropriately, but also to obtain their feedback, and act on the findings. An important consideration here is that a key reason for the lack of long-term sustainability of the dockless bike hire business model has been the limited attention and dedication of responses to maintenance in their determination to minimise overheads. This represents short-term gain versus long-term cost. However, maintenance is essential because the bikes have to operate and be made available in a harsh environment that includes both exposure to the elements, purposeful vandalism, and carelessness on the part of users. Improvement of maintenance would therefore be one way to improve adaptive capacity.

Nevertheless, the inherent character of dockless bicycle hire means that some degree of misuse is probably inevitable, given the relative ease with which the bikes can be stolen and dumped. In these circumstances it is necessary for operators and local authorities to work closely to ensure that the operator not only complies with conditions for managing the bikes, but also compensates the local authority for any cost and inconvenience caused in clearing up the bikes. Data obtained through the GPS trackers already built into the bikes could play a significant role here. However, such data, particularly if deployed to monitor users in real time, can raise issues of privacy. At the same time, the data itself is a valuable resource, and can be used by the local authority for wider planning purposes. It is therefore important for agreements to be established with the operator to share key data prior to implementation.

One other vital consideration is the areas of operation. For their part, the operators should require clearance from the local authority on the virtual boundaries of operation (known as geofencing), and consult with the authority if these are adjusted. At the same time, the local authority may wish the operator to extend operation into areas with social need, and in these cases some element of subsidy is likely to be required.

d. Do the dynamics of empowerment in the relationships between local authorities and innovators entail the construction of new types of collaboration, rather than conflict? What are the underlying bases of these relationships, e.g. the desire to promote bicycle use for health and environmental reasons, combined with the need to maintain regulatory order?

Rather than empowerment, the development of dockless bicycle hire has demonstrated the weaknesses on the part of both operators and local authorities. For the original operators, the limitations of the business model have severely restricted the scope for development. Evidence from the case studies suggests that operators such as Mobike have been modifying their strategy to seek greater operational stability over time, and also building firmer relationships with local authorities. For the public authorities, it has been the technological innovation in itself that was the attraction, rather than specifically identifying dockless bike hire as a key element in integrated transport strategies.

The weaknesses on both sides have created a vacuum in terms of ordered development and regulation. Dockless hire gives greater freedom to the user in terms of flexibility and cost, but on the other hand entails more detailed management and supervision with regard to the distribution, collection, and maintenance of the bikes. In turn, the impacts on the built environment of bicycle misuse intensify the need for collaboration between operators and public authorities. As dockless bicycle hire operation has progressed, so the operators have increasingly recognised the importance of building relationships with local authorities. Hitherto, their business models have not encouraged stability, although it could be argued that innovation has an inherent degree of instability and uncertainty. Consequently, in dealing with innovators and their schemes, a local authority is likely to require large amounts of resilience and adaptability, together with a recognition that risk is a basic element in the promotion and implementation of innovation. Similarly, it is also fair to expect more resilience and adaptability on the part of operators. In these conditions, there is likely to be a blurring of the public and private sectors, and so politically it is important to gain public understanding and sympathy for these procedures.

e. What are the wider implications of dockless bicycle hire for gaining a greater understanding of the evolving relationships between disruptive innovators, regulators, incumbent cycle and public transport operators, and users?

Over the past year, dockless bicycle hire has become more likely to be defined in terms of wider systems of micromobility. This refers to personal transport for one or two people, and in addition to docked and dockless bikes, also includes electric bikes and scooters. Consequently, dockless bicycle hire can be seen as both competing with these other forms of micromobility, and also offering the possibility of being

integrated with them. Currently, electric scooters are banned in the UK on public roads and footpaths, although the government is holding a consultation on the possibility of introducing them. The timing and outcome of this is made more uncertain through the Covid-19 virus outbreak, with e-scooter services being withdrawn in many European and US cities. However, electric scooters have spread rapidly across the world, led primarily by the United States based companies Lime and Bird. Significantly, Lime is operating dockless bikes in London, while in 2018 the ride-hailing app Uber purchased the electric dockless bicycle hire company Jump, and in 2019 commenced a service in London. Uber is emphasising that, for 'first mile-last mile' transport, the Jump bikes can be cheaper and more convenient than Uber's car service. Thus electric dockless bikes can widen the scope of operation in terms of distances covered, and also those able to use them. In turn, the development of these services raises questions about the degree to which they can be integrated into existing public transport services, and of the relationships between the public and private sectors. In fact, the Covid-19 virus outbreak has meant the reduction and withdrawal of many public transport services, and this has had the effect of boosting demand for cycle hire in many countries, an advantage which operators are promoting. For example, in London Jump is offering free rides to National Health Service workers.

As we have noted, to a large degree dockless bicycle operations have developed separately from public transport operators. In the future, by providing 'first mile-last mile' transport dockless bikes can complement public transport. At the same time, it can also offer competition for customers, and potentially take people away from public transport use. There is little evidence at the moment concerning the displacement impact of dockless bikes on public transport (although the success of the major docked scheme in London has affected both public transport passenger numbers and walking), but it is in these sorts of areas that local authority leadership can play a key role in seeking to bring greater co-ordination. In addition, there is a need for a clear mandate from national government in terms of rules, resources, and expertise, so that a genuine capability is created to enforce co-ordination.

With regard to users, their needs and preferences are largely missing links in the implementation of dockless bicycle hire. The operations have been producer led, with little consideration given to consulting the public. This raises the basic question of who the service is for, and that throughout the introduction of dockless bicycle hire the interests of the people who actually use it (or choose not to use it), have not been considered to be important. Paradoxically, it could be said that in cases such as Greater Manchester, it was the public in responding to the innovation after implementation that contained the disruptive force, rather than the innovator and the innovation itself. The public disrupted Mobike's expectations for their technological innovation, and the company lacked the means to respond in an appropriate way. The public therefore held significant power in terms of communicating responses directly, but this power was limited in terms of the innovator's reactions. In addition to its failures in taking account of public responses, Mobike was also unable to construct narratives that could allow the public to perceive the bikes in terms of a process of empowerment that could enhance mobility and choice of mode. In essence, the company failed to work within any significant framework of participatory exchange, and this inability to recognise user power indicated the limitations of an innovator that relied on the novelty of technological innovation.

The physical presence of dockless bike technology offers a route to power, as it allows consumers to express their preferences and needs, and to do so visibly in the public domain. However, societal expectations of technological innovations are unlikely to be satisfied, such as in the case of the environmental and health benefits of cycling, if those responsible for the innovation are unwilling, or lack the means, to interpret these choices in a strategic way over time.

3. Project Outputs

(i) The paper 'The Dynamics of Public Participation in New Technology Transitions: The Case of Dockless Bicycle Hire in Manchester,' was published in the major journal *Built Environment* in Spring 2019. The paper uses the project case study of the Mobike dockless bicycle hire scheme in Manchester to illustrate the reasons for failure of this disruptive innovation. This paper is at **Dockless a.**

(ii) The blog post 'The Sharing Economy and Blurring in Public-Private Relationships' was published on the *Built Environment Blog* web site in June 2019. The paper examines how the more direct effects of sharing are likely to result in a blurring of the public and private sectors where integrated service providers become dominant players. This blog is at **Dockless b.**

(iii) The blog post 'The Datafication of Urban Transport' was published on the *Built Environment Blog* web site in September 2019. The blog examines the value of data to urban transport planning, using dockless bicycle hire as a case study. This blog is at **Dockless c.**

(iv) The paper 'Urban Local Authorities and the Delivery of Smart Mobility: The Case of Dockless Bicycle Hire in the UK' will be submitted to a major journal. The article observes that, when it comes to delivering smart mobility, urban local authorities are under intense pressure from above and below. From above, there is pressure from central government to deliver policy 'solutions' that do not place severe burdens on public expenditure. From below, the authorities can recruit private sector innovators, who can apparently deliver the required 'solutions.' At the same time, this places the local authorities in the hands of smart mobility innovators who have their own commercial agendas, and these may be unstable and limited in their ability to deliver.

Nevertheless, if local authorities bypass these types of innovators, they can be drawn into alternative 'solutions' that have their own distinctive problems and limitations. In these cases, local authorities may take the 'solution' into their own hands, but this increases the public pressure to deliver, while national government maintains control of policy and financial resources.

The comparative case studies of dockless bike hire in Oxford, and the West Midlands Bikeshare scheme, are employed for this paper. The paper concludes that the pressures on local authorities to deliver smart mobility schemes are likely to increase, but the result can be a blurring of the public and private sectors, with these systems politically and operationally required to display a high degree of resilience and adaptability.

Completion of this paper has been somewhat delayed by the need to take account of continuing developments with regard to the West Midlands Bikeshare scheme, but it is now almost complete, and will be submitted shortly. We will also submit this paper to the Rees Jeffreys Road Fund.

(v) The article 'Micromobility and the Politics of Cycling' will be submitted to the major practitioner journal *Local Transport Today.* The article examines how the politics of cycling may be influenced by the development of smart mobility. Traditionally, the cycling lobby in the UK has been relatively fragmented and weak. A significant turning point came in the case of London, with the development of cycle highways and the 'Boris Bikes.' However, these developments have come at a considerable financial cost, which is not necessarily available to many local authorities in times of austerity.

Into this space came dockless bike hire, which appeared to offer a free means for local authorities to promote an attractive solution to urban transport problems. However, experience in places such as Greater Manchester has damaged the image of dockless, while in London itself it has proved difficult to regulate, while offering competition to Transport for London's own docked scheme.

Dockless bike hire in itself may have already passed its peak as a major solution to urban transport problems, but now more emphasis is being placed on developing systems of micromobility. These systems can potentially enhance the public image and use of cycling, particularly through developments such as electric bikes, but by integrating systems such as electric scooters, there is a risk that safety and environmental concerns can undermine the political strength of cycling.

This article awaited recent development in micromobility, but is now nearly completed, and will be submitted shortly. We will also submit this article to the Rees Jeffreys Road Fund.

(vi) Evidence will be submitted to the Department for Transport's *Future of Transport Regulatory Review.* This will be on the theme of micromobility, and how best to regulate the vehicles in this category. This evidence will be submitted in May 2020, and we will also submit it to the Rees Jeffreys Road Fund.

(vii) Twenty interviews have been conducted for the project. The material contained in the interviews is an invaluable resource, both in gaining an understanding of events, and in the insights the interviews provide into the questions addressed in the project. Those interviews included representatives of operators (3x), cycling and bikeshare sector representatives (4x), local policy makers and politicians (7x), and academic and other experts (4x). The numbers interviewed included two people who were re-interviewed.

(viii) A four page policy brief will be produced, that will summarise the key insights and recommendations of the project, and will be sent to all those interviewed for the project. Their responses will be invited and we will also submit the brief to the Rees Jeffreys Road Fund.

The Dynamics of Public Participation in New Technology Transitions: The Case of Dockless Bicycle Hire in Manchester

GEOFFREY DUDLEY, DAVID BANISTER and TIM SCHWANEN

New technologies are playing an increasingly important part in shaping the development of city transport and the wider built environment. Relatively little attention has, however, been given to how the technologies evolve in social and political terms, so that the public are not just seen as the passive receivers of new technology. Technological transitions are not only about the technology, but also about the social and political implications of innovation and how people respond to the new mobility. Participatory exchange and the policy process are essential parts of that approach. This paper explores the dynamics of how a technological innovation failed as a niche-innovation in terms of the socio-technical transitions framework. It uses the case study of the Mobike dockless bicycle hire scheme in Manchester to illustrate the reasons for failure. These included poor participatory practice in the earlier stages of the scheme, together with the inability of the innovator to respond appropriately through participatory exchange, including the direct participation of the public through the technology, in the implementation stage.

Disruptive Innovations and the Paradox of Public Participation

The essence of innovation lies in its ability to bring novelty and unpredictability to behaviours, and also seemingly established patterns of thinking. To an innovator, particularly in the case of a technological innovation operating in a competitive market, speed in acting can be the priority to gain advantage over other innovators, and to win a share of the market that results in financial viability. However, there can also be an innate tension between the power of the public as consumers of the innovation, and as citizens participating in a consultation process that considers the wider questions of public need. As consumers, the public can possess significant power, and thus cause the key paradox that, in placing predominant emphasis on seeking market share, the innovator may be unaware of the diversity of the market, and the local conditions. Consequently, if the innovator places too much focus on the technology of the innovation itself, then other essential elements, including strategy, business plans, marketing, and organisation can be overlooked in the anxiety to place the innovation on the market as fast as possible (Schneider, 2017, p. 78).

Spontaneous technological innovation has become more evident in recent years, particularly in the case of transport. This can be illustrated with examples such as ride-hailing and dockless bicycle sharing, where innovators are primarily concerned with obtaining investment capital so that they can gain market dominance, even though the innovation may be highly subsidized. After market share is achieved, the prices charged can be raised

so that profits are made. This is classic rent seeking strategy with the aim of obtaining local monopoly control. Perhaps the prime example of this method has been the ride-hailing app Uber, which expanded rapidly worldwide while continuing to make losses (Dudley *et al*., 2017).

The argument being put forward in this paper is that technological innovation in transport cannot be successfully implemented without a participation process, which can counter-balance the aims of the innovator to flood the market rapidly. These aims follow the tendency to work on the premise that people want innovation, and that after it has gained a dominant market position an innovation can subsequently be modified or extended, and prices raised so that profits are made. In terms of consultation this would result in minimum notice, limited collaboration with the local authority, and little concern over local factors. There would be no effective participation process, as defined by Rowe and Frewer (2005), or Cornwall (2008). In Arnstein's (1969) terms there would be total non-participation.

However, it can be said that participation in the scenario just described is limited to only the decision-making processes, whereas direct public involvement in the process of innovation will occur only after implementation, and not before. Such an approach to participation means that the public holds significant power, and places the onus on the innovator to react in a way that allows the innovation to be carried forward. As Cornwall observes, participatory interventions may result in effects that were never envisaged at the outset (Cornwall, 2008, p. 274). Consequently, much depends on how people take up and make use of what is on offer, as well as on supportive processes that can help build capacity, nurture voice, and enable people to empower themselves (*ibid*., p. 275).

This process of public involvement is dynamic, and its resolution determines the success or failure of any disruptive innovation, such as that described in this paper. Christensen (1997) describes the situation where a new product takes root initially in simple applications at the low end of the market, and then relentlessly moves up the market, eventually displacing established competitors. In elaborating the dynamics of these change processes, although the technological innovation in itself may be disruptive through its novelty, it is the reaction to it by the public that is the more important disruptive force. Thus 'low end disruption' (*ibid*., p. 23) may offer an innovation to a wider range of people than previously served, but it is the reaction of this public that will determine the intensity and the trajectory of the disruptive force. Equally, if the innovator fails to respond in a constructive way to this means of participation, then the innovation can fail. After implementation, it is therefore the public that can become the disruptive force, rather than the innovator or the innovation itself.

As Christensen *et al*. (2015) acknowledge, the qualification 'disruptive innovation' is misleading when it is used to refer to a product or service at one fixed point, rather than to the evolution of that product or service over time. Thus, in order to be able to become a successful 'new market disruption' that targets customers who have needs that were previously unserved by existing incumbents (Christensen, 1997, p. 23), an innovation can require a network of support that is integrally connected to partnership through participatory exchange. The dynamics of these processes, and the often complex interactions involved, highlight the need to understand how users frame their needs and expectations. Otherwise, participation can become co-opted for managerialist and justificationalist ends (Chilvers, 2009, p. 412). As Tritter and McCallum (2006) observe, a linear hierarchical model of involvement, such as Arnstein's ladder of participation (1969), fails to capture the dynamic and evolutionary nature of user involvement. They argue that a more appropriate approach must recognize the multiple sources of potential user power and the dependence of decision-makers on user sup-

port, and redraw the context within which conflict over the ability to influence decisions occurs (Tritter and McCallum, 2006, p. 165).

This paper follows the case study of a failed dockless bicycle hiring scheme in Manchester. This presents a means to examine participation as exchange in the form of a direct mechanism of engagement with the shaping of cities, through a widely accessible scheme, that apparently offered the potential to significantly shift transport demand, but where the innovator failed both to prepare the ground and to respond to public need. The case therefore represents a different type of 'participatory exchange' between planning actors that is (at least partly) material and performed, in contrast to the more usual emphasis in participation on oral communication and deliberation in relation to decision making.

The Dynamics of Dockless Bicycle Hire

The Business Model

Until 2014, when dockless bicycle hire companies began to operate, bicycle hiring schemes generally involved the bicycle being physically docked and locked in docking stations at appointed places. Over the last 20 years, this type of bike sharing has become more popular, given the convenience and the cost offered as an alternative to personal bicycle ownership. Consequently, the number of cities offering bike share increased rapidly from just a handful in the late 1990s, to over 800 by 2016 (Fishman, 2016). Given the fixed docking stations, the distance one lives from a station is an important predictor for bike share membership, with commuting the most common trip purpose for annual members (*ibid*.). Until recent years, these docked systems generally had a more advanced uptake in Europe, with notable systems acting as sources of learning, and inspiring the creation of new systems (Parkes *et al*., 2013).

Bicycle hiring in itself was not a new idea, but its spread in the twenty-first century reflects a greater exploration of the commercial possibilities, combined with a more intense search to tackle traffic congestion and environmental problems by finding viable alternatives to motor vehicle use (see Shaheen *et al*., 2010, 2011). The spread of bike sharing can therefore be dependent on institutional and personal learning. We have noted that this study examines a type of direct participatory exchange that is material and performed, rather than depending on oral communication and deliberation, and this distinctive type of exchange can be enhanced if local conditions are amenable to an understanding and sympathy for what the public is communicating. In this context, Schwanen (2016) argues that successful innovation depends not only on institutional embeddedness, but also on socio-spatial embeddedness. Thus he emphasizes that radical innovations are more likely to emerge and flourish in places offering 'institutional thickness', defined as a localized capacity to support innovation resulting from formal and informal institutions, such as grant schemes or knowledge brokers funded by local government, as well as place-specific cultural norms, values, worldviews and networks. However, we will see in the case study that the dockless bicycle hiring company, Mobike, is a globalized concern that in Manchester made little attempt to respond to local conditions, and where communication broke down with the public authorities, despite initially being welcomed. Institutional thickness in terms of a sympathetic local environment is not necessarily enough for an innovation to take root. As Schwanen comments with regard to bike sharing, cities cannot be heralded as actors who can bring about significant change unilaterally. This is to deny the social, political, cultural, technological, and other struggles that characterize cities, and the critically important role that national and supranational actors play in shaping their innovation and low-energy transition trajectories (Schwanen, 2015, p. 7107). Thus we will see in the case study that, even in conditions where institutional thickness appeared to exist, a breakdown in

communication and co-operation can cause a scheme to fail.

Given that docked bicycle sharing had its roots in Europe, conditions here have been relatively amenable to spreading the innovation throughout the continent. In the case of dockless bicycle hire, however, its roots are in China, so that spreading to new territories required rapid learning processes. As a variation of the more traditional bike sharing, dockless bike hire is not essentially new, but takes advantage of modern technologies to offer a more flexible and cheaper option. Typically, dockless bicycles can be tracked and locked or unlocked using a smart phone app. This means that, unlike an orthodox docked bicycle hiring system, a dockless bicycle can be collected and left at any location, although 'geo-fencing' can be adopted by an operator as a means of setting virtual geographical limits, in order to avoid bicycles being left in locations deemed undesirable. Consequently, by controlling where the bicycle is collected and left, the operator can hope to more closely supervise and control the diffusion of the bikes (Yi *et al*., 2018; Zhang and Mi, 2019).

This control of bike diffusion can be important for the viability of a dockless scheme, given the costs involved in collecting and moving the bikes. At the same time, as we will see in the Manchester case study, restricting the area of operation by means of geo-fencing can limit the usage of the bikes. Regardless of the operational area, however, the dockless technology is underpinned by significant behind the scenes labour, with the operators frequently employing third-party operators to physically reposition and maintain the bikes on the ground. It is estimated that around 10–15 people are required to be employed in order to look after 1,000 bikes, and that the workers monitoring the bikes can account for 30 per cent of total costs (*Financial Times*, 2017). In order to assist with bike control, the operators have generally charged a deposit, and employ a credit scheme, with penalties being imposed on those who leave the bikes in places outside the 'geo-fencing' areas and in inappropriate places (the bikes are tracked by a GPS system). Nevertheless, given the inherent character of dockless systems, they are more susceptible to theft and vandalism than the orthodox docked systems and, as we will see in the case study of Manchester, this has emerged as a major problem in some locations for the dockless operators.

From its outset in China, dockless bike hire has been subject to intense competition, with a number of operators becoming insolvent, including Wukong Bicycle and Go Bee. From this competition, two companies, Mobike and ofo, have emerged as the principal players. Ofo was launched in 2014, and Mobike in 2015, and both have received substantial investment, principally from the Chinese equity companies Tencent and Alibaba, respectively. For example, by the time Mobike launched its first scheme outside Asia in Manchester in 2017, the company had raised more than US$400 million dollars from investors in just over a year. However, given the intense competition in their home base, both Mobike and ofo have adopted strategies of expanding at a rapid rate by offering subsidized rides, with the result that they have been making heavy losses (in general, a dockless bike requires three hires per day to break even, even though the life of the bike before it needs replacement also needs to be considered). By 2018, it was estimated that Mobike was losing US$50 million per month, and ofo US$25 million per month (*Financial Times*, 2018). This has led to widespread criticism that the companies are not operating a sustainable model, and by 2018 ofo in particular was feeling the financial pressure. Consequently, it ceased its operations in India and Australia, and made significant cutbacks in Japan, South Korea, Singapore, and Hong Kong. In the UK, ofo ceased its operations completely in 2019.

For its part, Mobike has to some extent been cushioned financially by its takeover in 2018 by Meituan Dianping, China's largest online services company. This deal valued Mobike at around US$3.7 billion. Nevertheless, for

both Mobike and ofo, there is pressure from investors to make their business models more financially sustainable, meaning that the emphasis is now more on consolidating their presence rather than outright expansion. In 2018, Mobike operated 9 million bikes in more than 200 cities across 15 countries, and ofo operated 10 million bikes in more than 250 cities across 20 countries (although this was reduced in 2019).

As we will see in the Manchester case study, the premium placed on speed of expansion by Mobike and ofo perhaps inevitably fails to give public participation in scheme design and use a high priority. There is therefore the paradox that we noted earlier that although the companies depend on public use of the services, the business model – or seeming lack of it – precludes spending time on participatory exchange.

Nevertheless, these weaknesses should not obscure the innate potential of dockless bike hire as a technological innovation. For example, in the terms used by Christensen (1997), it could be argued that dockless bike hire is both a 'low end disruption' in offering cheaper hire than the docked operators (in the UK, the dockless charge has been typically 50p per half hour), and also, at least potentially, a 'new market disruption' that targets needs in terms of flexibility of use that were previously unserved by existing incumbents. The potential is indicated by one of the few evaluations of dockless bike hire (Sun, 2018) that takes Beijing as a case study. The survey found that the majority of dockless users use the bikes for their 'last mile' of travel, and that nearly half of the users always transfer to other modes of public transportation such as the metro (84 per cent), and bus (54 per cent) (*ibid*., p. 7). The convenience and price of dockless bikes therefore offers significant potential for furthering an integrated public transport system as an alternative to car use. It could nonetheless be argued that this potential in itself requires significant intervention and promotion from public authorities, and an understanding of this potential through public participation. Sun concludes that start ups such as dockless bike hire are too busy chasing territory and investment to focus on providing a good service, and that dockless bike hire as a disruptive innovator does not absolve cities from the principles of sound city planning, street design, and realizing the value of public spaces (*ibid*., pp. 10–13).

The Manchester/Salford Case Study

The Manchester/Salford Mobike case study has been chosen because of the dilemmas it poses between the aims of a globalized innovator seeking to expand its business as quickly as possible, and a commitment to a participatory exchange with the public in a particular locality. In this case, the company failed to recognize the power as a disruptor offered by the public rather than the innovator and its innovation, and made little attempt to address this basic weakness. In fact, public participation was notable for its absence from the time Mobike launched the Manchester scheme – its first outside Asia, in June 2017 – until the company made the decision to end the scheme in September 2018. In essence, Mobike acted unilaterally throughout this period, and also generally failed to co-ordinate its activities with the public authorities. As shown below, the company has subsequently accepted that this lack of co-ordination and participatory exchange was a mistake, although there is also an awareness that the operational prerequisites for a rapid technological innovation are not necessarily compatible with the best practice expectations of 'upstreaming' public involvement in scientific (Wilsdon and Willis, 2004) or urban development practice (RTPI, 2010).

This is not to say that Mobike was not welcomed by the local authorities in Manchester. On the contrary, in his election manifesto of 2017, the Mayor of Greater Manchester, Andy Burnham, had expressed his intentions to introduce a major bicycle hire scheme to the area. The Mayor of Greater Manchester (geographically a collection of

ten local authorities in and around the city with a population of around 2.8 million) was a newly created post, and the Mayor saw the cycle hire scheme, and the promotion of cycling generally, as one of the principal means to combat long-standing motor vehicle congestion and environmental problems in the area. As part of this plan, Burnham also appointed Chris Boardman, an Olympic cycling gold medallist, as the first Greater Manchester cycling and walking commissioner. In 2017–2018, Boardman produced a plan to construct major cycling infrastructure in the area. However, despite this commitment to create 'institutional thickness' for cycling in Greater Manchester, the area generally lacked a tradition of cycling promotion and development, and there was not an established governance framework to act as a counterweight to the activities of Mobike. Consequently, levels of cycling were generally low. For example, only 2 per cent of commuters in Manchester made use of a bike (*Manchester Evening News*, 2017*a*). This should be compared with the UK average of 4 per cent of commuter journeys made by bicycle (National Travel Survey, 2018, p. 0409).

For its part, Mobike introduced the scheme on the basis of distributing 1,000 bikes in the city of Manchester, together with the neighbouring city of Salford, in an initial six-month trial to see how events developed. This followed the company's strategy in Asia to seek rapid expansion and to subsidize rides in an endeavour to establish itself in a territory at maximum speed in order to deter competition. From the outset, however, Mobike suffered from high levels of theft and vandalism of the bikes that continued throughout the scheme, and eventually became the principal stated reason for its termination. Consequently, by the end of the scheme Mobike estimated that each month 10 per cent of its bikes were unavailable because of theft and vandalism.

The major measure the company took was to reduce the geo-fencing area radically in November 2017. This meant that the bikes could now be collected and left only in central Manchester. This measure was received adversely by the public, which complained that the restrictions on the use of the bikes severely reduced their convenience and scope for use over a larger area. There was also dissatisfaction over the quality of the bikes. Initially after reducing the geo-fenced area, the company expressed the intention to commit itself to the scheme in the long-term, but in September 2018 it decided to terminate the scheme.

In essence, Mobike lacked an understanding of the desires and needs of customers, and relied excessively on the attraction of the innovative dockless technology itself. No significant market research or consultation took place prior to the scheme, and the planning of the scheme was minimal. It was public reaction rather than the innovation itself that made it disruptive, and the lack of intervention by the public authorities did nothing to ameliorate the situation. In this context, the framework of socio-technical transitions can provide a valuable means of understanding better how an innovation can fail to take root.

The Dynamics of Disruptive Innovations as Failed Niche-Innovations

For Mobike in Manchester, public participation was by-passed in favour of acting unilaterally and at speed to implement its scheme. The priority was to establish market share, even at the price of operating at a loss. The cost of entry was low, basically involving the cost of the bikes. For their part, the local authorities welcomed in Mobike, as the scheme came at zero public expenditure, and Mobike was able to bypass the usual regulatory constraints. Mobike therefore operated independently of other transport services, and assumed that the market would be there for the 1,000 bikes they introduced to Manchester/Salford.

In order to understand better the dynamics of Mobike's failures in planning and public engagement, we can outline briefly how the

transitions concept of niches as protective spaces can provide a framework for analysing the limitations of the Mobike approach over time. In this context, the socio-technical approach to transitions highlights co-evolution and multi-dimensional *interactions* between industry, technology, markets, policy, culture and civil society. The multi-level perspective (MLP) on socio-technical transitions addresses the co-evolution of these elements (Geels and Kemp, 2012, pp. 50–51). The basic premise of the MLP is that transitions are non-linear processes that result from the interplay of multiple developments at three analytical levels: niches (the locus of radical innovations); socio-technical regimes (the locus of established practices and associated rules); and an exogenous socio-technical landscape (*ibid*., p. 52).

The MLP provides a longitudinal perspective on the dynamics of stability and change, but in this paper we are focusing on niches, and in particular how a technological innovation – a new technology, social practice, or special government intervention – may fail to advance because it is not able to attain the status of a niche-innovation. Niches are particular domains of use, actor constellations and geographical areas with special characteristics. Crucially, what happens in the niche is shaped by external developments. For example, the use of bicycles or electric cars is shaped by the road infrastructure, priority rules, fiscal measures, climate change concerns and the economics of using other means of transport. These developments not only shape the willingness of individuals to engage in the use of a bicycle or electric car, but also shape the expectations and strategies of companies and government (*ibid*., p. 53).

Thus niches are 'protected spaces' such as research and development laboratories, subsidized demonstration projects, or small market niches, where users have special demands, and are willing to support emerging innovations (*ibid*., pp. 52–53). Initial protection is deemed essential, because path-breaking innovations usually cannot compete successfully within selection environments embodied in incumbent socio-technical regimes. Hence, the protective space is needed to shield the innovation against (some of) the prevailing selection pressures. Within the protective space, niche actors can nurture the path-breaking innovation so it becomes more robust through performance improvements and expansions in supportive socio-technical networks (Smith and Raven, 2012, p. 1025).

The concept of a niche is important for the study of Mobike in Manchester/Salford because, if an innovation of this type fails to find the necessary protection to become a niche-innovation, then it is unlikely to become established in the mainstream in due course. It is therefore important to distinguish between Mobike as an innovation (i.e. a dockless bike sharing scheme) and Mobike as actor, which failed to construct the network of local support necessary to become a successful niche-innovation. Protective space therefore entails more than external research and market support to shield the innovation from selection pressures. In addition, it requires the innovator itself to take positive action in terms of market and business plans that can prepare the ground locally for the innovation and provide the means to act proactively in response to changes in market conditions.

It is also important to note that power and politics are keys to an innovation's pathway, and need to be considered (see Geels, 2014, 2018). In this context, Smith and Raven (2012) provide important insights into how an innovator may succeed, or fail, in creating a niche by identifying the three elements of shielding, nurturing, and empowering as being necessary for the essential protective space to form around an innovation (*ibid*., pp. 1025–1026). One of the key means to obtain niche empowerment is through the construction of narratives, whereby actors strategically re-tell the past to make new sense of the present, and envision alternative futures (*ibid*., p. 1037).

In the case of Mobike, one of its key failures was to construct an effective narrative that could give the public a vision of dockless bike hire providing a means to a more efficient and environmentally friendly built environment in the future. In order to organize these processes of shielding, nurturing, and empowering through the construction of narratives, then a process of strategic niche management is required to bring this about. Lovell (2007) describes how governments and other actors can foster the introduction of new technologies by establishing or facilitating experiments within protected niches. Lovell argues that, in order to manage a niche successfully, firstly, due regard should be given to the messiness of socio-technical change, secondly, the politics of socio-technical system change need to be considered in considerable depth, and thirdly, allowance needs to be made for non-governmental actors taking a lead role (*ibid*., pp. 35–42). Strategically managing a niche-innovation therefore requires articulation of expectations and visions, building of social networks, and learning processes (Geels *et al*., 2018, 26–27). An innovation such as Mobike, therefore, cannot become a niche-innovation purely by its own actions, important as these are. Instead, it requires a more co-ordinated and multi-actor approach over time.

If a strategic approach is required to form a niche-innovation then, as happened in the case of Mobike, it is important to understand better how the dynamics of innovations may fail to create the protective spaces necessary to form a niche-innovation. The case study will therefore examine how Mobike in Manchester/Salford failed to construct any system of public engagement through planning and market research, and so was unable to gain the support of policy-makers and the local population. It was shortcomings in these areas, more than shielding and nurturing on the part of bodies such as the public authorities, that caused the innovation to fail. In analysing these failures, we will consider whether a different way of engaging key actors by the company would have created more effective buy-in, and thus formed a network of support around the innovation in the Manchester/Salford case.

Case Study and Methods

The case study of Manchester was selected for the principal reason that it represented an innovation moving into new territory and seeking to quickly establish and consolidate its presence. Thus Manchester was the first venture outside Asia for the major Chinese operator Mobike. For their part, the Mobike venture was welcomed in by the public authorities, and there was initial public sympathy for the scheme. Nevertheless, within fifteen months the scheme was terminated. The case study therefore offers a good opportunity to examine how a technological innovation, with important implications for the built environment, can experience a breakdown in its operational viability in both public and financial terms. This can therefore enable an examination of the dynamics of a failed niche-innovation in terms of the socio-technical framework.

The study identified and examined relevant official and group publications, together with key secondary sources, including all published material on dockless bicycle hire for the *Financial Times, The Guardian,* and the practitioner journal *Local Transport Today.* In addition, all the online dockless bicycle hire material was studied for the local daily newspaper the *Manchester Evening News.* Particular attention was given to examining the evolution of the Mobike company strategy in order to gain a better understanding of the dynamics of the Manchester scheme. These data helped to understand the character of dockless bicycle hire as a distinctive technological innovation in the UK, and the implications for the operation of the Manchester scheme.

In order to gain an understanding of the underlying dynamics that determined the trajectory of the Manchester scheme, four interviews were conducted with major stake-

holders integrally involved in the case study. The four interviewees here represent the innovator (Mobike), the public authorities (Transport for Greater Manchester), the system (a design engineer), and a pressure group (a cycling campaigning group). The interviews were semi-structured, not only to give interviewees the opportunity to expand on aspects which seemed important to them, but also to place their experience in a wider personal, institutional, and narrative context. As researchers we had no material interest in, or connection with, the case study, and sought to ensure distance from the actors concerned by analysing their evidence at all times within the context of the analytical framework adopted for the article. Each of the interviews was transcribed, and the transcriptions were then analysed to identify the material that would enhance our understanding of transition processes.

The interviews offer key insights into the distinctive perspectives of the actors involved, together with an understanding of experiences and reflective commentary on how the scheme evolved, and the thinking behind key decisions, as well as *post hoc* reflections on activities. This provides an important set of data for tracing the distinctive dynamics of the Mobike scheme, and the underlying motivations and reasoning behind it. The chief weakness, as ever in such case study work (Yin, 2003), is that the interview data from key actors inevitably provide a partial perspective on the story. We strive, however, to critically appraise these accounts, triangulating them for accuracy with other material on the case (Sherriff *et al*., 2018), in order to examine the dynamics of a failed niche-innovation. Consequently, we recount the prominent narratives seen in the case, across several stages, using illustrative quotations, and drawing out lessons with regard to the nature of public involvement.

The Mobike Manchester/Salford Case Study

The account of the case study is divided into three parts, in each of which distinctive key themes emerge. Overall, the account foregrounds how dockless bikes in Manchester/Salford failed to become a niche-innovation both because of failures by Mobike itself to prepare the way for the scheme, and then to respond to the material and performed participatory exchange with the public after implementation, and also a lack of action by the public authorities both to monitor the scheme and to place it in the context of wider transport strategies.

The first stage of the account deals with the inception of the scheme, where the perspectives of the main actors precluded any significant public engagement. For its part, Mobike as a globalized company had a strategy of expanding the market at maximum speed, while the local authorities were happy to give the company freedom to operate, given Mobike's lack of demands on the public purse. Consequently, operational power was assumed by Mobike, but this came without the will either to provide its own operational strategy or to seek external help in constructing a niche-innovation.

The second section describes the operation of the scheme over a period of fifteen months. Here, the lack of detailed planning led to the scheme developing in an *ad hoc* fashion, while the failure of Mobike to communicate with the local authorities prevented any consideration of alternative strategies. In this case, we will see that the decision by Mobike to restrict the geo-fencing area indicated that the company was giving greater attention to the short-term financial viability of the scheme, and took insufficient account of the adverse public reaction. Together with theft and vandalism of the bikes, it meant that the public disrupted the innovation, but there was no commensurate operational strategy that allowed for this public engagement.

The third section describes the termination of the scheme. Theft and vandalism of the bikes was given as the ostensible reason for Mobike leaving Manchester, but other factors were also at work. Mobike had now amended

its strategy to give greater emphasis to commercial viability, and the company wanted to examine opportunities in other areas with greater potential for profit. For their part, the local authorities had become disillusioned with the Mobike approach, and were keen to explore new avenues. This strategy tied in with their plans to develop cycling infrastructure in Greater Manchester. Just as the perspectives of both the company and the local authorities led to the introduction of the scheme without significant public engagement, so its termination reflected the evolution of both parties' strategies. In doing so, it indicated that the dynamics of the interpretation of scheme meanings can produce a power vacuum in terms of public engagement, and inhibit the development of a niche-innovation.

The Mobike Strategy – June 2017

The Mobike scheme was initially welcomed into Greater Manchester by the public authorities. These included the Mayor, the Greater Manchester Combined Authority, the cycling and walking commissioner, and the executive body Transport for Greater Manchester. As we have seen, there was a political momentum to increase investment in cycling infrastructure and to promote its use, but there was not an official promotion of cycling in Greater Manchester that could have provided the necessary external support essential to the creation of a protected space for Mobike, and as we indicated earlier, this was reflected in cycling use. The dominance of the private motor vehicle was indicated in the finding by the National Infrastructure Commission that the average speed of vehicles in the city was 15 mph (24 km/h), the slowest in the UK outside London (National Infrastructure Commission, 2018).

Nevertheless, there was evidence that bicycle sharing offered a potential to promote the use of integrated transport in the city. Thus a survey about bike sharing in Greater Manchester (Sherriff *et al*., 2018) found that most of the sample would like to cycle more than they did, with the benefits of bike sharing including spontaneity, the potential to combine it with public transport, and being able

Figure 1. Mobike dockless, in Manchester. (*Source*: CC Dullhunk)

to cycle in a town or city other than the one they lived in (*ibid*., p. 29). When respondents were asked about the modes of transport that were either combined with, or replaced by, bike sharing, walking was the most prominent, followed by public transport, and then private car use. The report concluded that these responses implied the potential for bike sharing to be useful for 'first mile' and 'last mile' journeys provided at public transport interchanges (*ibid*., p. 30). However, the provision of 'first mile' and 'last mile' transport by bike sharing implied a degree of co-ordination with public transport services that was not evident in the case of the Mobike Manchester scheme.

One of the advantages for the Mobike scheme was that it did not face any significant competition from a docked scheme in Greater Manchester. In fact, the Mayor, the Greater Manchester Combined Authority, and Transport for Greater Manchester had been planning for a docked scheme prior to being contacted by Mobike. As an officer at Transport for Greater Manchester explains, a major attraction of the Mobike scheme was the lack of cost to the public authorities:

> We were in the middle of providing a traditional docked bike solution, and had got as far as a feasibility study. We were engaging with suppliers, and planning to put things out for tender, but then Mobike got in touch. It was quite exciting, and had got the 'get up and go' atmosphere. Mobike had a good reputation, and it would be a European first in dockless bike share. With our original scheme, we were looking at things that were going to cost us a few million pounds in operational expenditure, and Mobike were offering their scheme for free, so as an authority we said, let's give it a year and see what happens. If it doesn't work out we can go back to where we were and carry on. We were looking at 'new mobility', and trying out new things.
>
> (Interviewee, Transport for Greater Manchester)

From the outset of the Mobike scheme, it appeared that the councils would be adopting a *laissez-faire* approach to the technological innovator. As the interviewed officer at Transport for Greater Manchester explained:

> We got in touch with Manchester City Council and Salford City Council and we agreed a memorandum of understanding, and this was the regulatory approach we took with Mobike. They would move the bikes and talk to us about key performance indicators, but because they were providing the service there was no strict enforcement of it. It was just a document of good faith of what they were going to do.
>
> (Interviewee, Transport for Greater Manchester)

For Mobike, the plan in Manchester was to replicate the high-speed growth strategy that it had adopted in China, with little sensitivity to the local context. As explained by the Mobike representative:

> In Manchester, there was not any form of rigorous public consultation or market testing prior to launch. The business had grown very quickly in China. For a fast moving tech company the desire was to move quite quickly. With hindsight perhaps we did move too quickly. At the time it was an open door, and so we were keen to move quickly and launch. What the team from China looked at was, could the scale be replicated that we had seen there? The model in China requires high density, and this involves a large number of rides to get the network effects. Manchester was an investment, but there was not a clear window that saw where profitability or break even would occur. It was a question that we had this service, so let's see how it goes. It was a very high growth phase for Mobike, and launching in numbers of cities was the key measure of success.
>
> (Interviewee, Mobike)

The growth strategy used in Manchester was contrasted with the current business model used internationally by Mobike. The new strategy is 'slower':

> Where we are today is we have slowed down the launch in cities. We now focus on getting those cities to break even or move into profitability. We have launched in 22 markets in Europe, but that's when we decided to stop the expansion and work at establishing profitable operations.
>
> (Interviewee, Mobike)

In failing to take sufficient account of the local context, Mobike was unable to construct a power base or a set of narratives around its offer in niche-innovation protected space

terms. However, the company had anticipated difficulties with public engagement and still expected it would be a break on operationalizing the technology. This is indicated by the Mobike representative's comments on the merits of public consultation:

> What you have with public consultation is, on the good side, you get lots of input, but it also slows things down dramatically, and things don't get done. I'm sure if we had started consultation in Manchester in June 2017, we may still not be launched today. So as a disruptor you have to be more action orientated than consultative. That's a trade-off.
>
> (Interviewee, Mobike)

These observations about the initial set up suggest that Mobike's strategy was based in a set of assumptions about the operation of the bike hire technology in the locality of Manchester/Salford and the procedures needed. Mobike were operating in a context where neither government support nor regulatory resistance were expected, although the political actor, the Mayor, had suggested that the particular transport mode would be welcomed in principle. The low value placed on engaging the public at an early consultative stage was due to the belief that participatory exchange would be an obstacle to launching the technology. Thus at the initial phase of the case, the localized capacities to support a niche for the innovation were mixed, and local people were excluded due to assumptions about their cultural values.

Scheme Implementation – Fifteen Months of Operation

The key underlying issues in scheme implementation were the innate tensions between the practices of the innovator and public response to the details of the scheme that were produced.

Given the *laissez-faire* approach of the public authorities, the pricing structure was oriented towards the financial viability of the company. Within that, some assumptions were made about public acceptability of pricing structures. Mobike initially in June 2017 chose to charge a deposit of £49, which it reduced to £29 in November 2017. The bike usage itself was charged at 50p per half hour. The system of deposits was one that had been adopted in China, but was not sufficiently adapted for the Manchester context. As the interviewee from Mobike reflected, 'We began to realize it is not a very price sensitive market. If people want to use a bike they will do so, and so we now generally charge something like £1 for twenty minutes. It's designed to compete with the local tram or bus use, but it's noticeable that people are less price sensitive than we thought originally'.

The pricing model in Manchester was therefore not based on detailed market research, and reflected the general lack of engagement with the values and norms of potential scheme users in the locality.

Regarding the bikes themselves, the public appeared to like the flexibility of the dockless system. This strengthened their association with the benefits of cycling, including making this mode of transport more convenient, helping users to see more of the city, improving physical and mental health, and providing a sense of freedom (Sherriff *et al*., 2018, p. 12). However, there was significant dissatisfaction with the basic quality of the machines (*ibid*., p. v). The chief weaknesses are described by a representative of a pressure group, the Greater Manchester Cycling Campaign:

> The seat post was either too high or too low for people. The bikes also didn't have gears, and so you are limited to a very slow speed. If you just go around Manchester city centre they are ideal, but for longer distances you are just stuck in first gear all the time, so it is not very comfortable.

By far the most significant problem for Mobike was theft and vandalism of the bikes. In the first month of operation over fifty bikes were vandalized or stolen, often with the lock and GPS tracker broken off, which made it difficult for Mobike to trace them (*Manchester Evening News*, 2017*b*). In the first six months of operation, Mobike wrote off seventy bikes. A number of these were discovered dumped

Figure 2. Best use of a Mobike? (*Source*: CC Alistair Paterson)

in the canal, which created a visible adverse image for the scheme (*Manchester Evening News*, 2017*c*).

The issue of image was important for Mobike, with the novelty and style of the bikes set against the deficiencies of the machine, and the way they were treated by the public. The theft and vandalism continued to have a serious impact on the viability of the scheme, and was the principal reason given by Mobike for pulling out of the extension to the neighbouring town of Stockport in March 2018 after only eleven days of operation (*Manchester Evening News*, 2018*a*). By the time the scheme was terminated in September 2018, 10 per cent of the bikes had been lost to theft and vandalism each month (*Manchester Evening News*, 2018*b*).

The persistent theft and vandalism of the bikes hindered any positive narrative Mobike might have put forward to promote the image of the scheme or engage the public with information on its potential social value. However, an alternative perspective on the causes of vandalism emerged in the interviews, which suggested the problem might not have been due to low public awareness or 'buy-in' to the scheme, but quite to the contrary indicated a potentially enthusiastic cohort of users, who were frustrated by the barriers to access that

they encountered. This was neatly argued by a design engineer, who has advised Transport for Greater Manchester on bike sharing schemes:

> It was young teenagers that were breaking the locks. You've got bikes that look like kid's bikes, but kids can't use them as they are too young to have the credit card necessary to make the payment. With a little bit of application, they could use them. Maybe if there had been an age limit of twelve we might have got away with that. If you deny someone access to something they find useful, then they are going to find ways to use them. If you have a lower age limit, it would be better.

Public subsidizing of bike share for young people could have been a way to provide shielding and nurturing to the innovation. In this way, the protected space would be formed to create a niche-innovation, together with the strategic niche management necessary to carry it forward.

Indeed, reflections by the Transport for Greater Manchester interviewee suggest that such a move would have been feasible:

> We subsidize young people for bus and train travel, so if we wanted to have bike share we could subsidize that as well. People under sixteen are forming their travel habits. At the moment, they are using the car as the only way to get about, but if we can combine bike share with public transport, we have a viable alternative to the car to offer them, and it can change the landscape.

Mobike's operation of the Manchester scheme was unilateral and 'top-down', and lacked any public information strategy. As the Mobike representative put it: 'We didn't invest enough in having government affairs people working in Manchester, and communication was not enough'. A significant example was the decision to shrink the geo-fencing area greatly in November 2017 without any prior public awareness campaign. This meant that, from the perspective of the locality, all of a sudden bikes could only be parked in a strict 6 km^2 area within central Manchester.

The focus of decision-making on the geo-fence was narrowly instrumental, and did not expand to the sorts of niche-building work anticipated in the academic literature associated with the MLP. This is seen in the Mobike representative's reflections on the decision:

> It was very much our decision, and was designed to improve our operations. Before the restricted geo-fence, the bikes slowly became

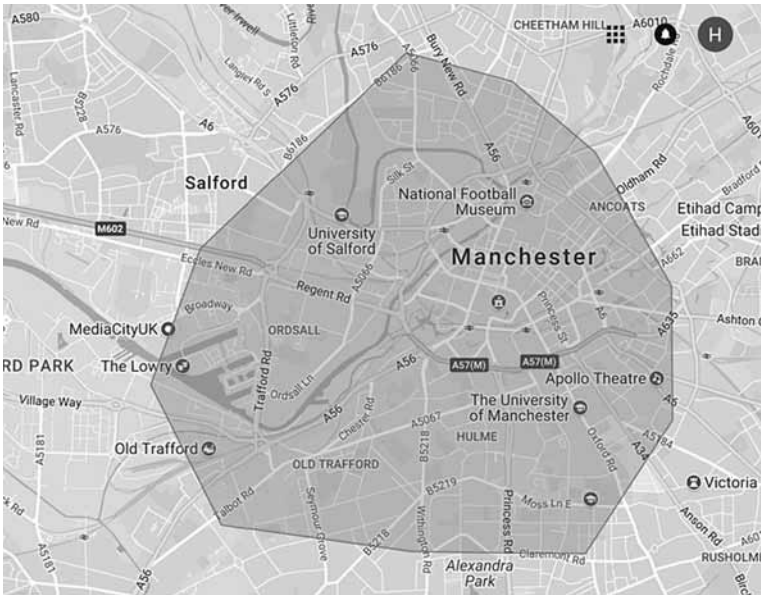

Figure 3. Mobike in Manchester geo-fenced area November 2017. (*Source*: Google)

widely distributed and did not have the density required. It gets to the basic model of bike sharing. There's a size of operation that can produce a financially sustainable scheme. We have a model of so many operators per bike, which we keep commercially confidential, but if you have twenty people supervising five hundred bikes, then your model isn't sustainable. That's why we try and manage geo-fenced areas quite tightly, so that the operational costs balance income from rides.

In addition to the frustrations associated with the lack of public information, the reduction in the geo-fenced area generated dissatisfaction with the functionality of the scheme (Sherriff *et al*., 2018, p. v). Mobike's already deteriorating relationships with the locality were worsened as the public authorities had expected much greater engagement, both with the public and policy stakeholders. This is demonstrated in the comments of the officer at Transport for Greater Manchester:

> In such things as the Mobike scheme you need a hands-on partnership, with regular meetings. One of the problems with Mobike was that there was not regular contact with Transport for Greater Manchester or the police. The relationship breaks down a bit. It was frustrating for both sides. It was hard to get hold of them, when we should have been on the same page. For example, when they reduced the geo-fencing area they didn't liaise with us. They didn't discuss their plans with us, and how we would align things with what we wanted to do. When they restricted the geo-fenced area it caught users on the hop. I think it was very counter productive.

Termination of the Scheme – September 2018

At the end of the six months trial in December 2017, Mobike expressed its intentions to remain in the city on a long-term basis. Nonetheless, the levels of theft and vandalism remained high, and the company was coming under increasing pressure to achieve financial viability and returns on investment. In August 2018, Mobike therefore issued what they called a 'final warning' to the 'anti-social minority' to stop stealing and vandalizing the bikes in Manchester. Two weeks later the company announced its complete withdrawal from the city, and the bikes used in Manchester were dispersed to other UK cities or recycled for spare parts (Interview, Mobike representative). The final decision was a commercial one, but it centred on the negative (criminal) public response to the innovative technology, as the Mobike representative interviewed conceded: 'Bike sharing requires hardware and investment in physical assets. It's not like a Facebook where there are no assets'. Irrespective of the ultimate withdrawal of the scheme, Mobike claimed that the scheme had been a success, since the bikes had been used on 250,000 trips covering more than 180,000 miles (*Manchester Evening News*, 2018*b*).

Again a potential to build a niche was missed, as subsidizing bike sharing would have assisted local planning objectives of different local actors. The Transport for Greater Manchester officer saw connections to spatial policy, for instance commenting that:

> In Manchester we've got obligations to serve the public and not just certain areas of it. We can have an area where the dockless operator wants to operate, but we want to see them go to less desirable areas, and they are not going to want to do this. If we're subsidizing it then we have some sort of control. If we don't subsidize then we are just helping the operator to make money. We can use profits from where there are seven rides per day to cross-subsidize areas where there are only two or three rides per day. I don't think anyone has done that yet.

In the interviews, the coalition building work was repeatedly associated with better engagement of the public. The representative from the Greater Manchester Cycling Campaign envisioned how the connections could have been made, saying:

> We had a new Mayor, and he was looking for a public bike hire scheme. Mobike came along and said they could do it for minimum cost, but the councils need to take responsibility and not just leave it to Mobike. They need to help them with parking spaces and also advertise the service. If people know how to use the bikes better, then maybe they would use them more.

Interviewees' reflections describe their increasing realization of the participatory sig-

nificance of the necessary infrastructure to promote cycling. The design engineer succinctly expressed this as follows:

> You can't just go around leaving objects about and not expect the local authority to take action. You have to think about the effects on other citizens. How you are going to manage it? Where are people going to go? It's just a planning process that has to be done. We have learned a lot of lessons from taking a *laissez-faire* approach to the planning of it in Manchester. Let's not forget it was a success in user terms. There were thousands of cycle trips that wouldn't have taken place otherwise.

This was supported by the perspective of the representative of the Greater Manchester Cycling Campaign on the cycling culture in the local context, who related the challenge of engaging people in bike hire. That representative pointed out significant challenges in respect of on-road experiences in the locality:

> How are you going to get people to use a Mobike when the roads are far too dangerous? People who cycle are those with bikes, but you want to attract people without bikes. If the roads are too dangerous, they are not going to cycle at all, even if the bikes are cheap. The reason people don't cycle is because it's not safe now. You need to enable people so that they feel safe to go out cycling, then it becomes better than being on a bus or being stuck in congestion in a car. Over the next five years you will see a radically different Greater Manchester. Perhaps then will be the time when you can have a bicycle hire scheme to complement these developments.

These findings underscore the significance of local culture in creating a niche. The perspectives of prominent stakeholders demonstrated how policy objectives and user experiences could have been bound up with action to encourage a niche for the innovation of dockless bike sharing. For instance, the construction of a protected space for cycling might have assisted in the creation of a niche for bicycle hire. A better connection between the wider narrative of infrastructure development and the niche-innovation might also have helped to create that niche. Engagement with local values could have brought to light possible value conflicts with users and the opportunity to develop strategic responses.

The Technological Innovator and Public Engagement

The empirical case study illustrates the power of the public in responding to technological innovations, not through orthodox methods such as formal channels of communication and deliberation with authorities in the context of decision-making processes, but via direct material engagement with the technology. Thus if dockless bicycles in Manchester/Salford are to be described as a disruptive innovation, then it was the public in responding to the innovation after implementation that contained the disruptive force, rather than the innovator and the innovation itself. Through the dynamics of the scheme development, the public indicated its response to this innovation. In direct response terms, while some users engaged through cycling, the most powerful responses were the prominent problems of theft and vandalism, which represented not only criminal behaviour, but also resistance to the scheme. At the same time, findings suggest there were also means through which the bikes could have been made more accessible to young people, who were the chief group responsible for the theft and vandalism. By lowering the age limit and giving them the means to pay, it was more likely that, at least over time, theft and vandalism could have been reduced.

The major decision by Mobike to reduce the geo-fencing area also indicated an inability of the company to interpret the public response. Thus, the problem of bike dispersal was seen by Mobike in terms of restricting the geo-fenced area in order to enhance commercial viability, when in reality this restricted the ability of the public to use the bikes in spatial and convenience terms. There were also problems with the bikes themselves that restricted their use in terms of safety and comfort.

The public were therefore communicating

through direct mechanisms of participatory exchange, but the company failed to engage with, and thus have the option to interpret, the messages, and respond in a way that could have carried the scheme forward from being, in Christensen's (1997) terms, a 'low end disruption' to becoming a more established 'new market disruption'. It was the public that disrupted Mobike's expectations for their technological innovation, and the company lacked the means to respond in an appropriate way. If Mobike in Manchester/Salford failed to make the transition to a niche-innovation, then it was due chiefly to a failure to recognize the power of the public as end-users, and then as citizens in the wider policy context, more than their ability to shield and nurture the innovation, even though the scheme was supported by the public authorities.

The public therefore held significant power in terms of communicating responses directly, but this power was limited in terms of the innovator's reactions. In addition to its failures in taking account of public responses, Mobike was also unable to construct narratives that could allow the public to perceive the bikes in terms of a process of empowerment that could enhance mobility and choice of mode. The findings from this case centre on the power of those who won out through 'disuse' of the scheme. It is important to note that other end users of the dockless bike share technology offered by Mobike in Manchester, such as those affected by the restrictions in the geo-fencing area, had agency, if not power, through their own direct participation. However, in this study it is not possible to assess the extent of their influence. Therefore, it could be of value in future to examine the part played by users in more successful cases of socio-technical transitions, looking at the means of participation and their effects on the construction of any niche-innovation.

As Tritter and McCallum (2006) argue, a more appropriate approach must recognize the multiple sources of potential user power, the dependence of decision makers on user support, and redraw the context within which conflict over the ability to influence decisions occurs (*ibid*., p. 165). Thus the typology of participation described by Arnstein (1969) is limited by its inability to recognize the need for communication through mechanisms of participatory exchange. This is very much a static and narrow interpretation of participation, and we need to understand more about its dynamics over the whole course of the policy process.

The failure of the scheme resulted chiefly from the inability of Mobike to prepare the ground properly for the scheme, then to introduce an efficient and ongoing system of research into the character of the locality, and also to construct narratives that could enhance the public image of the bikes. In essence, the company failed to work within any significant framework of participatory exchange, and this inability to recognize user power indicated the limitations of an innovator that relied excessively on the novelty of technological innovation. Had there been participatory creation of knowledge about such factors as identifying potential users, and the mobility needs of certain groups in the city, then the direct participation that took place could have been different. Crucially, the lack of meaningful participation in the early stages of decision-making, and in the generation and shaping of knowledge, sparked a concerned public into being – a public that made its dissatisfaction with exclusion visible through ways in which the bikes were re-appropriated in a manner that defied the rules of the game as imagined by Mobike (and the councils). Consequently, the practice and skill of transport planning can be an important factor in determining project success or failure, although the dynamics of participatory exchange after implementation can place a greater premium on the creation and political management of a niche-innovation.

In this context, the role of the public authorities was significant, but ultimately a subsidiary factor in explaining the failure as a niche-innovation. The local authorities adopted a basically non-interventionist

approach to the Mobike scheme. Significant attempts were being made to develop the organizational support for cycling and its infrastructure in Greater Manchester, but this had little influence over the Mobike scheme in terms of operational regulation. However, in any circumstances this may have had limits given the lack of willingness on the part of the company to adopt a partnership approach. Institutional thickness can therefore be potentially important for the trajectory of innovations, but the Mobike Manchester/Salford case indicates the limitations when a network of co-operation and mutual dependence cannot be constructed.

The physical presence of bike share technology offers a route to power in terms of introducing a material and performed mechanism of participatory exchange, as it allows consumers to express their preferences and needs, and to do so visibly in the public realm. However, societal expectations of technological innovations are unlikely to be satisfied, such as in the case of the environmental and health benefits of cycling, if those responsible for the innovation are unwilling, or lack the means, to interpret these choices in a strategic way over time.

REFERENCES

Arnstein, S.R. (1969) A ladder of citizen participation. *Journal of the American Planning Association*, **35**(4), pp. 216–224.

Boardman, C. (2017) *Made to Move. Fifteen Steps to Transform Greater Manchester by Changing the Way We Get Around*. Greater Manchester: Cycling and Walking Commissioner.

Chilvers, J. (2009) Deliberative and participatory approaches in environmental geography, in Castree, N., Demeritt, D., Liverman, D. and Rhoads, B. (eds.) *A Companion to Environmental Geography*. Chichester: Wiley-Blackwell, pp. 400–417.

Christensen, C.M. (1997) *The Innovator's Dilemma*. Boston, MA: Harvard Business School Press.

Christensen, C.M., Raynor, M.E. and McDonald, R. (2015) What is disruptive Innovation? *Harvard Business Review*, December. Available at: https://hbr.org/2015/12/what-is-disruptive-innovation.

Cornwall, A. (2008) Unpacking 'participation': models, meanings, and practices. *Community Development Journal*, **43**(3), pp. 269–283.

Dudley, G., Banister, D. and Schwanen, T. (2017) The rise of Uber and regulating the disruptive innovator. *The Political Quarterly*, **88**(3), pp. 492–499.

Financial Times (2017) Bike apps saddled with high labour costs. 27 December.

Financial Times (2018) Cyclical momentum as Meituan deal values Mobike at US $3.7bn. 5 April.

Fishman, E. (2016) Bikeshare: a review of recent literature. T*ransport Reviews*, **36**(1), pp. 92–113.

Geels, F.W. (2014) Regime resistance against low carbon transitions: introducing politics and power into the multi-level perspective. *Theory Culture and Society*, **31**(5), pp. 21–40.

Geels, F.W. (2018) Disruption and low carbon transformation: progress and new challenges in socio-technical transitions research and the multi-level perspective. *Energy Research & Social Science*, **37**, pp. 224–231.

Geels, F.W. and Kemp, R. (2012) The multi-level perspective as a new perspective for studying socio-technical transitions, in Geels, F.W., Kemp, R., Dudley, G. and Lyons, G. (eds.) *Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport*. New York: Routledge, pp. 49–79.

Geels, F.W., Schwanen, T., Sorrell, S., Jenkins, K., and Sovacool, B.K. (2018) Reducing energy demand through low carbon innovation: a socio-technical transitions perspective and thirteen research debates. *Energy Research & Social Science*, **40**, pp. 23–35.

Lovell, H. (2007) The governance of innovation in socio-technical systems: the difficulties of strategic niche management in practice. *Science and Public Policy*, **34**(1), pp. 35–44.

Manchester Evening News (2017*a*) Lots of people say they would love to cycle to work in Greater Manchester, but even more say they wouldn't feel safe. 14 November.

Manchester Evening News (2017*b*) Is Manchester really ready for Mobike. 19 July.

Manchester Evening News (2017*c*) Vandalism to Mobikes has forced owners to write off 70 bikes in 6 months. 11 December.

Manchester Evening News (2018*a*) Mobike is pulling out of Stockport – 11 days after launching in the town. 23 March.

Manchester Evening News (2018*b*) Manchester first

city in the world to lose bikes due to vandalism. 4 September.

National Infrastructure Commission (2018) *Urban Transport Analysis: Capacity and Cost*. London: National Infrastructure Commission.

Parkes, S.D., Marsden, G., Shaheen, S.A. and Cohen, A.P. (2013) Understanding the diffusion of public bikesharing systems: evidence from Europe and North America. *Journal of Transport Geography*, **31**, pp. 94–103.

Rowe, G. and Frewer, L.J. (2005) A typology of public engagement mechanisms. *Science, Technology and Human Values*, **30**, pp. 251–290.

RTPI (Royal Town Planning Institute, Planning Aid) (2010) *Good Practice Guide to Public Engagement in Development Schemes*. London: RTPI.

Schneider, H. (2017) *Creative Destruction and the Sharing Economy. Uber as Disruptive Innovator*. Cheltenham: Edward Elgar.

Schwanen, T. (2015) The bumpy road toward low-energy urban mobility: case studies from two UK cities. *Sustainability*, **7**, pp. 7086–7111.

Schwanen, T. (2016) Innovations to transform personal mobility, in Hopkins, D. and Higham, J. (eds.) *Low Carbon Mobility Transitions*. Oxford: Goodfellow Publishers.

Shaheen, S.A., Guzman, S., and Zhang, H. (2010) Bike sharing in Europe, the Americas and Asia. *Transportation Research Record*, **2143**, pp. 159–167.

Shaheen, S.A., Zhang, H., Martin, E., and Guzman, S. (2011) China's Hangzhou public bicycle: understanding early adoption and behavioural response to bikesharing. *Transportation Research Record*, **2247**(1), pp. 33–41.

Sherriff, G., Adams, M., Blazejewski, L., Davies, N, and Kamerade-Hanta, O. (2018) *Bike Share in Greater Manchester*. Salford: University of Salford.

Smith, A. and Raven, R. (2012) What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, **41**, pp. 1025–36.

Sun, Y. (2018) Sharing and riding: how the dockless bike sharing scheme in China shapes the city. *Urban Science*, **68**(2), pp. 1–19.

Tritter, J.Q. and McCallum, A. (2006) The snakes and ladders of user involvement: moving beyond Arnstein. *Health Policy*, **76**, pp. 156–168.

Wilsdon, J. and Willis, R. (2004) *See-Through Science. Why Public Engagement Needs to Move Upstream*. London: Demos.

Yi, A., Zongping, L., Mi, G., Yangpeng, Z., Daben, Y.W. and Chen, Y.J. (2018) A deep learning approach on short-term spatiotemporal distribution forecasting of dockless bike-sharing system. *Neural Computing and Applications*, 1–13. https://doi.org/10.1007/s00521-018-3470-9.

Yin, R.K. (2003) *Case Study Research: Design and Methods*, 3rd ed. Thousand Oaks, CA: Sage.

Zhang, Y. and Mi, Z. (2019) Environmental benefits of bike sharing: a big data-based analysis. *Applied Energy*, **220**, pp. 296–301.

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The Sharing Economy and Blurring in Public-Private Relationships

Geoffrey Dudley, David Banister, and Tim Schwanen

Now the use of digital technologies enables individuals to buy access to mobility as and when they need it, the desire and right of individuals to own and use a vehicle is no longer taken for granted. The wide range of services available includes peer-to-peer car sharing, car clubs, docked and dockless bicycle hire, electric scooters, demand responsive transport, and ride-hailing apps. It is the combination of these services into an integrated system rather than each on their own that can, at least in theory, offer a real alternative to individual car ownership. To what extent this is actually the case remains to be seen. Evidence to back up claims about the supposed obsolescence of car ownership is limited. The logic of giving up the car as the range of alternative modes becomes much more attractive can be countered by inertia in peoples' behaviours that are based more on familiarity, habit, independence, and the feeling of being in control.

The more direct effects of sharing are likely to result in a blurring of the public and private sectors where integrated mobility service providers become dominant players. The best example of this is the ride-sharing app Uber. From its foundation in 2009 Uber has adopted a strategy of worldwide expansion with market share being seen as the main success criteria. This business model has resulted in Uber making persistent losses, with the fares being heavily subsidised from the company's large-scale venture capital funds. Uber encountered widespread resistance from regulators and incumbent operators, and was forced to retreat in the face of competition from its main regional rivals in China (Didi Chuxing) and South-East Asia (Grab).

In 2017, the Uber chief executive, Travis Kalanick, was compelled to resign in the wake of widespread criticism of the company's business model, and his successor, Dara Khosrowshahi, adopted a more open and conciliatory approach. At the same time, there was still no sign of Uber making a profit, and in the first three months of 2019 the company made a loss of over $1.1 billion. Uber had operated as a private company, but in 2019 it took its shares to the stock market in an initial public offer (IPO) that valued the company at $82.4 billion. The IPO allowed the initial funders to recoup some (or all) of their investments, and so spread the risk across a much wider set of investors. This can have the effect of reducing the pressures to make a profit. At the same time, to maintain the share price over time Uber required an alternative to the previous model of worldwide expansion and market share. Instead, Khosrowshahi declared that Uber was now focused on executing a strategy to become a one-stop shop for local transportation and commerce, including freight. In the context of urban transport, Khosrowshahi expressed an intention for a switch in emphasis for Uber from cars to electric bicycles and scooters for shorter journeys as part of its long-term strategy, and to generally maximise the share of its market. In this new strategy, maximising market share entailed providing a range of complementary (or even competing) alternatives.

This new strategy manifested itself in 2018 when Uber acquired the electric dockless bicycle hire operator Jump for a reported $200 million. The dockless element means that the bikes are free floating, and unlocked and locked by means of a smart phone app, rather than being attached to a fixed dock. By 2019, Jump had expanded its

services rapidly, and operated over 4,000 bikes across thirteen cities in the US, as well as moving into Europe, with services in Lisbon, Paris, Berlin, and London. Jump also began rolling out an electric scooter sharing system in Santa Monica, California.

By expanding into alternative modes, sharing apps can increase the range of services they offer, but this can also create an ambivalent relationship with public transport modes, such as bus, light rail, and underground services. In terms of integration, both ride-hailing and bike hiring can be used for 'first mile-last mile' services that link with public transport. One example of this integration in practice occurred when Transport for London extended its night-time underground services in 2016. In response, Uber increased its ride-hailing services to provide 'last mile' transport, and this has resulted in its cars moving from the centre of London towards the suburbs. At the same time, ride-hailing has been blamed for a decline in demand for bus services. For example, after many years of increasing demand, between 2015-16 and 2016-17, the number of bus passengers in London declined by 2.3 per cent. Although this decline could be attributed to a variety of causes, including road works and increased congestion, the presence of ride-hailing, together with bike and scooter sharing schemes, can threaten public transport services.

Expansion can also create an ambivalent relationship with local authorities. On the one hand, the expansion of sharing services can assist in achieving policy goals of creating integrated transport services. At the same time, a decline in pubic transport patronage such as the bus (rather than a decline in car ownership) can heighten economic pressures to increase subsidies, and political pressures to maintain unprofitable, but socially necessary, services. Ironically, in these circumstances local authorities can call on ride-hailing apps to fill the gap. This has occurred particularly in the United States where, at a fraction of the cost of traditional public transport services, ride-hailers can provide a point-to-point ride. For example, in San Clemente and Dublin in California, local officials cancelled fixed-routed buses with the lowest ridership, and provided discounts for people to travel in Uber and Lyft (the other principal US ride-hailing company) services. In addition, Phoenix in Arizona is discounting the price of ride-hailing trips to and from 500 city bus stops, while Denver in Colorado is offering free Uber rides to suburban light rail stations. If local authorities become more dependent on ride-hailers to provide socially necessary services, then this increases the political leverage of the companies in policy decisions and the framing of regulations.

Similarly, the generation and distribution of data is another area where relationships between the public and private sectors can become more ambivalent. From one perspective, companies such as Uber can therefore work with local authorities to use travel data to improve the quality of the service and information available to the user. In addition, there are higher order and longer term effects, including concerns about overall service coverage, special needs transport, service integration, urban planning, and congestion reduction strategies. For example, in the US the city of Boston and Uber have created a partnership that leverages data provided by Uber. This provides insights to help manage urban growth, relieve traffic congestion, improve public transport operation, and reduce greenhouse emissions. There is also scope for Uber and local authorities to share data on their respective services. A recent example here is provided in London, where in 2019 Uber has integrated London's public transport data into its app. This shows users the fastest and cheapest way to get between

destinations using London Underground and buses, in addition to the ride-hailing type services provided by Uber. The company's long-term ambition is to build a full journey planner that combines cars, public transport, and Uber's Jump bikes (and eventually scooters, which are currently illegal on UK roads and footpaths) when recommending routes to users. In this respect, it aims to become an alternative to Google Maps and Apple Maps for journey planning.

This type of journey planner can assist local authorities in the integration and promotion of services. At the same time, the journey planner itself can become a valuable resource that is controlled by Uber, and on which the local authority is dependent for the promotion of its services. As in the cases where Uber and other sharing apps provide substitute services for public transport, the companies can enhance their political position by becoming indispensable to local authorities. This shift in the power balance can in turn improve the companies' potential to expand their position, as distinctions between the public and private sectors continue to become more blurred. These new relationships also highlight questions of trust and institutional structure, including how much autonomy can, or should, local authorities give to ride-sharing apps.

The Datafication of Urban Transport

Geoffrey Dudley, David Banister, and Tim Schwanen

In recent years, there has been growing interest in the acquisition and use of data generated by transport sharing services. These services include app-based ride-hailing such as Uber, dockless bicycle hire, and the hire of electric bicycles and scooters. Industry observers predict that the data generated by the sharing companies will determine their value more than the actual mobility services they provide. There is, however, little consideration of exactly how the data is valued, who should have access to it, and how it will be used. In reality, data can become a prime motivating force in political power struggles between mobility companies, users, and the public authorities, with the different possibilities playing an important part in shaping how the services are operated.

The development of technology has turned a relative scarcity of data into an abundance, but there is a need to understand where the true value of the data lies. In itself, aggregate data may have little value, and it is only when the data is broken down into a form that can have practical applications that it becomes of genuine use and hence value. As a senior executive of a major bike hiring company expressed it during an interview as part of our research on dockless bike sharing, you can have ten million customers, but if only one of them is actually riding, then what you really need to know are the figures for actual demand and take-up. Granular data is therefore more valuable than aggregate data in both commercial and public policy terms.

For example, in the case of dockless bike hiring, early versions of the app might only display and record the beginnings and endings of journeys. Now operators have the capacity to track riders throughout a journey. If local authorities have access to this data, it can assist them in making decisions on where infrastructure should be targeted, as they know the actual routes used. Granular detail can also be of value to local authorities in co-ordinating different modes of transport, allowing a full integration of all services. Note, however, that by definition the data only provides information on realised behaviour and not on potential demand for cycling using dockless bikes, or on situations in which people are prevented from using such bikes. Furthermore, it is unclear how representative the data is of the behaviour of all cyclists in a city.

Data can also be commercially valuable to the operators, when it is sold to third parties. For example, it would be useful for retail and food and drink businesses to know in what numbers, and when, people are travelling and congregating in certain areas, and data from sharing services can provide this information. Bike hiring data can also be sold as a component in corporate membership for companies. This means that a company can have bike hire membership for its whole staff, and by analysing the data the bike hire operator can report to them on how the scheme is being used. This brings in a revenue stream for the bike hire operators and can be designed to help companies encourage employees to get on bikes. This datafication of travel patterns can be used as a means of paying for bike hire schemes, and can avoid the need for public subsidies.

At the same time, the extent to which apps can track people while riding can be politically sensitive. Smart phones now become the means whereby people's movements can be comprehensively covered. The resulting loss of privacy seems to be accepted by younger people more readily than by older generations, who tend to have greater qualms about the tracking of movements as the new normal. Data will of course be anonymised for commercial or public authority use, but political pressures may develop to give people the option to opt out of the details of their journeys being tracked.

In the case of granular data, there can be power struggles between companies and local authorities over questions of access, where the companies are sensitive about releasing data that they perceive as being of commercial value to both themselves and competitors. With regard to interpreting the data itself, there is also the question of whether either the companies or the local authorities have the capacity to make the best use of the data. The analysis and evaluation of data requires resources and expertise, but can add to the costs of companies operating on thin margins, or local authorities providing services in times of public austerity.

Even in cases where local authorities are given access to the necessary data, there can be scope for political tensions. As a senior executive of a major dockless bike hire operator explained to us, a local authority may want an operator to work in areas with social need, but which are not commercially viable. In these cases an element of public subsidy is likely to be required, but can be difficult for authorities working on tight budgets.

Nevertheless, there are likely to be increasing public pressures for data to be made publicly available, such as the argument that, as the data is produced from public highways, so it should be made available for public use. However, data in itself is not a magic key in terms of providing answers to complex policy and investment questions. Effective use of data requires not only expert analysis, but also the political authority and judgement to bring about the desired policy objectives.

Protecting your privacy using a route mapping app.

Location of local bike sharing stations