

Development of Real-time transport applications in Sydney – A hybrid model

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Abstract: Real-time (RT) transport information conveys actual locations of transport services in real-time, as opposed to only timetabled departure times. The development of RT transport information mobile applications has become a focus of many public transport organisations due to their relatively low cost and high customer value. This paper explores a combinatorial approach taken by Transport for New South Wales, for the public transport network in Sydney, Australia. This approach cost effectively delivered six applications to market within months through the alignment of stakeholder interests. The paper traces the multi-stakeholder network of development from initial concept, into implementation, and continual expansion across the network. This study uses Actor-network Theory (Callon 1986; Latour 2005) as a research strategy to discuss the successful alignment of the interests of the range of stakeholders across the aspects of development. The case is presented in a multi-voiced account through the four moments of *Translation* (Callon 1986); *Problematization*, *Interessement*, *Enrolment and Mobilisation*. Actor-network Theory is an ontologically relativist and post-structuralist research strategy that respects potential symmetries of agency of both human and non-human entities. This study uses (12) interviews with stakeholders involved in the activity of the project to understand the Actor-network of the development of the RT applications and also refers to literature such as related media releases and news articles. This case deconstructs Sydney's case to a point where it is clearer as to what some of these formative influences were from the perspective of those participants in the development of the RT applications.

Intent of the study

The aim of this paper is to understand how each of the actors came into involvement and aligned with the project intent and how this alignment came to hold as a stable network. This paper explains the emergence of the management structure to act as a reference as other cities contemplate their means to make these RT information services available. The use of Actor-network Theory as a research framework expands the framing of the 'project' in problem definition to years before the 'official' Transport for NSW project commenced. The case a for less technology-led, more integrated and demand-driven approach to implementation of urban digital services is demonstrated in this case, with emphasis on public sector planning and facilitation of viable business opportunities for third party developers.

Background

Information Communication Technology (ICT) is integral to Transport systems. RT customer information systems are understood to have great customer experience benefit, with the capability to draw more patrons to public transport systems (Brakewood, Barbeau, & Watkins, 2014; Brakewood, Macfarlane, & Watkins, 2015). Smartphone usage now has the majority of the market in developed cities. In Australia, smartphone penetration is up over 79% (Deloitte 2015). There are clear financial incentives for public transport organisations to use smartphones as a communication channel rather than having to maintain their passenger information display systems (PIDS) at interchanges and bus stops. However from a planning perspective, there is little literature to support organisations wanting to implement such services make the decision around the most appropriate process by which these are designed, developed and maintained. Local governments have been identified as the focal actor to convene other actors to support and safeguard positive outcomes for all customers (ARUP et al 2014). Developed cities' local governments and other governing organisations have approached this service delivery of RT transport applications (apps) through varying models. Many cities have taken an *Open data* approach by releasing data to third party developers to varying degrees. This typically means putting the RT data in an accessible feed on a server outside the firewall of the public organisation, which has oversight of the system. The understanding here is that the open market will decide the best application, at very low cost to the government. This option is not without risk for how the data will be used by third party developers, over which the transport organisation has significantly reduced control. This can lead lack of consistency in customer outcomes. Other cities have opted to develop their versions of transport real-time applications and keep the RT transport information for their purposes. This model excludes third party application developers from having access to the RT data. This option is far more costly for transport

organisations but maintains the total control of the information system, thus lowering the risk of information being misrepresented. Sydney used a model that is a combination of the two, and thus, named in this paper as a *hybrid model*.

What the hybrid model is

Transport for NSW’s approach could be considered *hybrid* as it used a combination of *Open data* with a closed competitively selected group of five application development teams that worked closely with Transport for NSW to ensure high quality applications. In October 2012, the state government in a media announcement from the Minister for Transport Gladys Berjiklian publicly called for application developers to apply to attend a ‘hothouse’, to compete for limited positions in skills-based competition for exclusive access to the RT feed for Sydney’s buses. Five developer teams were selected to develop further their concepts and have exclusive rights to the RT data feed. Subsequently in February 2013, there was another hothouse for train data, resulting in another two developers being added to have access to the RT feed. Since that time, two developer groups have dropped out due to issues with the financial viability of their apps, and one of the included developers has added another application. Currently, there are six applications from five developer groups available for download and use on platforms including Windows phones, iPhone, Android and Blackberry. This approach has had several advantages for Transport for NSW; firstly having only five developers meant that there have been significant communication and relationships built between the developers and the transport organisations has been strong, allowing more agile improvement of services, as Transport for NSW brings more RT data from the various transport providers online. However, there are ongoing equality issues to the exclusion of other application developers from accessing the RT feed. Many argue that the RT data is from public services, so it is unjust to block access from other developers and users. That being said, it is Sydney has been seen as the earliest resounding success in the media and has become a public sector innovation narrative of how contemporary government should be operating.

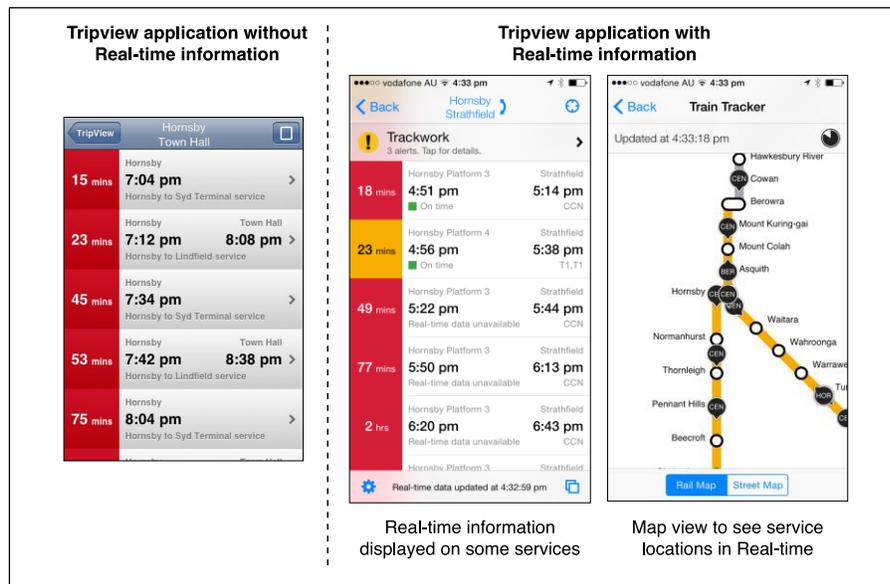


Figure 1. What a customer sees when they look at Grofsoft’s *Tripview*, developed by Nick Maher. On the left is prior to March 2013, when there was no RT data available for Train services, on the right is a what is available on Tripview, July 2015. Images © Grofsoft 2015. Images used with permission.

How other Australian cities approached RT transport applications

Each Australian city has their unique context of governing organisations and transport providers leading to different levels of preparedness for RT transport information. Perth, Melbourne, Adelaide, Brisbane have all had very different approaches to the delivery of RT transport information. Adelaide was the first city to put RT information systems within bus stops back in the early 1990’s, and now offer this service online through their website but not as standalone mobile application. Other cities have followed on individual modes of transport. In November 2014, Melbourne had announced it would be opening data up to third-party application developers. Public transport victoria’s (PTV) app, offers RT tram tracking and coverage of some buses. Melbourne, unlike Sydney, did not have GPS tracking on all buses but announced it would be adding this functionality with the aim of creating RT applications in March 2015.

The RT feed was released in May 2015 (PTV 2015). Perth has withdrawn what was an *Open data* feed to deliver their application Transperth, which will be the only application with access to the feed. Brisbane rolled out the service on buses in May 2015 in their 'MyTransLink' application.

Conceptualisation

Actor-network Theory in Information system (IS) research

The discipline that focuses on the development, use and impact of information technology on business and organisational settings is 'Information Systems' known as IS for short (Myers & Avison, 2002). This area of study emerged in the 1960s and had grown substantially since its inception. More interpretive methodologies have become dominant in IS research in recent years. Interpretive methodologies assume that the world is not a fixed constitution of objects, rather 'an emergent social process – as an extension of human consciousness and subjective experience' (2002). These approaches, in many cases, are limited to the realm of the social, which in the case of technical systems of heterogeneous elements is limited. Actor-network Theory (ANT) has arisen at a time when complexity and interwoven nature of social, political, technological aspects of systems are increasingly inseparable when in analysis. ANT emerged from the Sociology of Technology and Society (STS), in France by Michael Callon (1986) and Bruno Latour (1987). Later work by Latour (1993; 1995), can be viewed as an aspect a wider school of study – the social construction of technology (Bijker, Hughes, Pinch, & Douglas, 2012). "ANT is concerned investigating the social and the technical taken together or...with the creation of coextensive networks of human and nonhuman elements which in the case of information technology include people, organisations, software, computer and communications hardware and infrastructure standards" (Walsham 1997, p. 466). ANT argues that people and artifacts should be analysed with the same conceptual apparatus. An Actor-network is a heterogeneous network of aligned interests, including people, organisations and standards. These are not fixed, networks, instead, are emergent, but are only temporarily stable. ANT is often referred to as a research strategy, as it does not clearly articulate 'how to' carry out the research. Criticisms of ANT share a few common concerns namely; has a limited analysis of social structures, it is seen to have an amoral stance, and the concept of generalised symmetry in which human and nonhuman actors should be analysed with the same apparatus has been challenged (1997). Finally, ANT as a research strategy is the difficulty in illustrating a case in shorter than book length formats (1997). As the theory emphasises the importance of detail, Latour (1995) expresses the ability to reduce to represent research of an unlimited number of entities that grasp one and other in limited ways.

Using an Actor-Network Theory framework

Actor-network theory is also known as *the Sociology of Translation*. *Translation* is the central tenet of ANT, which is the process of alignment of the interests of a diverse set of actors with the interests of the focal actor (Callon 1986). To translate is "a verb implies the transformation and the possibility of equivalence, the possibility that one thing might stand for another (for instance a network) (Law 1992). In paper format, this case is presented along the four stages of *Translation*. *Problematization* is the first (1) moment of translation, in which a focal actor defines identities and interests of other actors that are consistent with their interests and establishes itself as an obligatory passage point (OPP), thus rendering itself indispensable (Callon 1986). An OPP is a situation in which all of the actors have to achieve their interests as defined by the focal actor (1986). *Interessement* is the second (2) moment of *Translation*, in which actors must be negotiated with to accept the definition of the focal actor. *Enrolment* is the third (3) moment of *Translation* in which other actors in the network accept (or get aligned to) interests defined for them by the focal actor (1986). Finally, the last moment of *Translation* is *Mobilisation* (4) refers to a set of manners utilised by a focal actor to ensure that all actors have legitimate speakers to represent them in the groups and avoid betrayal from the latter (1986). Betrayal refers to the breakdown of the actor-network, in which an actor acts outside of their defined role.

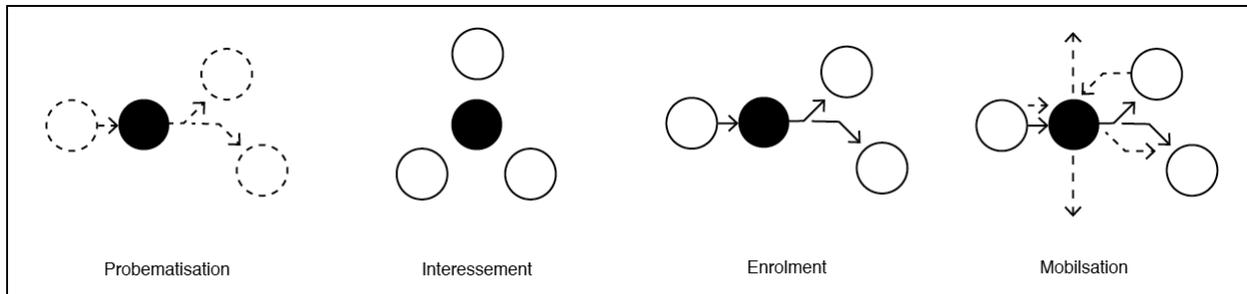


Figure 2. The four moments of *Translation*, adapted from Callon 1986.

Methodology

ANT usually relies on semi-structured interviews with actor participants as well as observations. In this case, 12 semi-structured interviews were conducted with the relevant stakeholders who were actors in the network. The stakeholders were two Transport Project Managers, one executive, three information service managers, five application developers, and one consultant. The researcher was engaged with the primary stakeholder Transport for NSW as part of a parallel ARC Linkage project over this period from 2012-2015. The case is also supported with reference relevant to media coverage and official government documents, which have been referred to by participants. These interviews were synthesised to establish key actors, and how they were enrolled into the project and subsequently affected the course of activity. The challenge of writing up such a case is how to distil the immense complexity of the project down to the key *Translations*. 'A good ANT account is a narrative or description in which all of the actors do something and don't just sit there.... A good text elicits networks of actors when it allows the writer to trace a set of relations defined as so many translations' (Latour 2005, pp. 128-129).

The Case as framed by Actor-network Theory's moments of *Translation*

1. First moment of Translation: Problematiation (2006-2012)

Transport for NSW defined the framing of the problem 'as a project'. This *Problematiation* was eventuated in RT transport information delivered to customers smartphones in late 2012. The official start in the eyes of the public was at the launch of the call for developers to attend the October 2012 Hothouse. However, commitment of Transport for NSW to the RT applications in late 2012 was not the first iteration of transport applications, as many had been on the Sydney market since 2006 with the arrival of the Iphone. The problem definition was partly the role of application developers, customers, exemplary overseas cases, when finally Transport for NSW took complete ownership of the RT project in 2012.

...I think it is an example of where a really good idea has benefitted both parties... It has really benefitted the customer, it has given us an opportunity to get closer to the customer via our application developers, it's also connected us with people that are third party partners, that are really enthusiastic about what we are doing as well as what they are doing, and how it provides this benefit to the customer so I think just a very good idea not doing it yourself. Transport Project Manager

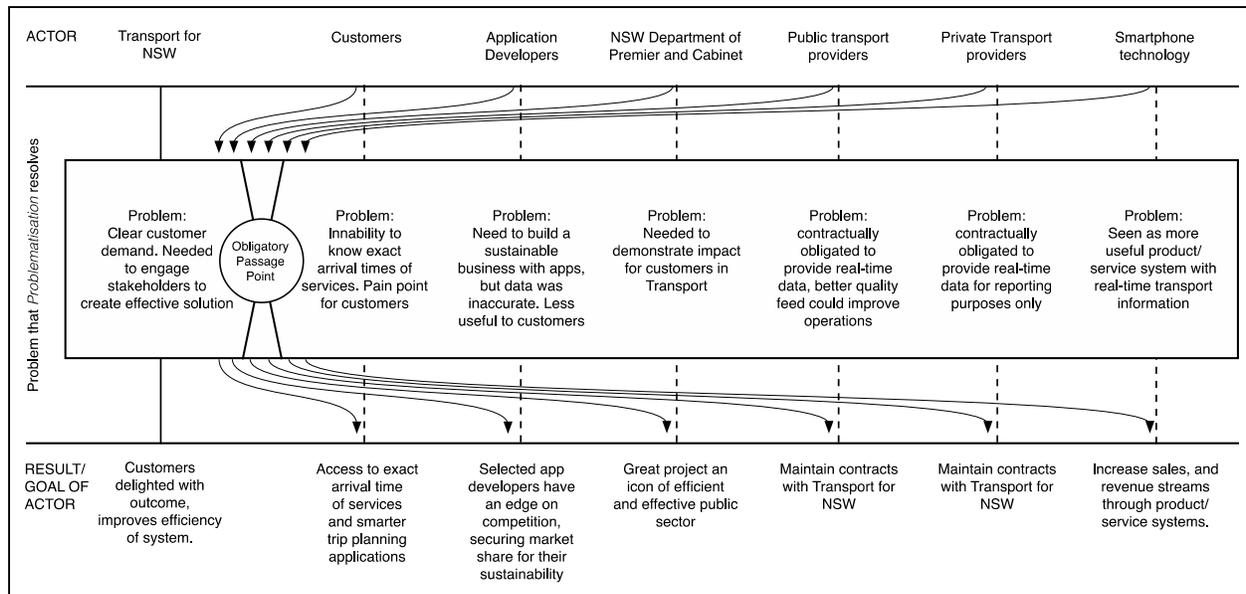


Figure 3. *Problematisation* and the Obligatory Passage Point (OPP) of the RT project, 2012. Adapted from (Callon 1986; Gunawong & Gao, 2010)

In each of the phases of Translation, six actors are discussed. These are customers, application developers, NSW Department of Premier and Cabinet, public transport providers, private transport providers and smartphone technology. These are not a complete list of actors but a useful summation of the varying perspectives involved in the project. In Transport for NSW's *Problematisation*, this summary outlines what each role was in the definition of the problem.

1.1 Customers

Sydney's population is 4.7 million, taking over 2 million trips on public transport daily (Transport for NSW 2014). Between 2006-2012, some applications had already established themselves with a substantial customer base, clearly demonstrating the demand from the customer perspective. In addition to these internal customer research reports of Transport for NSW, knowing when services were going to arrive emerged as a principal concern.

...I had Tripview downloaded on my phone...So we thought there was a possibility where we could deliver the same service to the customer, not by the government owning the solution but by working with those guys, so that is how we approached it at the time, and that's how we tried to take transport through that journey. Consultant

Transport for NSW's customer research had evidenced RT information for customers as a strategic imperative.

1.2 Application developers

The application developers already acknowledged the problem, and as such had developed applications to profit from the customer need, doing what they could with the government's previously uncooperative approach to data provision. Some, such as Nick Maher with the Tripview application had started developing applications as early as 2006.

It started off as just a side project I built a little app, not even for smartphones you know, sort of, this was back in 2006, I got a Sony-Ericsson phone and you know you could do basic java programming on it, and I thought it would be fun to get the Cityrail timetable onto it, and so I had a little replica of the blue indicator screens that you can see. Nick Maher, Application developer

Applications such as Tripview were so popular with customers that Transport for NSW needed to include them in their approach to have a better chance of success. In an earlier attempt, Applications for NSW, a State government run initiative in 2009, gave some developers access to the bus RT feed over a weekend, yet two weeks later cut the feed off, interviewees speculated it was because the data was not at a good enough level of quality.

It took [an application developer] 1½ days to create an application about Sydney Buses that people wanted to use. It took the government two weeks to close it down. (Saulwick 2011)

Transport for NSW knew they had to engage with these developers as their applications were well established with more than one million users at the time. If Transport for NSW had opted to design their own application would mean that they would have to compete against these applications.

1.3 NSW Department of Premier and Cabinet

The new Liberal NSW Government was supportive of projects that would quickly benefit the customer, original proposals for RT information had been approached as internal IT projects that had been forecast for completion over the subsequent five years. Ongoing briefings by the Transport for NSW team had established support for the project at the Ministerial level.

1.4 Public Transport Providers

Public transport acknowledged the need for the service regarding customer experience outcomes, but also from an efficiency perspective. With the ability of customers to look at their phones for transport information, that would create less reliance on staff on platforms to explain where services are, and expenditure on other display monitors built into stations. This focus on smartphone information a dramatically different perspective to that held in 2009, where RailCorp (now Sydney Trains), threatened to sue four application developers, for 'scraping' timetable information on their website. It marked a shift in their perspective on control of information, moving towards a more customer centric approach to information service delivery.

Actually [using smartphones instead of fixed screens] would save us a lot of money and open up opportunities for a better level of service, so the phones themselves give us an interactive canvas we almost can never have with our fixed infrastructure even on the trains or the stations, they are lowest common denominator devices by definition. Transport Information service manager

1.5 Private Transport Providers

Ferry and Light Rail services in Sydney are privately operated. Private contractors also service the majority of the 15 bus contract regions in Sydney metropolitan area. These private bus operators were contractually bound to supply RT data, however, generally only for reporting, and in many areas of the network this was incomplete data. Projects are in place to improve the quality of this overall. The Ferries and Light Rail were not contractually bound to provide data at all, and thus were left for later negotiations in a third phase of the project after the rest of the system been activated.

1.6 Smartphone technology

Smartphone technology is intrinsically linked to the customer, as this is the interface by which customers view the information. However, the technology can be recognised an actor in itself, as without it, the system would not exist at all. Thus, all the applications have to function on the dominant platforms, in Apple iOS, Android, and Windows phone and blackberry. The applications to reach the customer must be placed on the respective application stores, such as the Apple Application Store, Google play and the windows store. Capabilities regarding download speeds are linked to the mobile data network. The smartphone is ultimately the interface between the customer and the developer. Applications would have to comply with all constraints of these platforms.

2. Second moment of Translation: Interressement (late 2012-late 2014)

Interressement is the moment of *Translation* where the actors in the network accept the definition of the focal actor (Callon 1986), in this case Transport for NSW. There were compelling reasons for most of the actors to accept Transport for NSW's definition of the problem.

2.1 Customers

Customers, by proxy, accepted the definition made by Transport for NSW, like the apps, many of which would automatically update with the new features. The real *Interressement* of customers came at the point of launch to market, at which point, marketing and media coverage played the role of interesting customers in the applications. This approach was proven to be successful in many cities around the world, so customer interest for Transport's definition was clear years before it was rolled out.

2.2 Application developers

Accepting the definition was the point at which the application developers enrolled in the Application Hothouse in October 2012 for bus data, and February 2013 for train data. Only a few teams were accepted to attend the hothouse. The selection criteria were pre-determined, under four themes, of customer experience outcomes, business viability, technical feasibility and proven application development capability. These criteria were developed in conjunction with partnering consultancy PriceWaterhouseCoopers (PwC). Thus to be selected, the application developers had to accept the *Problematization* of Transport for NSW.

Yeah so that I mean all that sort of happened at the end of 2012, I just got an email ...saying there is going to be an application hothouse in October or whatever that was in 2012, and you are invited to apply to come along.. Nick Maher, Application developer

2.3 NSW Department of Premier and Cabinet

The Minister's office became interested in the project when a team inside Transport for NSW, had found the capability to develop the applications in-house, this was taken to the GM. Who then in turn involved the Minister for Transport, Gladys Berjiklian. The project aligned well with the objectives of the newly formed government, and broader open data policy.

2.4 Public Transport Providers

The public transport providers were required to provide more accurate data as a result of the *Problematization* of Transport for NSW. The public transport providers, Sydney Buses and Sydney Trains were the first data feeds to be proposed to provide to the application developers. As these organisations were newly formed subsidiaries of Transport for NSW. There was an unquestionable mandate from within their organisation, and Transport Minister's Office, which allowed for resource allocation to the project, unprecedented access to decision-makers, which resulted in the aggressive deadlines for delivering the applications to be met.

2.5 Private Transport Providers

Private transport providers accepted the definition of the problem in a staged way. Transport opted to roll out part of the bus network, those areas operated by the public operator, the State Transport Authority (STA). The GPS tracking systems on the buses, which are operated by both the Sydney Buses part of State Transit Authority (STA), and nine third party private providers, such as Busabout, Busways, and Hillsbus. Third parties, also operate Sydney Ferries the Light Rail from Central to Dulwich Hill. Ferries and Light Rail were added in a later phase.

2.6 Smartphone technology

Smart phone technology was unquestionably enrolled in the Actor-network as this was the decided technological platform to act as the communication channel to customers.

3. Third moment of Translation: Enrolment (late 2012-early 2013)

Callon (1986, p. 8) describes *Enrolment* as 'how the allies are locked into place'. At this point the identified actors, can either enrol, or refuse to be part of the actor-network. It is at this third moment of *Translation* Transport for NSW sought to impose and stabilise the identity of other actors.

3.1 Customers

Customers became enrolled in the system, mostly automatically. If they had the application when the RT data was added, they were already enrolled. The media and ministerial announcements did the marketing to those who were unaware of the apps. Word of mouth played a critical role in spreading the reach of the applications.

3.2 Application developers

To maintain their position, the winning application developers had to sign contracts, which stabilised Transport for NSW and the application developers as a network. These contracts stipulated how in what ways the data could be displayed, and that Transport for NSW could remove access if this were breached. The application developers own their applications, and can generate revenue how they see fit. It was encouraged that the developers offer a free version of the applications to cater for some sections of the market.

3.3 NSW Department of Premier and Cabinet

The Minister's office were committed at the time that they set the launch date and agreed to support the process. There was little time to change their mind as the applications were launched within two months of the hothouse.

3.4 Public Transport Providers

Public transport service providers were enrolled by proxy, being part of the NSW government 'Transport Cluster'. They were already contractually obligated to provide the data, and could understand the planning and customer service benefits of having a reliable source of information about the network operations.

3.5 Private Transport Providers

In 1985, saw the development of Public transport information and priority system (PTIPS). The Department of Main Roads, which later became the Roads and Traffic Authority and now RMS, placed GPS devices on buses for both traffic signal priority and monitoring of bus activity for contracting purposes. For the private bus contractors, this was the system used to gather the real-time vehicle locations. *Enrolment* of the private bus operators was staged by regions. Firstly different areas of the bus network were brought into the data feed through negotiated through from the bus network. In mid-2014, Ferry and Light Rail RT data was brought online after negotiations with contractors.

3.6 Smartphone technology

Smartphones were enrolled in the system by the initial nature of the proposal and was always assumed to be the interface over which the information would be delivered to customers. Enrolment did happen at the point of uploading the applications to the relevant application stores; at which point the Application vendors became the principle marketing device for the applications. Through which customers made decisions on which application they would use. Application developers must manage feedback on their applications to avoid receiving a poor feedback on the application store. In this case, many developers manage this by being able to give feedback within the application, rather than doing so through the store feedback mechanisms.

4. The fourth moment of Translation: Mobilisation (early 2013-late 2013)

Mobilisation is where an actor that speaks on behalf of (or stands in for) other actors (Callon 1986; Walsham & Sahay, 1999). The Minister for Transport and the Deputy Director General of Customer

Experience publicly speak on behalf of the project and are the dominant voice. All media releases are from the Minister's office, or updates to the Transport for NSW website that runs through the media department. The RT applications have, in the case of the application developers, Nick Maher the designer of Tripview, quite often is the one represented in the media. The Application stores, such as the Apple App Store, Google Play, and the Windows store act as a representative of the applications, being the point of sale through which all application downloads take place. Established communication channels have been set up through, monthly meetings in which the application developers come to Transport for NSW and discuss what is coming up in terms of new data being released and have the opportunity to feed back information to Transport about customer feedback, from black, or unreliable spots on the transport network, where data is not being received, and it should be. Representatives from the Transport for NSW, Information technology and information services, are present, as well as key representatives from the contractors or Sydney trains.

Additional ANT Concepts exhibited in this case

Inscription

Inscription is the creation of artifacts that would ensure the protection of certain interests (Latour 1992). In this case, the creation of the hothouse, and subsequent contracts and relationships with Application developers ensures that the interests of Transport for NSW are protected. Breach of these codes would be betrayal that could see their access blocked. Even the applications themselves, solidify the relationships between customers, the application developers and transport. The infrastructure that manages the data collection throughout the organisation and outside of the firewall ensures the one-way distribution of data.

Irreversibility

Irreversibility is the "Degree to which it is subsequently impossible to go back to a point where alternative possibilities exist" (Walsham & Sahay, 1999, p. 42). Several aspects of this network are now Irreversible regarding the actor-network. Now, for example, if data is opened up to a broader range of developers, those existing in the market have huge advantage due to their existing market and brand awareness. The commitment to data standards such as General Transit Feed Specification (GTFS), would make implications of alternative modes of data cost inhibitive.

Discussion / Evaluation

Networks are often treated as self-evident. This case demonstrates the importance of understanding and aligning purpose and intent across stakeholders to form a stable network. A shortfall of ANT as exhibited in this case is the inability to draw strong conclusions from the narrative of the network. However, what is clear is the complex and interconnected nature of 'the project' of technology implementation to its pragmatic context. The activity as discussed rolled out over multiple years and there was no master plan for the duration of activity. This pragmatic understanding of innovation as an emergent and complex responsive process is discussed in both innovation and strategy literature (Chia & Holt, 2009; Fonseca 2002). A limitation of this study ties back to one of the criticisms of ANT as mentioned earlier is its amoral stance (Walsham 1997). As exhibited in this case, there is little space for sociological discussions of inclusion and social outcomes of this approach. The inclusion of many stakeholders at the moments of Translation is by proxy, particularly as evidenced by the customer as actor. Where both application developers and the focal actor, Transport for NSW speak on their behalf. Effectiveness of an Actor-network is measured by stability, in this case, has remained relatively stable over since 2013. The question remains of whether the data should be opened up and what benefit that could bring. This would be at the risk of upsetting the stability of the existing actor-network. Network persistence is the repetition of interactions between participants, which, in this case, are well ingrained between stakeholders.

Conclusion

As public sector organisations are under more pressure to cut costs while delivering improved services, the ability to partner, and find opportunities for third parties to capitalise is important. However, it is crucial not to undermine the quality of service, or increase risk of the organisations involved, it is an act of balance between all problematized actors. This case demonstrated an approach that worked well in the

context of Sydney. However, from this deconstruction it is clear that many other factors handled the success of the project, not just an idea from Transport for NSW. For other cities transport organisations, or more broadly public sector organisations to take such an approach the value of using an ANT view of the context. The role of the public sector in an increasingly neo-liberal society is to deliver the services that the private sector will not, and thus, as service provision can be segmented, as in this case, aspects of the customer information systems, to be provided by other parties, while the transport services are still delivered by the transport providers. Transport for NSW established itself as the focal actor, and thus creating some control over elements in the network that it previously had no access to. For other organisations wishing to replicate such modes, this case is testament to the micro-practices of emergent innovation that as in this case, were some eight years in the making and took a unique confluence of actors in the actor-network to modify their activity as they faced challenges in an emergent way.

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