How Digital is Disrupting Transportation and Economies

Author: Brad Davies - Vector Consulting
Context for report

Cisco developed this paper to create a starting point for discussions about the digitisation of transportation, and its downstream impact on cities, regions and economies. The report comprises a range of inputs, including discussions with global experts such as those who attended the Intelligent Transport Systems World Congress in October 2016, as well as contemporary research and insights.

Cisco is a global technology company focused on helping organisations prepare for and respond to the impact of digital technologies. By investing in thought leadership, Cisco intends to contribute to the debate and potential solutions, rather than being a passive observer.
Purpose of this report

Governments, institutions and companies are experiencing immense disruption. Business and engagement models are being transformed by rising citizen and customer expectations, and fueled by mass connectivity. The transportation sector is poised to move from ‘human scale’ to ‘machine scale’, creating a wave of innovation propelled by the ability of humans to connect to machines, or for machines to connect with other machines. The transportation industry is projected to experience more change than most sectors, in large part because it offers solutions to some of the world’s most acute challenges: environmental sustainability and rapid urbanisation.

Digital transportation solutions are forecast to improve safety, energy and operational efficiency, and performance in mass transit, rail, freight and logistics, aviation and road transit.

The purpose of this report is to investigate emerging trends in transportation. It is intended to stimulate thought, provoke discussion and raise awareness of the opportunities presented by digital and how to capitalise on those opportunities. The report concludes with the role of digital infrastructure in creating a robust, secure and future-proofed platform for innovation.

Digital is disrupting business models, processes and engagement in transportation

Cisco recently interviewed¹ 1000 global business leaders from 12 industries to better understand the potential effects of, and preparedness for, digital disruption. The research concluded that roughly four of today’s top 10 incumbents (in terms of market share) in each industry would be displaced by digital disruption in the next five years. One sector in the midst of acute disruption is transportation, which broadly encompasses mass transit, rail, roadways, aviation, freight and logistics, and private/public vehicles. Intelligent transportation systems (ITS) describes the range of technologies that capture, manage and use data to improve the safety, efficiency and performance of transportation networks.²³⁴ ITS – and the transportation sector – is economically important for two primary reasons:

1. It is a significant employer and economic driver in its own right.
2. It is an enabler of mobility, efficiency and livability that underpins cities and regions.

³ http://documents4sharing.itsa.wikispaces.net/file/view/What+is+ITS.pdf
What’s driving the focus on mass transit?

Digital is disrupting business models, processes and engagement in transportation

The digitisation of transportation—particularly mass transit—is creating opportunities and risk for regulators, asset owners, transit operators, funders and users. Several issues have come into sharper focus, which has elevated the importance of mass transit:

**Increased traffic congestion**

Urban traffic is forecast to increase by 2% per annum, lifting Australian congestion costs from $16.5B in 2015 to $37B by 2030. More than a third of that cost—about $6B billion—will be paid directly by individuals to get from home to work, education and services. Australians spend an average of 85 minutes a day trying to get around our capital cities. The situation is similar overseas; in Denmark it is estimated that 10 million hours are wasted per year on motorways around the Copenhagen district.

**Focus on environmental sustainability**

Approximately 80% of CO2 emissions are caused by vehicles. Copenhagen—one of the most environmentally active cities in the world—estimates that 30% of the city’s traffic congestion (and carbon emissions) is due to people looking for a car park.

**The high-cost, long-term payback and poor rate of return of new road construction**

Figure 1 summarises a McKinsey study comparing the rate of return from ITS with investments in traditional infrastructure and road-widening projects. Investment in optimisation of traffic signals produced a 20-fold greater rate of return than investment in traditional road construction.

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**Figure 1: Average benefit-to-cost ratio for ITS investment compared with traditional road capacity**

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5 Department of Infrastructure and Regional Development, Bureau of Infrastructure, Transport and Regional Economics 2015, Traffic and congestion cost trends for Australian capital cities, Commonwealth of Australia.


7 https://www.weforum.org/agenda/2015/03/why-our-cities-need-smart-transport/

8 McKinsey Global Institute, Infrastructure productivity: How to save $1 trillion a year 2013
An unreasonably high proportion of private vehicle users

Private vehicles account for 87% of passenger trips in Australia, which many consider unreasonably high. By actively encouraging citizens to move to more efficient and sustainable modes of transport, government has the potential to delay investment in road infrastructure and potentially avoid it altogether. Consider that up to two-thirds of road infrastructure is taken up by the gap that is left between vehicles. In an autonomous vehicle environment, where vehicles will ‘talk’ to each other (vehicle to vehicle or V2V) and to the surrounding infrastructure (vehicle to infrastructure or V2I), the gap may be reduced to centimetres, not metres, freeing up valuable capacity and potentially eliminating the need for additional road infrastructure. The need for an infrastructure to support connected roadways is clearly needed to support V2I as a priority.

Digital investment decisions in mass transit are being driven by three priorities

Three priorities underpin the business case for investment in digitisation of mass transit: safety, efficiency, and passenger experience. Figure 2 identifies critical metrics that drive government and operator investment decisions, and opportunities to realise benefits from digital.

![Figure 2: Drivers of value in mass transit where digital has a potential role to play](image)

The challenge in mass transit is achieving all three of these imperatives (safety, efficiency, and the passenger experience) simultaneously. New digital platforms represent the only lever with the potential to do so, recognising that low-hanging fruit efficiencies have already been picked.

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9 Department of Infrastructure and Regional Development, Bureau of Infrastructure, Transport and Regional Economics 2015, Traffic and congestion cost trends for Australian capital cities, Commonwealth of Australia.
Investment in digital is being driven by the same three factors

1. Efficiency: Driving efficient operations and optimised infrastructure

There are three critical issues related to efficiency where digital has a role to play:

   a) improving infrastructure utilisation and capacity management;
   b) reducing the cost of service delivery; and
   c) improving service availability and punctuality.

Capacity/availability issues have traditionally been tackled through capital investment in physical and human infrastructure: more rolling stock/vehicles, more operators and shorter regular refresh cycles. ITS offers better leverage to deliver greater efficiency across existing assets. Examples of where digital offers efficiency include:

Next generation signaling

Conventional signaling wastes capacity because it is based on the block system, the principle of rigid geographical separation between trains established more than a century ago. This approach also requires costly trackside infrastructure. Advanced main line signaling allows operators to safely run trains closer together and permits higher speeds. This technology creates shorter ‘blocks’ using a continuous flow of signaling information direct to a screen in the driver’s cab. The next generation of signaling technology does not map trains to fixed physical points on the network, only other trains, creating even higher efficiencies.

Remote and predictive asset management

Better asset visibility is critical to efficient operations. Remote monitoring of critical assets such as points, point heaters, signaling power supplies and track circuits helps prevent in-service failures. While many mass transit operators have this technology, predictive asset management is emerging to identify asset risks before they fail. By using historic behaviour patterns and big data technologies, such as predictive analytics and modelling, operators are able to identify risk patterns and intervene in a more targeted way.

Benefits accrue to:

- **Citizens:** Access to real-time data can improve travel connections.
- **Government:** Gets a more efficient network, which frees up capital for other essential services or reinvestment into higher ROI activities such as ITS.
- **Operators:** Able to increase utilisation, minimise downtime, delay or avoid capital investment and increase profits including through use of new business models.
2. Safety and security: Improving passenger safety and risk management

The primary responsibility of any transit operator is to move passengers safely and securely. Efficiency and customer experience are secondary considerations. While the track record of Australian transit systems is excellent by global standards, the perception and reality of passenger safety and security are critical issues. Key safety metrics range from avoiding catastrophic incidents to minimising attacks on people (passengers and staff) and property. Protection of amenity and safety now extends to the cyber environment. Examples of digital’s impact on safety include:

Automated incident response
The deployment of sensors, intelligent IP video infrastructure and analytics tools is enabling operators to identify incidents in real time (e.g. algorithms that detect interactions outside of normal parameters) and automated responses. Singapore MRT is developing analytics to study sensor data (such as faults and breakdowns), and mobile phone, video and ticket data for a better response to situations.

Threat detection and monitoring
Using live video feeds and analytics, several transit operators have been able to automate intrusion detection, perimeter defence, camera tampering, loitering detection, tripwire counting and automated incident response.

Benefits accrue to:
- Citizens: Improved safety, greater confidence in public transport safety, rapid responses to issues and harm minimised.
- Government: Greater confidence in a taxpayer-funded transport system, increased patronage and economies of scale.
- Operators: Improved response times and better situational awareness, commuter safety and reduced costs associated with damage, compensation and reputational damage.

3. Engagement: Improving the passenger experience

Two issues are driving investment in engagement: a) a positive experience drives patronage; and b) political imperatives. Public transit operators are faced with difficult choices, including whether to invest before or after demand has been created. Investing after means overcrowding is inevitable, along with longer travel times, lower satisfaction and reduced punctuality. Examples where digital platforms have been used to improve passenger engagement include:
Reducing ‘friction costs’ for passengers

MTA smart ticketing will be introduced to the New York subway. The ticketing system supports Apple Pay and MasterCard (via the MasterPass app) to allow fast, cashless transactions at stations. Passengers use their smartphones to generate tickets – eliminating the need to queue.\(^\text{10}\)

Journey planning

The Go LA app captures all forms of transportation options, such as mass transit, taxis, car-sharing and private transport, and calculates the fastest, cheapest or most sustainable way to get to your destination.\(^\text{11}\) The ability to book services, measure environmental impact and integrate public and private transport make this a true multi-modal planning app.

Smart stations

Indian Railways collaborated with the Ministry of Urban Development to ensure designated smart cities in India also have ‘smart railway stations’. Railway stations and surrounding areas will be redeveloped with an aim to providing easy access to stations, better passenger amenities and optimal utilisation of land at railway stations.

Real-time updates on arrivals and passenger load

Up to 70% of a passenger’s journey time is spent waiting for a scheduled service to arrive, then depart.\(^\text{12}\) Passengers increasingly expect real-time information about services, rather than relying on published schedules. In the Netherlands, data is also provided to passengers on train platforms about individual carriages. An Intelligent Platform Bar, an LED screen along the length of the platform, tells travelers in real time the location of the doors, first and second-class cars, and bicycle and wheelchair access in the train they are waiting for. This enables passengers to be in the right place to board safely and quickly. Implementation has begun at three stations: Schiphol Airport, Amsterdam Zuid, and Utrecht Central. This approach could be beneficial in an Australian context when one considers that research by Public Transport Victoria (PTV) showed some passengers travelled in carriages almost twice as crowded as others on the same train. An additional benefit of spreading passenger load evenly is that doors, seats and other equipment wear at similar rates.

Benefits accrue to:

- **Citizens**: Higher satisfaction, greater flexibility and control over their journey.
- **Government**: Increased political capital.
- **Operators**: More informed passengers, reduced costs associated with grievances and capacity to develop richer profiles of passengers, greater capacity to meet schedule targets and make real-time updates to schedules as situations dictate.

\(^\text{10}\) [http://www.smartrailworld.com/mta-finally-deliver-the-news-that-all-smartphone-users-have-been-waiting-for](http://www.smartrailworld.com/mta-finally-deliver-the-news-that-all-smartphone-users-have-been-waiting-for)

\(^\text{11}\) [http://golaapp.com/](http://golaapp.com/)

\(^\text{12}\) McKinsey & Company 2015, The Internet of Things: Mapping the value beyond the hype
**Case study: Using data from tram infrastructure to improve passenger experience**

*A partnership between Public Transport Victoria (PTV), Yarra Trams and Cisco*

PTV is testing a new analytics system on Melbourne’s Yarra Trams to automatically count the number of people riding trams and waiting at tram stops. The trial between PTV, Keolis Downer and Cisco not only counts passengers, it also assesses their gender and age range. The trial is helping PTV:

1. Understand the demographic profile of riders.
2. Calculate average journey times (by segment).
3. Understand utilisation of the tram network.

De-identified data is captured from cameras installed on trams and tram stops and offers the ability to inform decisions about timetabling, passenger experience and myriad other issues. Collected data can also inform passengers at tram stops how busy the tram is, not just arrival time.

The trial is part of PTV’s broader strategy to provide real-time, relevant information to passengers at the point of decision. PTV CEO Jeroen Weimar said mass transit providers had a responsibility to passengers to use available technology to improve their experience. “People don’t want to look up timetables any more, they want to know when the next service will arrive and whether it is worth waiting for,” he said. Data from digital platforms also offered the potential to drive efficiencies, which taxpayers expected PTV to do.

PTV CIO Sendur Kathir said the trial highlighted the desire to find new ways to efficiently collect accurate data, rather than focusing on the user application. PTV was increasingly looking to make its data available to developers and others, realising that innovators will find creative applications for compelling datasets.

“Our job is less about developing the coolest app and more about ensuring we get accurate data to those that can leverage it. The only exception is if we see the app building customer intimacy,” he said.

PTV’s investment mirrors interest from other transit operators, particularly in Europe. As an example, buses in some European countries are being referred to as ‘porcupines’ given the number of antennae and sensors capturing information, from temperature and location to velocity. It’s not just the capture of data that is done locally, the ‘compute’ is also done locally so that demands on the network can be minimised.
Digitisation in the broader transportation sector

Innovation and digitisation are occurring outside of mass transit. The 2016 ITS World Congress provided a snapshot of major trends, particularly in autonomous vehicles, and smart freight and logistics.

**Autonomous vehicles**

*Major conversation topics:*

- *Transition to autonomous vehicles:* The move will be gradual with automation incrementally added (e.g. cruise control, automatic parking, driver over-rides in accident situations).

- *Potential move away from citizens owning vehicles:* Young people are moving away from car ownership towards ride sharing. The proportion of 16-24 year olds in the US with a driver’s licence dropped from 76% in 2000 to 71% in 2013, while car-sharing membership has grown by more than 30% a year in North America and Germany over the past five years.\(^{13}\) Vehicle autonomy is forecast to make mobility as a service even more prevalent and attractive.

- *Disruption to adjacent industries:* Car insurance will decline significantly and even the construction industry will be forced to change. Construction peak body prefabAUS is considering how houses will be redesigned so spaces can be adapted when people no longer need a garage.

- *Vehicle connectivity is now a basic customer expectation:* 13% wouldn’t buy a car without connectivity\(^{14}\) and 37% of customers would switch to another manufacturer if it were the only one offering full access to applications, data and media.\(^{15}\)

- *Fully autonomous vehicles will be deployed first in highly controlled and low-speed environments:* Testing and development has commenced to allow drivers to ‘valet’ their vehicles in car parks. The car park and test vehicles are equipped with networked sensors that allow cars to be parked autonomously. Investment is justified by fact that a high proportion of accidents (up to 30%) occur while vehicles are being parked.

- *‘Fake cities’ are emerging to experiment with new technologies and policy:* Examples include Mcity in Michigan, Willow Run (Michigan) and RELLIS (Texas), which are being used as test environments. GoMentum Station (California) will take testing to another level, allowing hundreds of vehicles to be tested at higher speeds. These include next generation public buses for the elderly, or those with disabilities, rather than private vehicles only.

\(^{13}\) http://www.mckinsey.com/industries/high-tech/our-insights/disruptive-trends-that-will-transform-the-auto-industry


\(^{15}\) McKinsey & Company 2015, Competing for the connected customer – perspectives on the opportunities created by car connectivity and automation
Questions governments are grappling with:

- What incentives will drive people to the mode of transport that’s best for the city (financially and environmentally)?
- How to share costs, data and infrastructure between government areas?
- How to more effectively scenario-plan in the wake of digital disruption?
- What are the implications for future road infrastructure decisions?
- What are the appropriate standards and policy frameworks?

Freight and logistics

Major conversation topics:

- Double-sided market platforms are emerging in the freight industry: The decision by Uber (defined as a double-sided market platform because passengers and drivers have the capacity to find each other) to create a freight and logistics arm is a sign of what is to come. Uber freight – and competitors that follow – have the potential to radically increase performance and price pressure on operators and redefine user platforms.

- Australia is considered a global leader in trialing ‘truck platooning’: This comprises trucks equipped with state-of-the-art driving support systems, closely following one another and mutually communicating. Platooning can improve traffic safety, reduce fuel consumption and emissions, and improve traffic flow. The short distance between vehicles also means less space taken up on the road.

Questions governments are grappling with:

- How to support safe trials and innovation?
- How to regulate and tax disruptive players?
- How to create incentives for operators to adopt efficiency measures?
- How to reassure citizens about safety?

Profile of a contemporary transportation environment

Governments, owners and operators understand that smart transportation is underpinned by appropriate physical, organisational and human infrastructure. The profile of a robust environment tends to be underpinned by three elements:

1. Digital Capabilities
2. Data Capabilities
3. Secure Digital Ready Network Foundation
Digital Capabilities
Data or technology does not create value of itself. Organisations are increasingly realising that their capacity to extract value from digital is directly linked to their maturity and competency in the following areas:

- **Capacity to deliver a personalised customer experience**: one of the benefits of digital channels is the capacity it offers to efficiently deliver bespoke services at scale. A good example is static timetabling information. In an immature digital environment, all passengers get access to the same static content rather than getting access to data that is aware of the passenger’s own context and responds accordingly. Cisco works closely with organisations to identify ways to use its infrastructure to improve data quality and decision making.

- **Workforce innovation**: the digitization of the transportation sector is a continuous process, not a destination. Organisations wanting to capture benefits from digital invest in their people and culture. The most mature organisations treat innovation as a mainstream competency, not an island or ‘ghetto’. These organisations also ensure that work is, where possible, co-designed with users and industry partners. The uptake of digital collaboration technology is demonstration how organisations are finding new ways to communicate, share and collaborate to drive workforce innovation.

- **Optimized business operations**: the availability of discretionary capital and customer expectations are trending in opposite directions. Organisations are increasingly focused on optimizing business operations to free up capital for value-creating purposes (including customer experience and innovation). Cisco’s infrastructure is increasingly being used to capture data about the efficiency of systems (e.g. energy management, building utilization, traffic flow) and allowing organisations to respond to this data faster.

- **Risk management**: the term risk management tends to be associated with process risk (i.e. protecting systems and processes to mitigate against physical or commercial harm). In a digital context risk management increasingly applies to business and operating models, and digital-oriented organisations are continuously assessing how digital can be used as an offensive and defensive tool in ensuring their own sustainability.

Data Capabilities
The term digital is frequently used interchangeably with the word technology. However, its more obvious correlate is with the term ‘data’. A digital-enabled organization has the infrastructure in place to be able to capture, manage, analyse and monetise data. This data also needs to be secured. An organization with secure data capabilities is one that has:

- **High levels of connectivity and infrastructure availability**: digitally-enabled organisations use their underlying connectivity for uses other than their primary purpose. As an example, Wi-Fi infrastructure deployed for passenger connectivity can also be used to capture data about space utilization. Video surveillance infrastructure can also be used to capture data about passenger numbers, movement, dwell times and even mood.
• **Sophisticated data management and capacity to generate insight efficiently**: organisations need the capacity to securely and efficiently store data, process it and retrieve it (increasingly in private or hybrid cloud environments). The capacity to generate insight from data is a major focus for organisations, and Cisco now provides sophisticated data analytics and visualization functionality to ensure that data can be interpreted by those that can make more informed decisions on the basis of it.

• **High levels of data security and governance**: cyber resilience goes beyond an institution’s own systems – it involves monitoring entire supply chains and ensuring that a weakness in a supplier’s systems and data integrity cannot be used to back door into sensitive operational, commercial or passenger data.

**Secure Digital Ready Foundation**

Digital and Data capabilities need to begin with a secure and solid foundation and the network is responsible for bringing all these elements together to allow organisations to reach their full potential. A Digital Ready Network should be open, extensible and software-driven with the following key architectural components: Virtualisation, Automation, Analytics and Cloud.

**Conclusion**

Sophisticated, digital-oriented organisations recognise that they need a robust, scalable and secure Digital Network Architecture (DNA) if they are to realise benefits quickly and sustainably. However, in the scurry to get started on a digital agenda too many organisations are starting at the wrong place – with mobile apps. These organisations mistakenly believe that creating a slick app or set of apps will create momentum or build the support base for investment in digital more broadly.

What this approach fails to recognise is that digital strategy and implementation needs to be a whole-of-business priority, not a discrete item. While it is possible to achieve quick wins, any sustainable digital approach needs to be built on a robust network architecture, organisational digital capability and secure data capability. In many cases organisations already have much of this capability in place and the focus needs to be on extracting more value from existing infrastructure. In other cases, targeted investment may be required.

Cisco can help organisations identify where they are on the digital infrastructure spectrum, manage critical risks and most importantly help to identify ways to capture benefits quickly.