Thinks
Insight & Strategy

Connected Places Research: Thematic Report

Report prepared for the Department for Science, Innovation and Technology (DSIT)

Table of Contents

1. Introduction

1.1 Background and objectives

To support policy development, the Secure Connected Places Team within DSIT commissioned Thinks Insight & Strategy to conduct qualitative research with professionals in the higher education, rail, aviation, sports and culture sectors who are responsible for the procurement, deployment, and management of connected places technologies.

The objective of the research was to provide insight into approaches to connected places and cyber security, specifically:

- How do professionals in the target sectors understand connected places?
- What are the drivers and barriers to uptake of connected places technology?
- How, if at all, is connected places technology currently being deployed in target sector organisations?
- Are there any future trends for connected places technology in these sectors?
- What approaches are being taken to cyber security of connected places?
    - What, if anything, is the role of cyber security guidance within this?

This report forms an overarching analysis of Thinks' research across the whole sample. Further detail can be found in the three individual sector reports, for higher education, transport (rail and aviation combined) and culture and sports respectively.

1.2 Method and sample

Thinks first conducted a literature review, looking into existing connected places guidance for education, rail, aviation, sports and culture sector organisations, findings from which can be found in the appendix below. Thinks then conducted a total of 50 qualitative interviews with professionals working in these sectors. These interviews were 60 minutes long, and afterwards professionals also completed a 5-minute survey.

All interviewees were employed by either directly by their organisation or worked as a consultant. All had responsibility for at least one of the following:

- Designing and procuring connected places,
- Deploying and managing connected places,
- Cyber security associated with connected places.

Participation in the research was on an anonymous basis, but some example job titles of participants include: Chief Information Security Officer, Director of Estates, Head of IT, Head of Operations, and Head of Business Intelligence.

Greater detail on the method can be found in the technical report.

2. Typologies of organisation

The "places" that non-Local Authority sector organisations are responsible for are highly heterogeneous. The ways in which they differ include:

- **The size and complexity of the place.** This ranges from managing a single building (such as a museum), to several buildings (such as a university), to a building with several operators (e.g. an airport which 'houses' multiple airlines), to buildings and fleets (e.g. those in the rail sector who manage stations and trains).
- **Number of visitors / users:** Professionals within the sample range from being responsible for managing the flow of thousands of people each day (e.g. large airports), to sites which attract tens of visitors (e.g. a small, regional museum).
- **The extent to which their place interacts with the local area.** For example, professionals based at airports, universities and sports stadiums are more likely to note the importance of connecting with local transport infrastructure. This feels less relevant to smaller museums.

As a result, professionals' starting points for deploying connected places technology is highly variable, including within each sector.

- For example, whilst higher education institutions are a relatively homogenous group of organisations, there is a great deal of variation within the sports and culture and transport sectors.
- Detail on differences within sectors can be found in individual sector reports.

That said, the size of the organisation (regardless of the nature of their place) is often the key differentiator in relation to usage, awareness and understanding of connected places technology.

- **Larger organisations** which include most universities, airports, rail, but only a minority of sports and culture organisations in our sample tend to have dedicated team members to manage technology and/or their estate. This means they have greater awareness of the benefits of connected places technology and are deploying it to some extent within their organisation.
    - A minority of larger organisations are more pioneering when it comes to deploying connected places technology. They tend to be using the technology extensively and often have broader ambitions to create a joined up system.

- **Smaller organisations,** which are often in the sports and culture sector, do not have dedicated team members to manage their technology and/or estate. Instead, professionals tend to have expansive roles (e.g. CEO, Head of Operations) of which technology is a very small part. These professionals have low understanding of connected places technology and are only using it to a very limited extent within their organisation – often unknowingly.

3. Understanding of connected places

Across all sectors, the term 'connected place' isn't well recognised. Instead, some variation of 'smart' as a prefix is recognised, understood and used.

- The large majority of professionals use the word 'smart' in combination with terms which are specific to their sector, i.e., 'smart station' or 'smart campus' to describe connected places projects.
- A minority of organisations who are typically leading in their sector might use their own term to describe their connected place, for example, 'intelligent' campus or 'open' airport.

> *"We would tend to use 'smart campus' as the sectorial definition for this type of activity… 'Connected places' is a term I'm familiar with and something I've heard before but tends not to be used so much in the university sector."*
>
> Higher Education

Despite low awareness of the term 'connected places', there is high awareness of the types of things that the technology can do.

- Overall, most professionals understand how deploying technology to collect data could be used to improve decision-making about how their place is run.
- Understanding is highest amongst professionals in the higher education, sport and aviation sectors, which comprise organisations which are either larger or have deployed more connected places technology to date.

Consideration for DSIT:

- Consider adapting the language used to communicate with the non-Local Authority audience to better reflect what they recognise, use and understand. For example, talk about 'smart campuses' rather than 'connected places'.

4. Aims, barriers and facilitators to deploying connected places

The past few years have been challenging for <u>all</u> sectors interviewed. Consequently, there is a really strong focus for all organisations on financial security.

- The impact of closures during the COVID-19 pandemic and the cost of living and energy crises continue to have an impact on all organisations.
- This means organisations are focused on introducing measures or strategies which:
    - Save money on delivering their core purpose.
    - For private sector organisations, maximise revenue.

'Being connected' isn't an intrinsic aim for the majority of organisations. However, it can be seen as an important facilitator of financial security.

- Most organisations understand connected places technology as a means, rather than an end in itself. This is reflected in none of the organisations in our sample having a 'connected places strategy'.
- However, professionals do see the technology as an important element of broader strategies to decrease outgoings or maximise revenue, for example by:
    - Better managing their estate, such as using space and energy more efficiently.
    - Offering a better experience to customers / visitors / students, thereby increasing satisfaction.

"We don't have a specific connected places strategy, but we do have within our strategy a recognition of the need to integrate our digital and physical environments."

Higher Education

"If we were looking at adopting new approaches in this area it would be from an environmental standpoint and also a financial one. We'd be looking to reduce cost spent on utilities and we'd be looking to reduce [environmental] impact."

Culture

As a result of perceiving connected places technology primarily through the aim of financial security, organisations:

- **Do not view connected places technology as a distinct category of technology.** Instead, they perceive them as additional technological devices used to achieve or supplement business goals.
- **Tend not to have specialist staff working on projects internally** beyond the staff required to deliver their organisations' IT needs. The number and range of staff roles is correlated with the size of organisation.
- **Do not have a strong sense of the cumulative network effects,** which means they are often deploying connected projects in a piecemeal rather than strategic fashion.

The largest barriers to further deploying connected places technology are therefore a lack of knowledge and finances.

- Across sectors, a lack of skills and expertise internally is the primary barrier to further deploying connected places technology.
    - Organisations who have more extensively deployed the technology tend to have a member of staff responsible for doing so. They are able to advocate for projects internally.
    - On the other hand, organisations without a dedicated staff member lack awareness of what is 'out there' and often struggle to carve out time to investigate amongst their other responsibilities. This is particularly true for smaller organisations where professionals hold more expansive job roles, e.g. Head of Operations.
- Regardless of the level of knowledge, lack of funding is a significant barrier. This is again particularly true for smaller organisations.
    - This relates both to the outright cost of some connected places projects, but also the need to clearly demonstrate the financial value in order to get access to funding in the first place.
    - As well as working with larger budgets, the benefits (relative to cost) of using connected technology can be more obvious for larger organisations. For example, a small cultural venue might use personnel to count visitors, whereas larger stadiums, stations and airports have a greater need for technology to manage crowds, and they might invest in a network of crowd counting sensors or CCTV with AI overlay as a result.
    - In addition, professionals across sectors cite the cost of retrofitting connected technology as a barrier to implementation. This includes retrofitting older physical buildings which may be listed, as well as retrofitting legacy technology systems.

"Our scale of venue, we're not so much in a position to pilot that [connected places technology] particularly easily and we're a relatively small team. There are 14 of us... even discovering schemes that we might be able to get on, all of this takes time to research, all of this takes time to be able to have that meeting, find that person... we don't have a staff member on site who has a particular focus on that area."

Culture

"If we wanted to make our heating or air conditioning systems smart across the stadium, that's a big bet. Because quite often it's difficult to retrofit some of this technology, so quite often the smart element actually ends up being the smallest cost."

Sport

The biggest facilitators of connected places technology are the flipside of the barriers, namely: having the required expertise and financial resource.

- Organisations which can hire or upskill staff to have the requisite technical expertise to design and manage connected places, leads to greater awareness about the potential benefits of connected places. This in turn allows them to advocate for the projects more within their organisation.
- Secondly, organisations with greater financial resource are in a better position to trial new technology projects. This is more often larger organisations.
    - If connected places projects are able to demonstrate a benefit or clear link to other organisational priorities (e.g. growth or sustainability), this also acts as a facilitator of deployment.

"I think what will drive it again will come back to that student experience. It will be that pupils expect some of this and they'll see it in other areas of their lives and they'll wonder why they're not experiencing that on a university campus."

Higher Education

Outside of knowledge and resource, other factors influence deployment of connected places projects within sectors.

- For example, procurement is often a key barrier for rail and aviation organisations. Some professionals in these organisations feel

disincentivised by the length of time and amount of effort projects will take to be authorised.

"If it's a case of 'we can't build that ourselves', then going through the procurement measures to do it and making sure we follow all the right rules, there's a lot of red tape that slows it down. [...] I don't think it's a tech problem, I think it's a business problem."

Aviation

- Using the technology to be more sustainable as an organisation is a key facilitator in the culture and higher education sectors (albeit professionals note that saving energy *costs* is more important).

"Smarter campuses, what are they doing to reduce carbon footprint, sustainability? They [students] are clued up on everything, you know, 'They're doing great smart things for the environment, climate change,' etc. Yes, that's where students make their mind up and go to university, because it's a competitive market out there."

Higher Education

Consideration for DSIT:

- To promote further deployment of connected places technology, DSIT should demonstrate the benefits to organisations of doing so. Ideally, these should be as tailored as possible and focus on the financial benefits (both in terms of money saving and the potential to increase income) of deploying connected places technology.

5. Operating connected places

Professionals are aware of a range of technologies used within their organisation to deliver connected places projects. Across all sectors, these include:

Used more often	IoT – e.g., lighting, heating, air conditioning Occupancy/footfall monitoring (e.g., infrared sensors or tracking mobile data, people counting cameras) Sensors for heat, CO_2 or air quality monitoring Wi-Fi / 4G / 5G connectivity
Used less often	Bluetooth beacons Interactive screens / dashboards, digital signage Route mapping apps Cloud data storage AI (e.g., overlaying onto CCTV) Automatic number plate recognition
Used in sector specific cases	Remote condition monitoring for trains (Rail) Security machines at airports (Aviation)

Professionals across sectors focus on what the technology delivers, rather than specific devices.

- Professionals typically do not think about particular specifications until the procurement stage.

> *"I'm not a deep technology person and some people get obsessed with certain bits of technology and they think that everything's going to be IoT or everything's going to be artificial intelligence. In a way, I don't really care what the underlying technology is, I just want to know what business outcomes it's going to achieve."*
>
> Aviation

The majority of organisations have a standard process for procuring connected place projects. However it is focused on specific outcomes (e.g. counting the number of people in a room), rather than taking into broader network efforts of the technology (e.g. linking this data to other available data sources for broader decision-making).

- The majority of organisations – with the exception of small culture organisations – have a standard process for procuring new technology, which is felt to cover connected place projects. This typically includes assessing the risks and benefits, a tender process and a pilot stage.
    - Smaller culture organisations tend not to have a formal or competitive procurement process. They will often buy technology based on a recommendation or their own research.
- Professionals are typically assessing the risks and benefits of the projects based on their individual outcomes (e.g. how much energy will this project save?) rather than their potential of laddering up to an entire connected place.

"We look at the business case, then the funding mechanisms. Then it would be, 'we know who is good in this space, let's go out to tender' and then we'd go out through that formal tender process."

Rail

Consequently, connected place projects are deployed in isolation; very few currently ladder up to achieve a whole 'smart campus', for example.

- However, making their systems increasingly integrated and automated is a priority for some larger organisations, who have already deployed the constituent technologies to see the benefits of 'joining up' their operations moving forward.

Consideration for DSIT:

- Consider demonstrating the benefits of a joined up connected place to organisations. This should be coupled with advice about how to procure technology for connected places projects with this in mind.

Case studies:

Higher education

This university strives to be the most sustainable in the country, a goal which drives its implementation of connected places technologies. To achieve this, it employs:

- **Occupancy sensors,** combined with **smart heating and lighting** systems, to ensure that energy is used in its buildings only when necessary.
- **Smart timetabling,** to make the most efficient use of campus space and adapt to increasingly hybridised working patterns.

The university is also currently working towards **integrating its operations with local public transport systems** to make it easier for students to travel to and from the campus sustainably.

Rail

This rail provider views connected places technology as a means of **empowering staff,** to optimise their decision making and provide the best level of customer service possible. The technologies employed in the support of this are predominantly **sensors which provide data on station conditions** to support more dynamic staff deployment. They include:

- Sensors measuring **platform surface temperature** to guide gritting efforts in the winter.
- Sensors in toilets which provide up-to-date information as to **when cleaning is required.**
- **Occupancy sensors** measuring dwell time to flag any potential overcrowding or anti-social behaviour.

The primary barriers to the further implementation of connected places technologies are issues of **cost and data processing capacity.** There is a concern around front-loading implementation, for example by investing in sensors whilst lacking the capacity to process the data produced into an actionable form. Plans for a more coherent smart station strategy were also set back by the disruption to the industry caused by the COVID-19 pandemic.

Aviation

This airport has **extensive and sophisticated connected places technologies,** implemented with the aim of optimising their operations. This is achieved by **pulling data from devices across the airport into a central repository**, to be analysed holistically in support of the effective and efficient working of the **airport as a whole**. This is the case in terms of providing insights to support decision making, such as:

- **Monitoring footfall** across the airport to predict periods of high and low demand at points such as security and border control, and pre-emptively adjusting staffing levels accordingly.
- **The use of geolocation technology** to track equipment across the airport, minimising staff time spent finding it.
- **Turning off lighting and HVAC systems** at terminals not in use and automatically turning them back on when a plane is scheduled to arrive.

The key barriers to the further implementation of this technology have been the **difficulties of carrying out research and development** in a capital expenditure-heavy industry, and the significant **security and regulatory requirements** of employing these kinds of technologies within critical national infrastructure.

Sports

This large organisation regularly runs sports events for thousands of visitors at a time, and is driven to create the best experience possible for fans and consumers. They have introduced a connected places project that currently consists of two key technologies: equipping players with **GPS technology** (allowing fans and experts to analyse performance) and equipping the stadium with over 1,000 **wireless access points** so that fans, staff and journalists can be connected and post about their experience in real time.

With a dedicated technology and cyber security team, this organisation is aware of a range of opportunities afforded by connected places technology. In the near future, they plan to use **sensors to measure footfall**, prevent areas from overcrowding through **flexible pricing** at hospitality stalls, and to **regulate light and temperature**.

Culture

This small art gallery wants to measure footfall to find out the parts of their attraction which are most popular with visitors. Therefore, a former staff member contracted an external supplier to install and operate **people-counting cameras.** However, the absence of a digital strategy and expert staff made it difficult to effectively operate this technology when this person left the organisation.

A newly appointed staff member who is responsible for digital development is now assessing how this technology can be used effectively, by liaising with the supplier to interpret the data and translate it into actionable measures for the art gallery.

Still unsure how to best make use of the technology in place, the gallery is not planning on deploying additional connected places technology in the near future. Instead, it is currently working on a digital strategy to think about the current and future role of technology at their organisation, which will include connected place projects.

6. Future trends of connected places

Participants across sectors think that it is inevitable that the use of connected places technology will increase in the future.

- In part, this is due to the expectation that use of technology in general will increase over the next 5-10 years.
- However, professionals feel that increased connectivity (e.g. 5G) and building connected places by design (e.g. in new builds) will drive increased use of connected places technology specifically.

"5G technology will allow far easier deployment of these sensors because at the moment they need physical Wi-Fi networks or cabling. 5G will allow us to go for really cheap sensors that connect over the mobile networks."

Higher Education

"A new building will be put up and there'll be a consideration of smart as we do it… The expectation is that faculty by faculty we'll effectively move them out of old unsuitable estates, put them into new, smart, fit-for-purpose estates, and get rid of the old."

Higher Education

In line with knowledge barriers, organisations who are using the technology in a more limited way do not have a clear sense of how it will develop.

- Whilst expecting the use of technology to increase, these organisations struggle to give specific examples of potential future connected place projects. Instead, the barriers they face (lack of knowledge and funding) feel much more tangible and are often their main area of focus.
    - In particular for smaller organisations, generating additional data from connected places technology may not be beneficial if they do not have the staff to analyse it and use it for decision making.

On the other hand, organisations who are using the technology more extensively are able to picture future development.

- These – often larger – organisations aim to make systems more joined up, in order to produce increasingly intelligent, coordinated and automated systems.

"Hopefully, you can end up in situations where you have one biometric and it allows you to smile and get through, smile to go

in to the US, smile to leave the US and smile to get back into the UK, that's it. All taken care of."

Aviation

7. Cyber security and connected places

The level of perceived risk posed by connected places technology varies across organisations depending on their size.

- At a high level, organisations are aware of the main cyber security risks associated with connected places technology. Their primary concerns are hacking and data breaches, and the potential for rogue or unauthorised actors to access commercially sensitive information or to force operations to cease.
- Larger organisations who are either responsible for expansive spaces (e.g. stadiums) and/or large numbers of users (e.g. universities) perceive a greater level of risk due to:
    - Believing they are an appealing target for malevolent actors, therefore making an attack more likely.
    - The potential to pose a threat to the physical safety of users (e.g. by locking doors remotely).
- The impact on their reputation from a cyber-attack.

"The biggest risk there being if someone could get connection to signals. Ultimately you could put every signal on green and just allow every train to crash into each other."

Rail

- On the other hand, smaller organisations which are used by fewer users feel less under threat.

However, professionals do not feel connected places technology poses a materially different threat to other categories of technology within their organisation.

- Instead, they feel the connected places technology differs in degree rather than type of risk. In this context, professionals do not feel projects require a bespoke risk management approach.

In larger organisations there are clearer distinctions between those responsible for cyber security and those responsible for using connected places technology.

- Larger organisations across the sample have a dedicated in-house cyber and information security team that is responsible for overseeing the day-

to-day management of technologies, network security testing, and for assessing whether the commission of external expertise is necessary.

    - They are often responsible for building cyber security considerations into projects 'by design' at the procurement stage.

- This means that those who are responsible for designing or using projects feel a lower sense of *personal* responsibility for cyber security because it is 'someone else's job'.
- On the other hand, smaller organisations tend not to have staff who are solely responsible for cyber security.

> *"So we do quite a bit of internal training on that stuff as well. That's a mix of our internal security team and also external partners that they bring in sometimes to do various training on different areas. But it is quite segregated by tower. So most of us stick to our lane and it's generally a case of you bring in subject matter expert in whatever area to put together a service."*
>
> Rail

Consideration for DSIT:

- Perceptions of cyber security policy will likely hinge on the size of the organisation. For example, whilst smaller organisations without dedicated staff may benefit from training materials, this will likely feel less relevant to professionals at larger organisations.

8. Appendix – findings from the literature review on current connected place guidance

Existing cyber security guidance, across all sectors, tends not to refer to connected places specifically.

Instead, it tends to focus on the following 7 areas:

1. Understanding the organisations' aims and strategy
2. Understanding the cyber risks, threats and vulnerabilities
3. Where possible, deploying 'security by design'
4. Taking a proactive approach to risk management
5. Robust incident response planning
6. Establishing clear responsibilities and accountability throughout the organisation e.g. empowering all staff to have the correct skills to be secure
7. Managing the risk of supply chains

However, within these overarching documents there is little to no mention of connected places and the specific risks and management they require.

Instead guidance on connected places is contained within specific sources.

There is guidance related to connected places, including:

- NCSC's Connected Places Cyber Security Principles
- DSIT's Secure Connected Places Playbook
- NCSC's Cyber Security Best Practice for Smart Cities

Guidance within these sources echoes the 7 key areas of focus for cyber security outlined above. However, there are different points of emphasis when it comes to connected places. For example:

- Highlighting that connected places lead to an increased and more complex attack surface, which can mean poorer visibility over risks.
- Emphasising the importance of outlining roles and responsibilities as the network is wider.
- Emphasising the role of data management and protection (including handling data that does not fall under GDPR).
- The importance of supplier management.

However, there is no sector specific connected places guidance. Current guidance tends to focus *either* on sector specific cyber security *or* connected places, requiring organisations to 'join the dots'.

There is also little available research on connected places and the relevant sectors. Existing research tends to focus on supply side organisations or local authorities. Within most sources the sample of non-LA demand side organisations is low and therefore any findings are indicative.

Literature review source list (links to these sources can be found in the technical report)

Source no.	Article/report name	Author/client organisation
1	Meeting digital and technology standards in schools and colleges	Department for Education
2	Aviation Cyber Security Strategy	Department for Transport
3	Secure Connected Places Playbook	Department for Science, Innovation and Technology
4	Governance in a box (from Playbook)	Department for Science, Innovation and Technology
5	Procurement and supply chain management (from Playbook)	Department for Science, Innovation and Technology
6	Conducting a STRIDE-based threat analysis (from Playbook)	Department for Science, Innovation and Technology
7	Connected Places Cyber Security Principles	National Cyber Security Centre
8	Secure connected places (smart cities) guidance collection	Department for Science, Innovation and Technology
9	Surveying UK connected places	Department for Science, Innovation and Technology / Department for Culture, Media and Sport
10	Cyber Essentials scheme: overview	Department for Science, Innovation and Technology / Department for Culture, Media and Sport
11	Cyber security guidance for business	Department for Science, Innovation and Technology / Department for Culture, Media and Sport
12	UK Safety Tech Sector: 2023 analysis	Department for Science, Innovation and Technology / Department for Culture, Media and Sport

13	The Connected Places Market in the UK 2022	Department for Science, Innovation and Technology / Department for Culture, Media and Sport
14	National Cyber Strategy 2022	HM Government
15	The Cyber Threat to Sports Organisations	National Cyber Security Centre
16	Cybersecurity Best Practices for Smart Cities	National Cyber Security Centre (with international collaborators)
17	Manual for Smart Streets	Technology Transport Forum
18	Cyber Security for Higher Education Institutions	National Cyber Security Centre
19	Rail Code of Practice for Security Informed Safety	Centre for the protection of National Infrastructure (now NPSA)
20	ITS Cyber Sign-posting guidance	Technology Transport Forum