



Urban Technology Framework

12 Key Trends and What Drives Them

Digital is becoming a key factor in the success of cities and the quality of life of the people who live and work in them, alongside 'traditional' factors such as geography, climate, transport and utilities infrastructure, health services and skills.

The digital debate is no longer focusing just on technological advancement but is also considering the economic opportunities and future social impacts of digital change. The urban land community will be expected to take a leading position in the process of designing the role of digital in the future city.

"This is about ensuring that everyone can benefit from the fruits of globalisation and that we have fair inclusive economies. The route to achieving this goal is to enhance the advancement of tech and proactively shape the future relationship between technology and society for the benefit of everyone. From social media and the gig economy to automation and AI."

Sadiq Khan, Mayor of London, SxSW Keynote, March 2018

The ULI Urban Technology Framework will support this process by encouraging a common understanding and dialogue between all the people involved, and provide a basis for more detailed research. The overall goal is to improve cities through technology, and so create value for the people who are part of them.

About ULI

The Urban Land Institute is a global, member-driven organisation comprising more than 40,000 real estate and urban development professionals dedicated to advancing the Institute's mission of providing leadership in the responsible use of land and in creating and sustaining thriving communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, lawyers, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 76 countries.

The extraordinary impact that ULI makes on land use decision making is based on its members sharing expertise on a variety of factors affecting the built environment, including urbanisation, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

Peer-to-peer learning is achieved through the knowledge shared by members at thousands of convenings each year that reinforce ULI's position as a global authority on land use and real estate. In 2017 alone, more than 1,900 events were held in about 290 cities around the world.

Drawing on the work of its members, the Institute recognizes and shares best practices in urban design and development for the benefit of communities around the globe.

ULI has been active in Europe since the early 1990s and today has more than 4,000 members across 27 countries. It has a particularly strong presence in the major European real estate markets of the UK, Germany, France, and the Netherlands, but is also active in emerging markets such as Turkey and Poland.

More information is available at uli.org. Follow ULI on [Twitter](#), [Facebook](#), [LinkedIn](#), and [Instagram](#).



ULI UK Tech Forum

The Tech Forum brings city, real estate, technology and innovation professionals together to share knowledge, best practice and creative thinking to enable truly innovative solutions to be applied to our urban environment. Interlinking with ULI's wider initiatives, the Tech Forum delivers a diverse programme that focuses on real-life challenges and solutions that enable the betterment of: people and society, our urban realm, the life-cycle of buildings and capital.

The Tech Forum also intersects across ULI's existing forums which include the Sustainability Council, Residential Council, Infrastructure & Regeneration Council, Development Forum, Capital Markets Forum, and Young Leader programme.

Special thanks to

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Introduction

The evolution of cities has always been shaped by the adoption of new technologies and the value these bring.

Each new layer of technology – for example water, sewerage, railways, electricity, steel framed buildings, cars, telephony, and fibre – goes through its own adoption curve, passing from the novel to the ordinary over time.

Digital technologies are having no less impact on cities, but not as a single ‘meteor strike’. Instead, digital innovation is playing out as a cumulative series of changes, each caused by different combinations of factors. The complexity of the context – of the city as an organism – helps explain the sheer variety of individual digital technology-driven changes. In this context, the ULI UK Tech Forum has developed a framework for considering urban technology. It identifies key trends in the use of digital technologies in cities, and the factors that interact to cause and shape these trends.

The framework has three objectives:

1. To provide a current, accessible ‘primer’ for urban technology that supports a deeper understanding in how our urban environment can be enhanced by technology.
2. To establish a ‘modular’ framework for urban technology that allows for future, more detailed research.
3. To encourage connection, dialogue and translation between all people involved.

Urban Technology Framework Summary

Individual technology-driven changes group into broader trends that drive the impact of digital technologies on people and cities.

Digital twins: Augmented and virtual realities (and associated city systems models) create digital versions of cities that become part of the city.

Tribalisation: Social media and mobile connectivity create small, fluid tribes defined as much by digital as physical places.

Share and share alike: The subscription and sharing economy extends to ever more of our ‘stuff’: houses, cars, even clothes.

Smart cities: Tech progress creates denser, more efficient cities, better governance, and the orderly provision of citizen services.

Builders assemble: Onsite construction becomes a final assembly process for large, complex sub-assemblies manufactured in factories.

Smart buildings: The Internet of Things makes buildings and places better machines: more efficient, flexible and sustainable.

Digital retail: From stores to omni-channel; from ‘things’ to experiences.

Future of work: Emphasis of work changes from the company to the individual and the project.

Digital manufacturing: Additive manufacturing sees making things return to the city centre.

What a wonderful day! The monitored and quantified self supports healthy and happy lifestyles and citizen wellbeing.

Mobility-as-a-service: Public, private and active transport become joined-up, pay-as-you-go.

Smart machines: My house, my car and my robots all understand me.

All of these are underpinned by a meta-trend - big data. Ever-increasing volumes of data are forming into data sets that are increasingly well-structured and interconnected: people and communities, buildings and places, resources and the environment. Citizens are demanding personal privacy and the security of their own data, whilst also expecting transparency and controls on the data and algorithms used by public authorities and businesses.

Digital technologies

Urban land factors

**ULI Urban Technology Framework
12 key trends**

**Digital organising and
business models**

Three factors drive the patterns of digital change we see in cities – digital technologies, urban land factors, and digital organising and business models.

New digital technologies are the raw materials of digital change – the components that are used to build and operate digital products and services. Foundation technologies such as PCs, connectivity and the Internet are now utilities. The current wave of technologies - social media, mobile, big data and cloud computing - have become part of everyday life. The next wave is forming, and technologies such as IoT, smart machines and AI, and additive manufacturing and 3D printing will change how cities work.

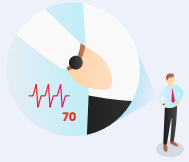
Urban land factors drive demand for digital change - the people and organisations, places and buildings, and property-cycle activities to which digital can add value. Digital investment and adoption decisions are made, and benefits and risks are assessed, within this compass.

The demands of people and organisations and the supply of innovative technologies are brought together by new digital organising and business models, which provide functional and commercial mechanisms for the application of digital technologies. Uber and Airbnb are not new digital technologies; they are new digital business models that combine many technology and process elements in innovative ways to offer more efficient services and greater value to citizens.

Each of the key trends presents a balance of opportunities and risks for people and cities. The scale of this grows as cities become larger and denser, presenting ever-greater challenges.

The urban land community has the opportunity to shape this balance, and now needs to consider the principles that guide our decisions. These are brilliant technologies, and if we apply them with creativity, empathy and stewardship, we have a real opportunity to improve our cities.





What a wonderful day



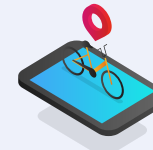
Future of work



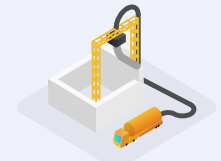
Digital twins



Smart buildings



Mobility as a service



Builders assemble



Smart machines



Share and share alike



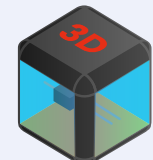
Digital retail



Smart cities



Tribalisation



Digital manufacturing

Digital twins



Tribalisation



Share and share alike



Smart cities



Key trends: Augmented and virtual realities and associated city systems models create alternative versions of cities that become part of the city.

Current impact and benefits:

Digital experiences are authentic, but different. Digital natives do not perceive this difference in the same way.

The digital twins of cities inform decision making for the real city: from impact on views to flows of pedestrians.

Questions on future direction:

When will AR and VR become 'real' enough to create authentic experiences people will pay for? Will this replace real places?

As models combine more physical and personal data, how can they balance the needs for transparent decision making with security and privacy?

Key trends: Social media and mobile connectivity create small, fluid tribes defined as much by digital as physical places.

Current impact and benefits:

The new gentrification? May support more diverse local communities as tribes are less delineated by physical place.

Tribes become more specialised and fluid through the dynamics of social media.

Questions on future direction:

Does this enhance or diminish social cohesion?

How do we design places to support this new dynamic? And limit the risk of reduced social cohesion?

Key trends: The subscription and sharing economy extends to ever more of our 'things': houses, cars, clothes.

Current impact and benefits:

As people share more, the total amount of 'stuff' reduces. This supports smaller houses, offices etc.

This will not just be people's 'stuff' - businesses will want to sell spare capacity, and either trade with or join the sharing economy.

Questions on future direction:

What levels of sharing can be achieved for principal assets like homes and cars?

How far can sharing extend? Take clothes. Some people have always shared clothes (rented a tuxedo, worn a coat from a charity shop), but will we all do it, all the time?

What implications will this have for the use of resources and the movement of products and materials?

Key trends: Tech progress creates efficient cities, better governance, and orderly provision of citizen services.

Current impact and benefits:

Smart city technologies are delivering point solutions in areas such as traffic management and energy use.

Cities have been less successful in joining all of this up into seamless technology platforms for the city as a whole.

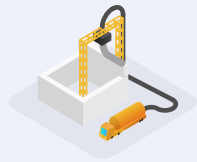
There are utopian and dystopian versions of this story.

Questions on future direction:

How long until this is executed successfully (and it will be - eventually new technologies are made to work)?

Will this demonstrably improve the quality of life in cities?

Builders assemble



Smart buildings



Digital retail



Future of work



Key trends: Additive manufacturing sees making things return to the city centre.

Key trends: The IoT makes buildings and places better machines: more efficient, flexible and sustainable.

Key trends: From stores to omni-channel; from 'things' to experiences.

Key trends: Emphasis of work changes from the company to the idea and the project. Watch out for: the gig-economy evolving into the touring-economy; star ratings as the new CV; my co-worker is an AI.

Current impact and benefits:

Demands greater sophistication than current waves of 3D printers.

Current impact and benefits:

Becoming a no brainer for new construction. Value of retrofitting to existing buildings is harder to prove, other than energy savings.

Current impact and benefits:

Much analysed area. Online retail is predicted to plateau as a percentage of total retail (at 25% for clothing, for example) but online has great potential for creating authentic relationships (and losing them in an instant).

Current impact and benefits:

Again, heavily analysed. Keep in mind that where people work has had a defining impact on the entire urban landscape. Work and business are different things – we may have central business districts and distributed work.

Companies may need to get bigger to fund huge ideas and platforms, even as the pieces of work needed to deliver this get smaller and more distributed.

Questions on future direction:

What does this mean for the factory and the distribution centre...?

...and for international trade and taxation?

What does this mean for traffic in cities and the delivery of materials?

Questions on future direction:

Can flexibility be monetised? Today a shop, tomorrow an office or a home?

Where are the limits of flexibility? Are these a reflection of human characteristics or minimal societal needs?

Questions on future direction:

How authentic can digital retail and brand experiences become when compared to life's other experiences? (A: surprisingly so, probably)

How do we house these experiences? Does digital retail have to be digital only or could it be augmented within the city context?

How will we pay for things? Crypto-currencies? Subscription services? (For example clothes rental - see also 'share and share alike'). How will we actually get the goods (drones?) and what will this mean for our streets?

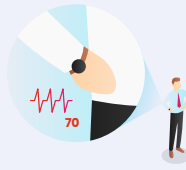
Questions on future direction:

Will a post-work society develop, or will we just work differently? How will we be paid? How do workers decide what they want to work on? What are the implications of a bifurcation between creative idea and project work, and process driven manufacturing and distribution?

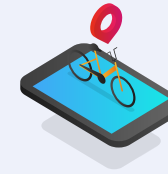
Digital manufacturing



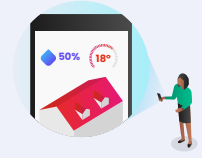
What a wonderful day



Mobility-as-a-service



Smart machines



Key trends: Onsite construction becomes a final assembly process for large, complex sub-assemblies manufactured in factories.

Key trends: The monitored and quantified self supports a healthy and happy lifestyle.

Key trends: Public, private and active transport become joined-up, pay-as-you-go.

Key trends: My house, my car and my robots all understand me.

Current impact and benefits:

2017 UK budget says we need to build 300,000 houses a year. A large (c£250M) offsite manufacturing facility can make 10,000 homes a year.

Current impact and benefits:

Technology will allow ever smaller and more targeted interventions - e.g. wayfinding that avoids poor air quality.

As people live longer, technology has a role in making buildings and the city more 'age-friendly'.

Technology can also contribute to making more of these additional years 'healthy years' for individuals.

Current impact and benefits:

Driverless cars will soon be safer than humans; current global road fatalities 1.25m pa.

Transport becomes lower cost or free in exchange for your data.

Current impact and benefits:

The word Robot is derived from the Czech word for slave . . .

Some find this troubling - barriers to privacy become ever higher, more complex to navigate.

Questions on future direction:

What happens to cities when high economic output 'multiplier effect' construction activity moves out?

What will the dividend be in terms of increased sustainability?

Questions on future direction:

Does increased life expectancy require more buildings? Different buildings?

What are the wider benefits and savings to public services as more people gain access to these technologies and benefits? Will everyone gain access?

Questions on future direction:

Will there be fewer cars? Will cars get simpler, last longer?

Will we travel more by car because it is easier?

What will we do in 'cars' when we don't need to drive?

Where would we have done this before, and will we need less of that space?

Will mobility-as-a-service be universal, or will some groups and places be have-nots?

Questions on future direction:

What value security, privacy, public safety? What is the impact of this on social equality?

New Digital Technologies

Digital technologies include individual technologies and the data and technical platforms that support these.

The first wave of digital technology started in the early 1990s and continued to around 2010. This wave is framed by the internet and fixed connectivity in combination with home and office PCs; content - in the form of music, films, games and books - and the emergence of e-commerce.

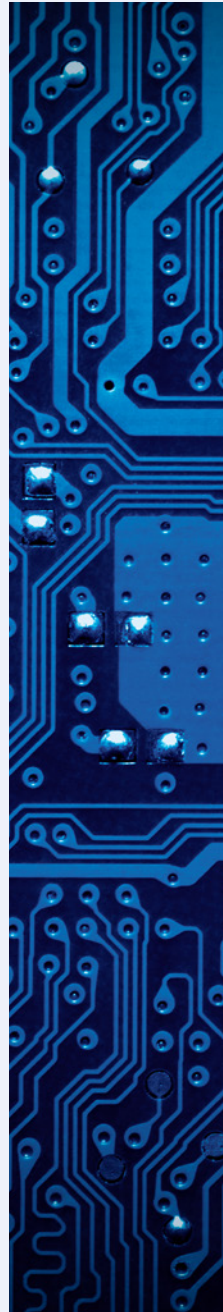
The second wave started around 2005 and is currently peaking: social media; mobile (in particular the combination of Smartphones and 3G/4G); big data; and cloud computing.

The third wave, currently forming, covers some technologies with great potential for disruption: IoT; smart machines (cognitive and physical, including AIs, robots, and autonomous travel); additive manufacturing / 3D printing; augmented and virtual reality and associated wearables; and blockchain and 'trust'.

Future waves are hard to predict, but may well include:

- 2020s: Materials / nanotechnology; space 2.0; and androids / biomedical
- 2030s to 2050s?: Full AI; quantum computing; enhanced humans; and private energy

These technologies will rely on data technical platforms. The data will include people and communities, buildings and places, resources and the environment. The technical platform will include the ability to store and process data, the connectivity to move it around, and the associated security and identity services needed to protect it.



Wave 1 1990–2010	Wave 2 2005–2020	Wave 3 2010–2030	Future Wave 2020s–2040s	Future Wave 2030s–2050s
PCs	Social	Internet of Things	Nanotechnology	Full AI
Connectivity	Mobile: Smartphones, 3G/4G	Smart Machines: AIs, Robots, Autonomous Vehicles, Drones	Space 2.0	Quantum Computing
Content	Big Data	3D Printing, Additive Manufacturing	Androids and Biomedical	
Internet and eCommerce	Cloud Computing	Augmented Reality, Virtual Reality, Wearables		
		Blockchain, Trust		
		Private Energy		
Data:	People and Communities	Buildings and Places	Resources and Environment	
Technology Platforms:	Store and Process Data	Connectivity	Security	Identity and Privacy

People and Organisations	Places and Buildings	Property Cycle
Communities	Metro Area and City	Plan
Public Authorities, Utilities	Districts	Invest and Fund
Property Investors and Developers	Neighbourhoods and Places	Design
Property Funders	Buildings	Build
Property Consultants	Units	Operate
Construction Firms	Rooms	Refurbish



Urban Land Factors

Urban land factors comprise the compass within which digital technologies operate and create value in cities. This has three dimensions: people and organisations (and the decisions they make), places and buildings, and the property cycle.

People and organisations defines the stakeholders who will apply and use the technology. This covers multiple actors including public organisations, utility and transport operators, businesses based in cities, property investors, property consultants, construction firms and most importantly people - the people who live, work and play in cities.

Places and buildings sets out the spatial order of magnitude a technology addresses. This ranges from an entire city to an individual room, via neighbourhood places and buildings.

Property cycle sets out the point at which a technology is applied. This includes stages from planning and design, through construction, buying and renting, operation and management, and subsequent refurbishment, adaption or deconstruction.

Digital Organising Models

People and organisations use a range of models to decide whether to encourage, engage, invest in and adopt digital technologies and how to value the benefits and risks.

1. Economic and social models create rational frameworks of economic benefits and costs, environmental sustainability, and social factors including health, wellbeing, happiness, privacy and social improvement.
2. Planning models look at how different cities approach 'digital master planning' to foster digital innovation. Four paths identified in a recent research paper are facilitative, learning, systems and interventionist.
3. Investment models focus on creating a successful business and generating investment returns.
4. Adoption models consider the processes a person goes through when they adopt a new technology. One model outlines five stages: knowledge, persuasion, decision, implementation and confirmation. It establishes five tests for the decision: relative advantage, compatibility, complexity, trialability and observability.

Digital Business Models

Digitally-driven business and organising models bring together new digital technologies with the demands of people and cities. Many digital services fit principally into one of the following models, although these distinctions are often not absolute:

1. E-commerce and e-service models that digitally enable the provision of traditional goods and services – for example Amazon, Alibaba, citizen services provided by 'City Hall'.
2. Trading platform and dynamic supply chain models that create a market. Common features include dynamic pricing, dynamic and flexible supply, and a simple tool for consumers – for example Uber, Grab, and DiDi.
3. Crowdsourcing and crowdfunding models that rely on mass input of ideas and capital from individuals to drive innovation – for example TripAdvisor, Kickstarter and coUrbanize.
4. Social network models that create value by sharing information and experiences. 'Sharing economy' models are a variation of this. Airbnb is a good example – more than a trading platform, it brokers spare (and hence low marginal cost) capacity with demand on a transaction platform.

Digital Organising Models	Digital Business Models
Economic and Social Models	eCommerce and eService
Digital Master Planning Models	Trading Platform, Dynamic Supply Chain
Investment Models	Crowdsourcing and Crowdfunding
Adoption Models	Social Networks and the Sharing Economy



Conclusion

The adoption of digital technologies will change the face of cities as surely as any previous technology, whether the railway, the car or the skyscraper.

However, rather than one huge 'meteor strike' impact, digital will create many individual heterogeneous changes, clustered into trends that, collectively, may have the same level of impact.

These patterns of change will affect every aspect of the city: individuals, communities and institutions, the buildings and public realm, the utility, infrastructure and public service networks, and general economic and social activity.

Each of these trends presents a balance of opportunities and risks for the city. The scale of this grows as cities become larger and denser, presenting ever-greater challenges.

The urban land community has the opportunity to consider this balance, and now needs to develop the principles that guide our decisions. These are brilliant technologies, and if we apply them with creativity, empathy and stewardship, we have as great an opportunity as any generation to shape the city for good.

Related Innovation and Technology Reports

Building the Innovation Economy: City Level Strategies for Planning, Placemaking and Promotion:
<https://europe.uli.org/building-innovation-economy-city-level-strategies-planning-placemaking-promotion/>

Technology Real Estate and the Innovation Economy:
<https://europe.uli.org/technology-real-estate-and-the-innovation-economy/>

Supporting Smart Urban Development: Successfully Investing in Density:
<https://europe.uli.org/supporting-smart-urban-development-successful-investing-density/>

Driverless Cars and the City:
<https://uk.uli.org/councils-and-forums/driverless-cars-city-conference-infoburst/>

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Illustrations kindly provided by Squint / Opera

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