Smart city technologies and testbeds for tourism-led cities

Nicos Komninos
URENIO Research, Aristotle University of Thessaloniki
Conference “Cyberspace, The Final Frontier”, Iasi, 30 Oct 2021

Introduction: Smart city development by ecosystems

Tourism and smart tourism in cities composed of many ecosystems

Tourism-led cities with tourism as unique or dominant ecosystem

Conclusion

PPP available at
https://www.komninos.eu/category/ideas/

Introduction: Cities and smart cities are structured by ecosystems

A 1943 map showing how London would look based on 'social and functional analysis', which Patrick Abercrombie helped to draw up

SMART ECONOMY (Competitiveness)
- Innovative spirit
- Entrepreneurship
- Economic image & trademarks
- Productivity
- Flexibility of labour market
- International embeddedness
- *Ability to transform*

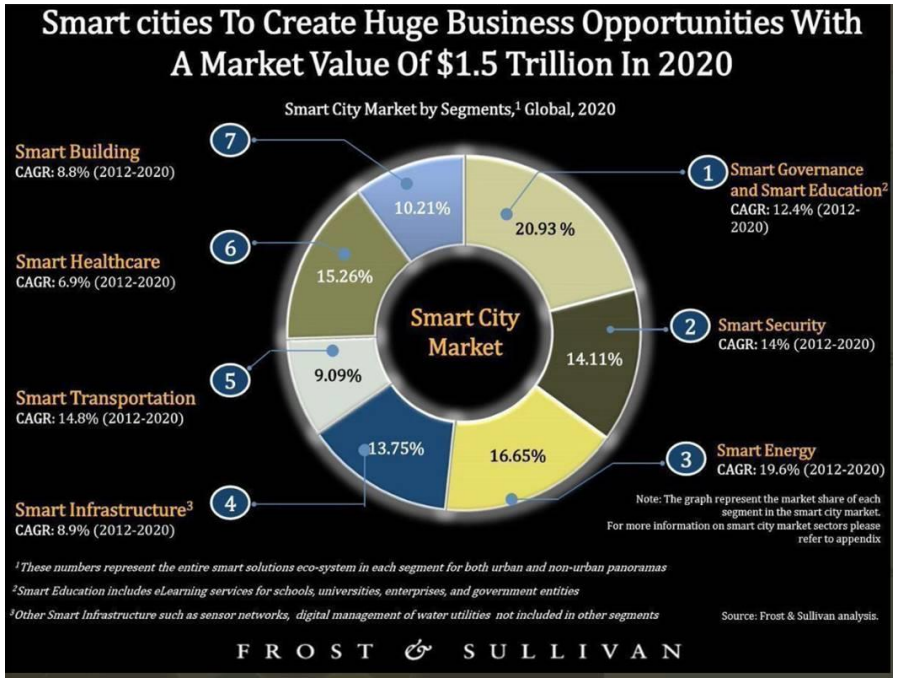
SMART PEOPLE (Social and Human Capital)
- Level of qualification
- Affinity to life long learning
- Social and ethnic plurality
- Flexibility
- Creativity
- Cosmopolitanism/Open-mindedness
- Participation in public life

SMART GOVERNANCE (Participation)
- Participation in decision-making
- Public and social services
- Transparent governance
- *Political strategies & perspectives*

SMART MOBILITY (Transport and ICT)
- Local accessibility
- (Inter-)national accessibility
- Availability of ICT-infrastructure
- Sustainable, innovative and safe transport systems

SMART ENVIRONMENT (Natural resources)
- Attractivity of natural conditions
- Pollution
- Environmental protection
- Sustainable resource management

SMART LIVING (Quality of life)
- Cultural facilities
- Health conditions
- Individual safety
- Housing quality
- Education facilities
- Touristic attractivity
- Social cohesion



Abercrombie: The city as sum of ecosystems	Giffinger et al. (2007): 6 activity based	Frost & Sullivan: 8, most network based

At least 20 ecosystems can be defined in any city:

Area-based ecosystems, defined by districts & neighbourhoods	1. *City centre* 2. *Marketplace* 3. *Housing* 4. *Public space / recreation* 5. *Natural ecosystems* 6. *Hub (port / rail / bus)*	**Vertical ecosystems,** defined by activities	7. *Manufacturing* 8. *Food production* 9. *Education* 10. *Tourism, hospitality, etc.* 11. *Culture and branding* 12. *Public services & safety* 13. *Government*	**Network-based ecosystems**, defined by utility and other networks	14. *Transportation* 15. *Energy* 16. *Water* 17. *Waste* 18. *Telecom, broadband* 19. *Recycling* 20. *Environment, emissions*

Smart city development by ecosystems: a survey

SC projects per sector of activity or city ecosystem

Type of ecosystem	City ecosystems	Frequency in sample cities	
		No of cities	*%*
Area-based ecosystems (3.49% of all ecosystems)	1. District renewal-Multi-use districts	1	5.88
	2. Hub district (port / rail / airport)	1	5.88
	3. City centre	-	-
	4. Technology district	-	-
	5. University campus	1	5.88
	6. Housing	-	-
	7. Public space / natural ecosystem	-	-
Activity-based ecosystems (45,35% of all ecosystems)	8. Governance	11	64.70
	9. Health	6	35.29
	10. Startups, innovation, skills	5	29.41
	11. Safety	5	29.41
	12. Living, quality of life	5	29.41
	13. Education	4	23.53
	14. Tourism, hospitality, shopping	3	17.65
	15. Manufacturing	-	-
	16. Culture, recreation	-	-
Network-based ecosystems (51,16% of all ecosystems)	17. Telecom, broadband	17	100.00
	18. Mobility	10	58.82
	19. Energy	8	47.05
	20. Environment	4	23.53
	21. Water	3	17.65
	22. Circular economy, recycling, waste	2	11.76

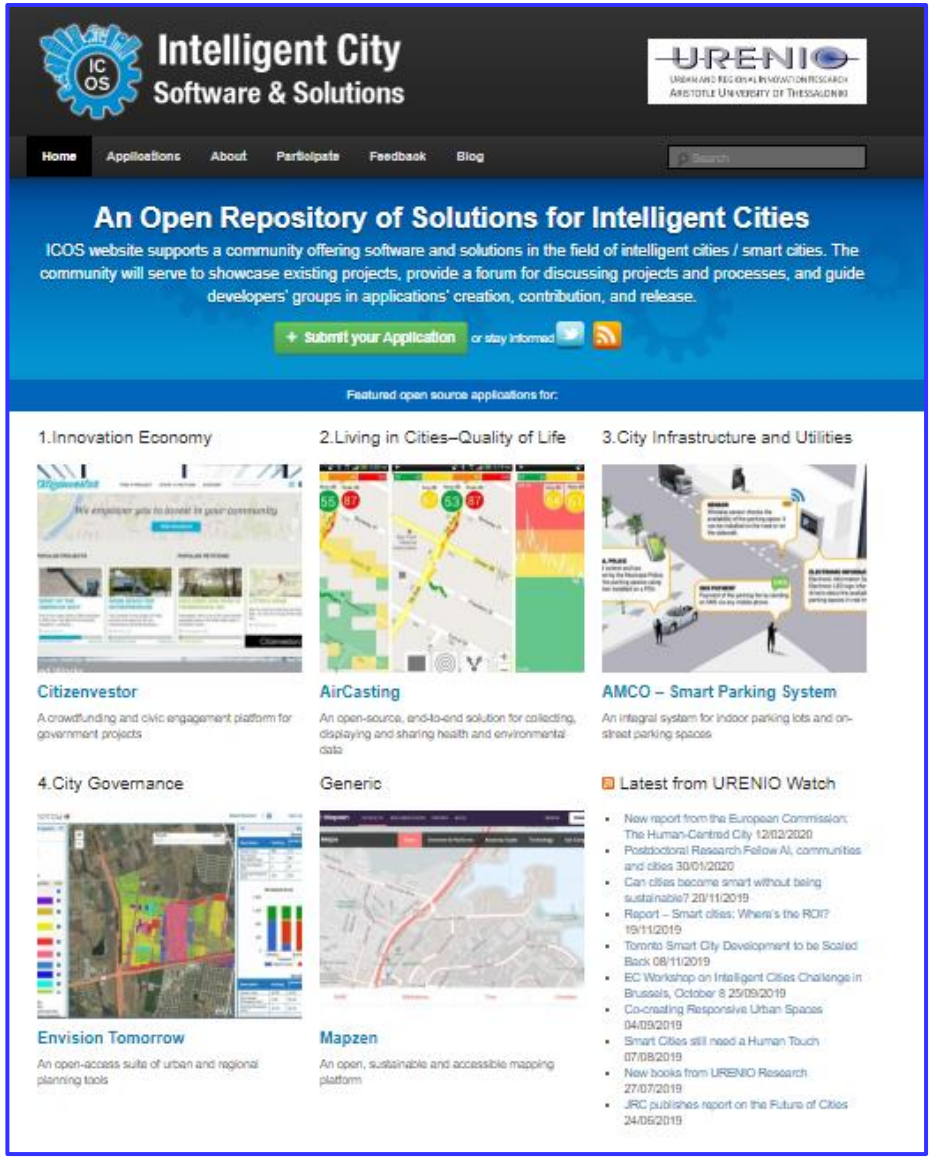
- A survey in 20 cities from around the world shows clearly that smart city strategies are organised by ecosystems
- The Table shows the **city ecosystems** in which smart city projects are implemented: 86 ecosystems in 17 cities. On average 4 per city.
- 16 different ecosystems are identified, classified per (a) areas, (b) activities, and (c) networks.
- T**hree types of ecosystems** have quite different locational behaviour: area-based ecosystems cluster spatially to form city districts, activity-based ecosystems spread throughout the city, and network-based ecosystems locate along the axis and transport networks.
- **Most frequently** projects fall into ecosystems related to networks (broadband, mobility, energy, etc.) (51.16%); then follow ecosystems related to activities (economy, health, safety, etc.) (45.35%); and a few only cities work with area-based ecosystems, such as district renewal, port and university campus renovation (3.49%).

Smart city applications & e-services are also organized by ecosystems

- At URENIO we classified smart city solutions / applications per city ecosystem
- ICOS is a repository of software. 190 applications in 5 fields / 20 subfields
  - Innovation economy
  - Living / quality of life in cities
  - City infrastructure
  - City governance
  - Generic
- Open repository, anyone can submit an application
- Available at https://icos.urenio.org/

View applications for:

- 1.Innovation Economy
  - Commerce
  - Entrepreneurship
  - Funding & crowdfunding
  - Tourism & entertainment
- 2.Living in Cities–Quality of Life
  - Environment & green spaces
  - Health & social care
  - Safety & security
- 3.City Infrastructure and Utilities
  - Energy saving & renewable energy
  - Mobility & parking
  - Waste management
  - Water management
- 4.City Governance
  - City planning & city management
  - Decision making & citizen participation
  - Government services to citizen
- Generic
  - City functions related
  - Data related
  - Sensors related



Tourism and smart tourism in cities composed of many ecosystems

Tourism is a vertical ecosystem. Can be optimized by smart city systems

- In most cities, especially those with strong cultural heritage, tourism is a vertical ecosystem in the economic sectors of the city (agri, manuf., services)
- **Tourism includes** activities of trade, transport, accommodation, gastronomy, entertainment and others that offer services to visitors. These fall under many NACE classes:

45. Wholesale and retail and repair
47. Retail trade

49. Land transport
50. Water transport
51. Air transport

55. Accommodation
56. Food and beverage services
68. Real estate activities

77. Rental and leasing activities
79. Travel agency and tour operator services

90. Creative, arts, entertainment
91. Museums and other cultural activities
93. Sport and amusement and recreation

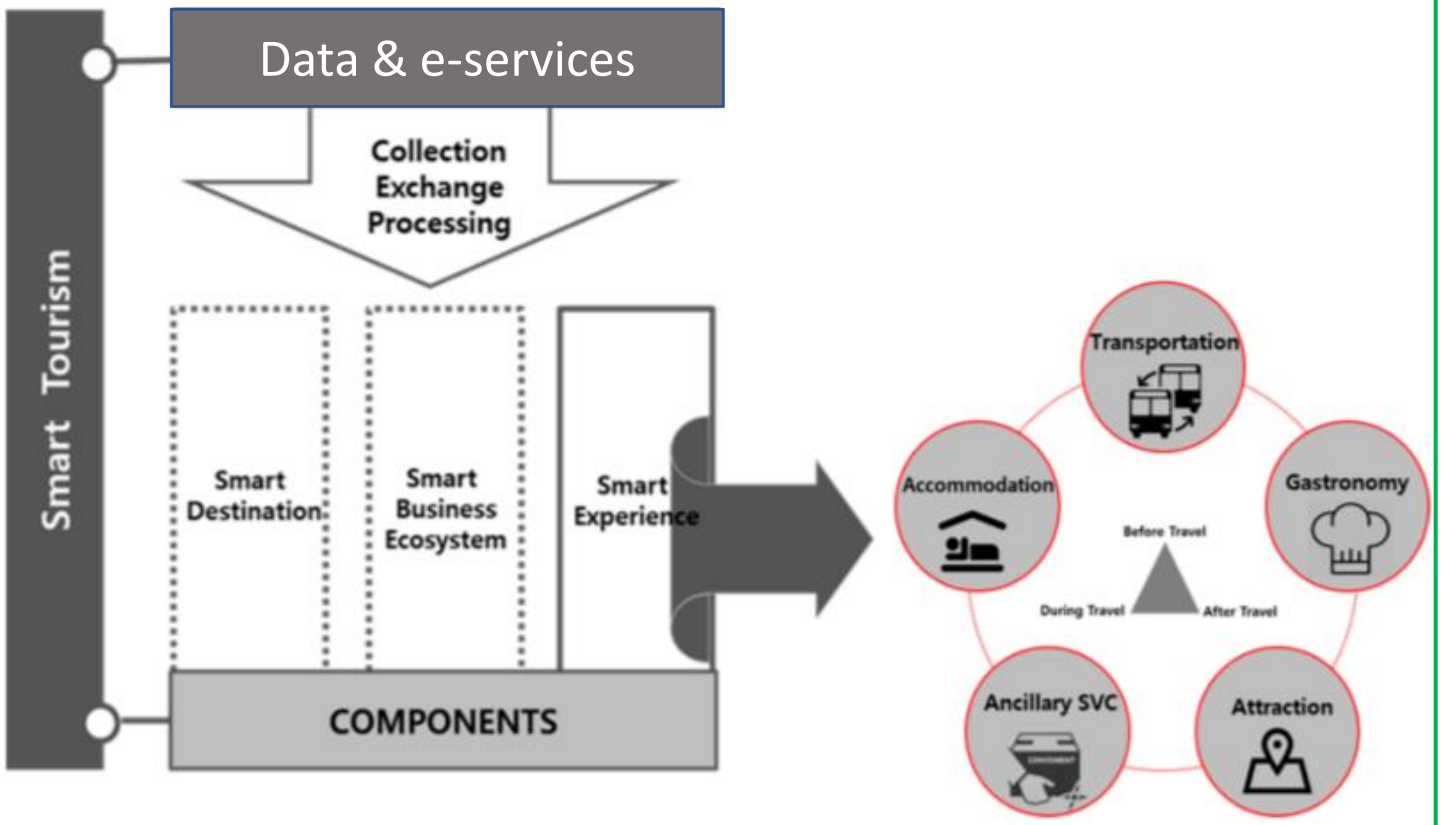


Figure 2. Components of smart tourism.

Source: Lee, P., Hunter, W. C., & Chung, N. (2020). Smart tourism city: Developments and transformations. *Sustainability*, *12*(10), 3958.

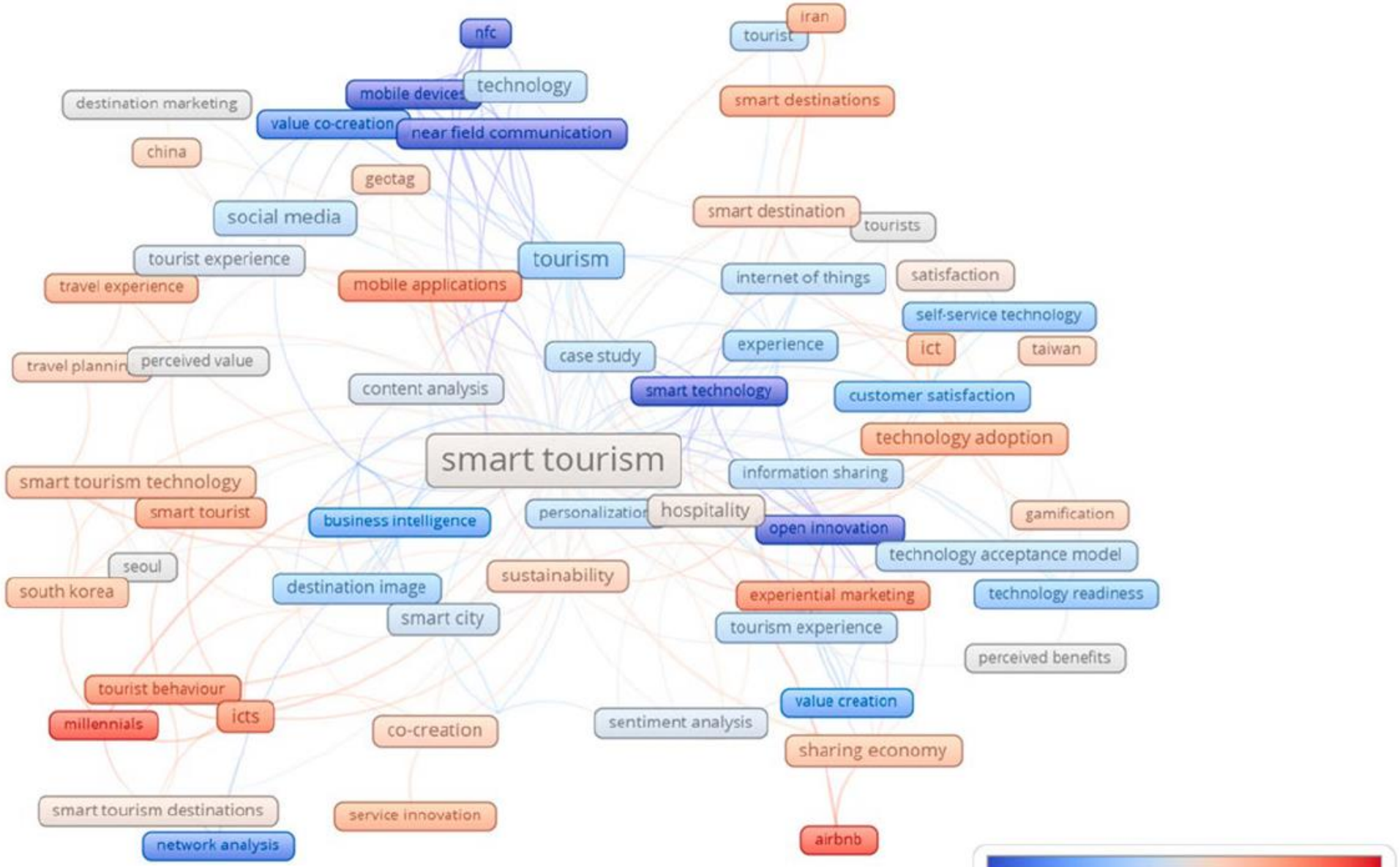
Smart tourism strategy and projects

- A few cities only have a declared smart city strategy targeting on tourism.
- It is most common to cities to recognize tourism and hospitality as important sectors of economic activity but fail to design and implement smart city projects and services targeting this sector.
- This is the case of ***Dehradun*** [Dera Doon] the capital and the largest city of the Indian state of Uttarakhand, and ***Tunis***, the capital and largest city of Tunisia.

In cases of smart city strategy targeting on tourism, projects appear under many different domains:

- ***Changsha*** for instance, a 10 million city, the capital and the largest city of Hunan Province in central China, tourism is a clear domain of the smart city strategy.
- Related smart city projects are about (1) **travel**, online services facilitating travel in airport, stations, underground railway, information and selling tickets, (2) **electronic payments**, and (3) **hotels and tourism venues** online reservation, tickets, payments.
- ***Torino***, smart city projects related to tourism are placed under the domain of **health and well-being**, and tourism figures in the weak domains of the smart city strategy

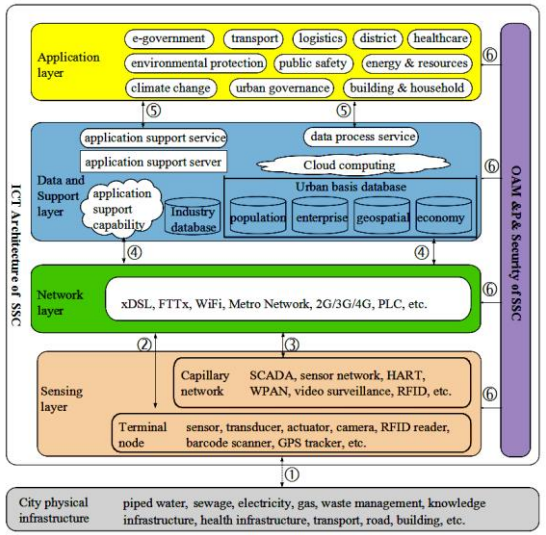
Smart tourism: Technology themes 2015-2020 (almost everything of the SC domain)



Trinchini, Lino (2021) Value Creation in Smart Destinations. The Case of Manchester. Doctoral thesis (PhD), Manchester Metropolitan University.

Most usual digital applications and e-services

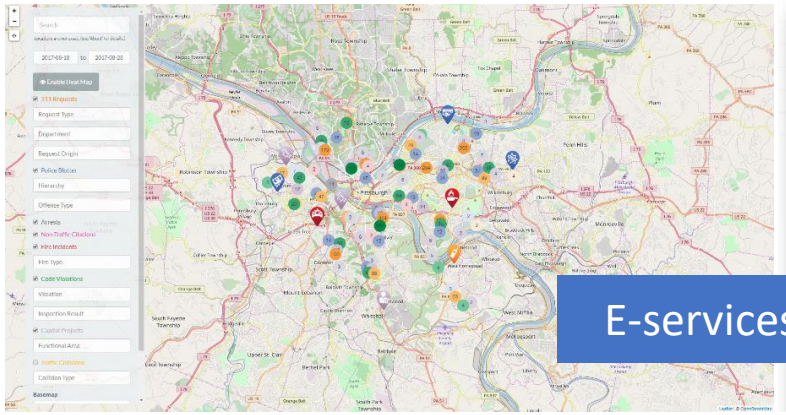
- **Usual digital applications and e-services** that support activities of tourism are those of information sharing, points of interest, hotel reservation, tourism venues, e-payments, the city as a platform for various e-services
- They rely on an array of conventional smart city technologies, including (1) sensing, (2) network, (3) data and computing, (4) application programming, and (5) analytics

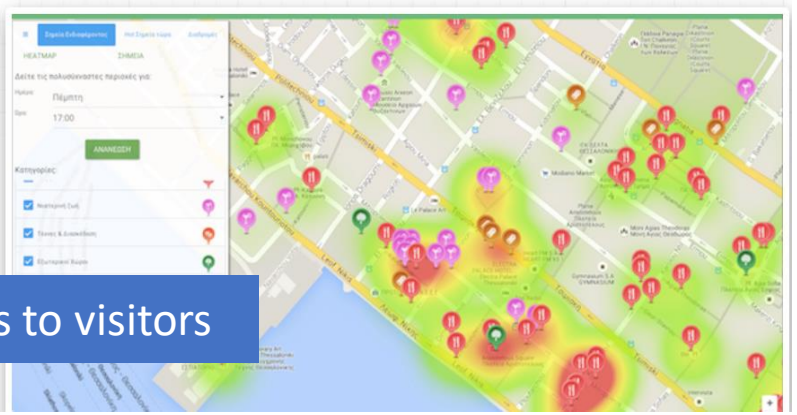


Source: ITU-T FG-SCC (2015) Setting the framework for an ICT architecture

City branding

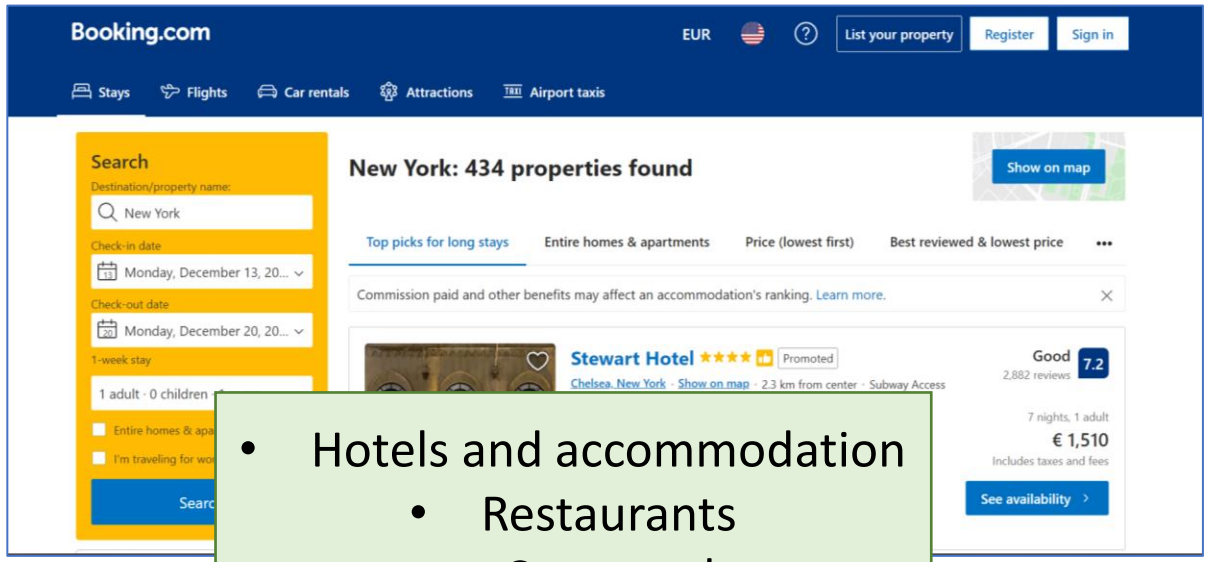
Augmented reality

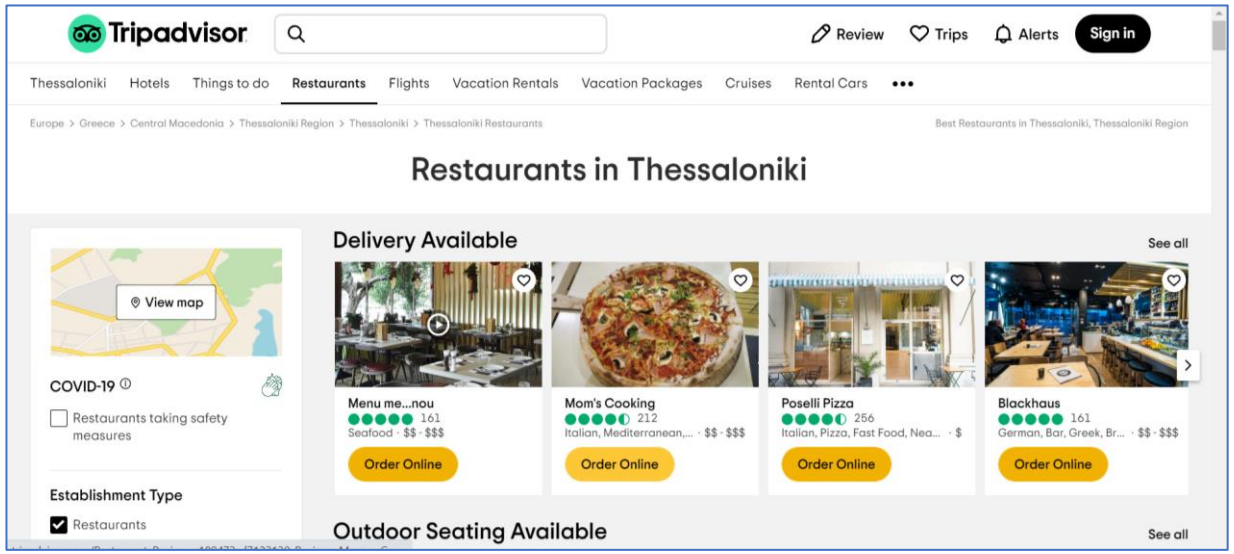




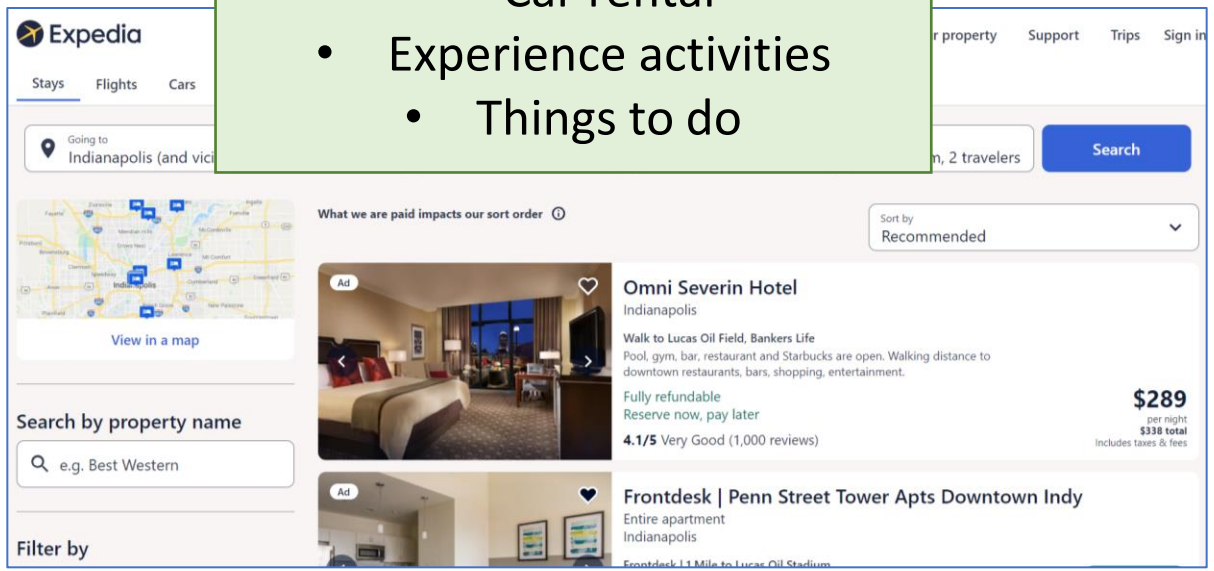
E-services to visitors

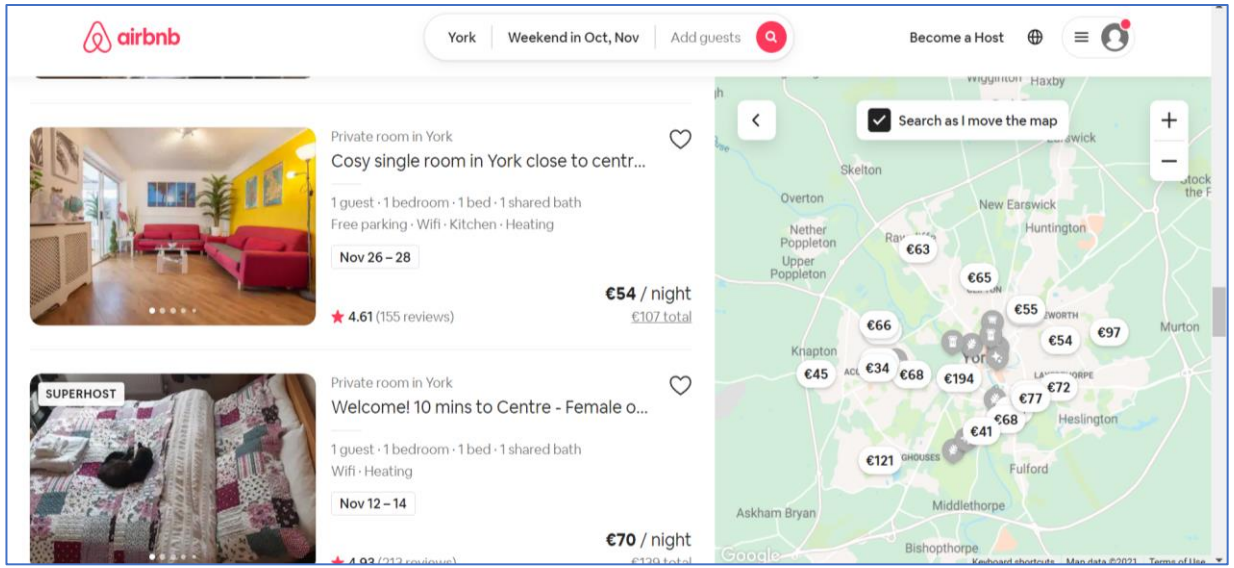
A series of e-services are offered by big global platforms





- Hotels and accommodation
  - Restaurants
  - Car rental
  - Experience activities
  - Things to do



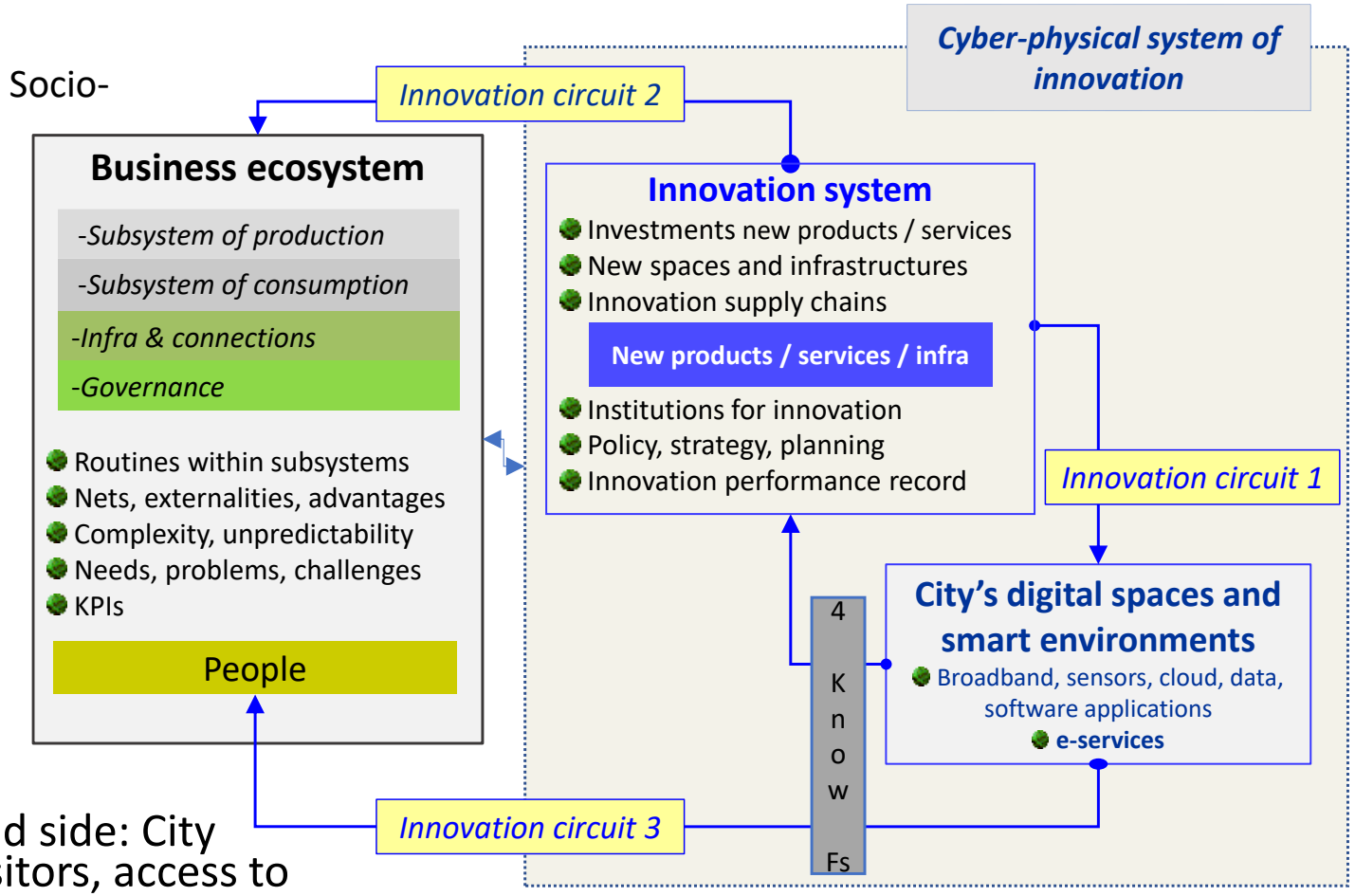


Beyond the state-of-the-art: Custom strategy, Service-Dominant logic

Mapping

- Context: social and environmental
- Composition of the ecosystem: service providers, services offered, skills, technology capabilities
- Demand. Number of visitors. Socio-economics of visitors

Innovations at the supply side supporting new investments: e-services, start-ups, capacity building, digital skills, business intelligence, crowdsourcing



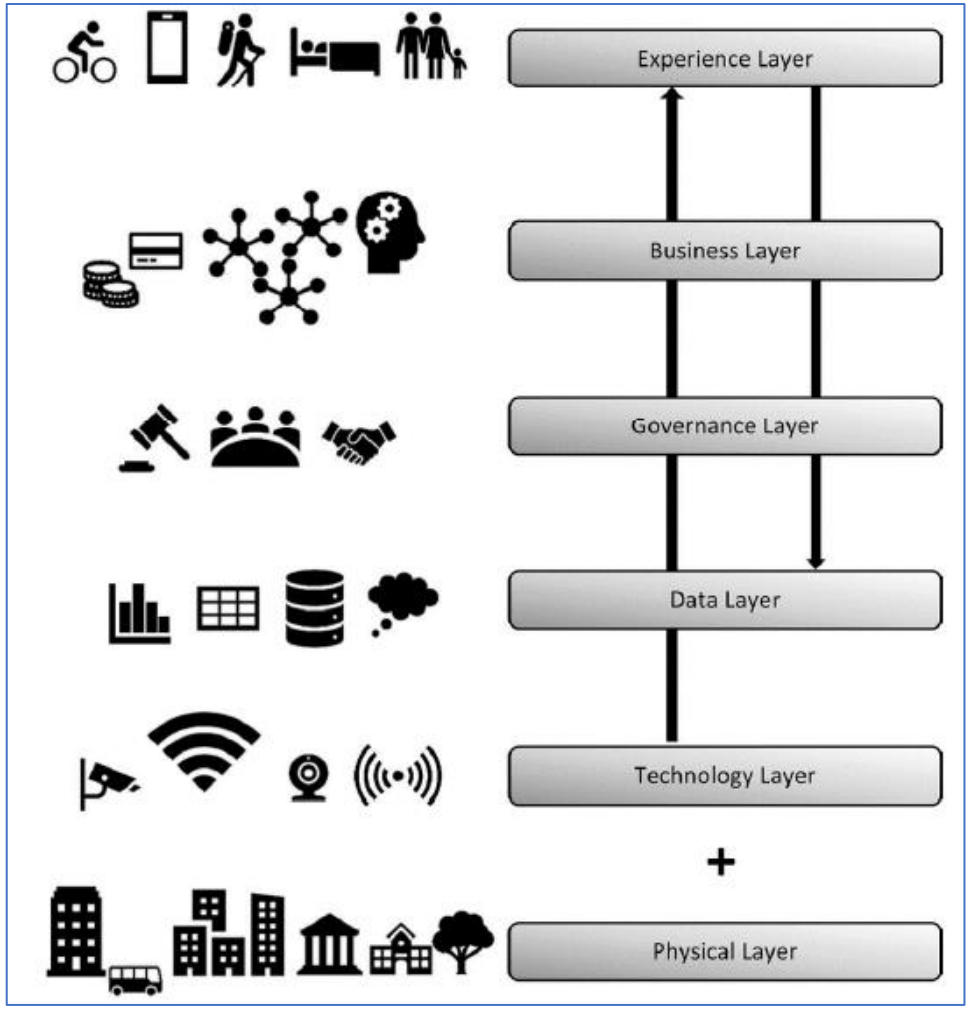
Innovations at the demand side: City branding, attraction of visitors, access to global markets.

Tourism-led cities with tourism as unique or dominant ecosystem

Tourism-led cities: higher user experience by complementary ecosystems

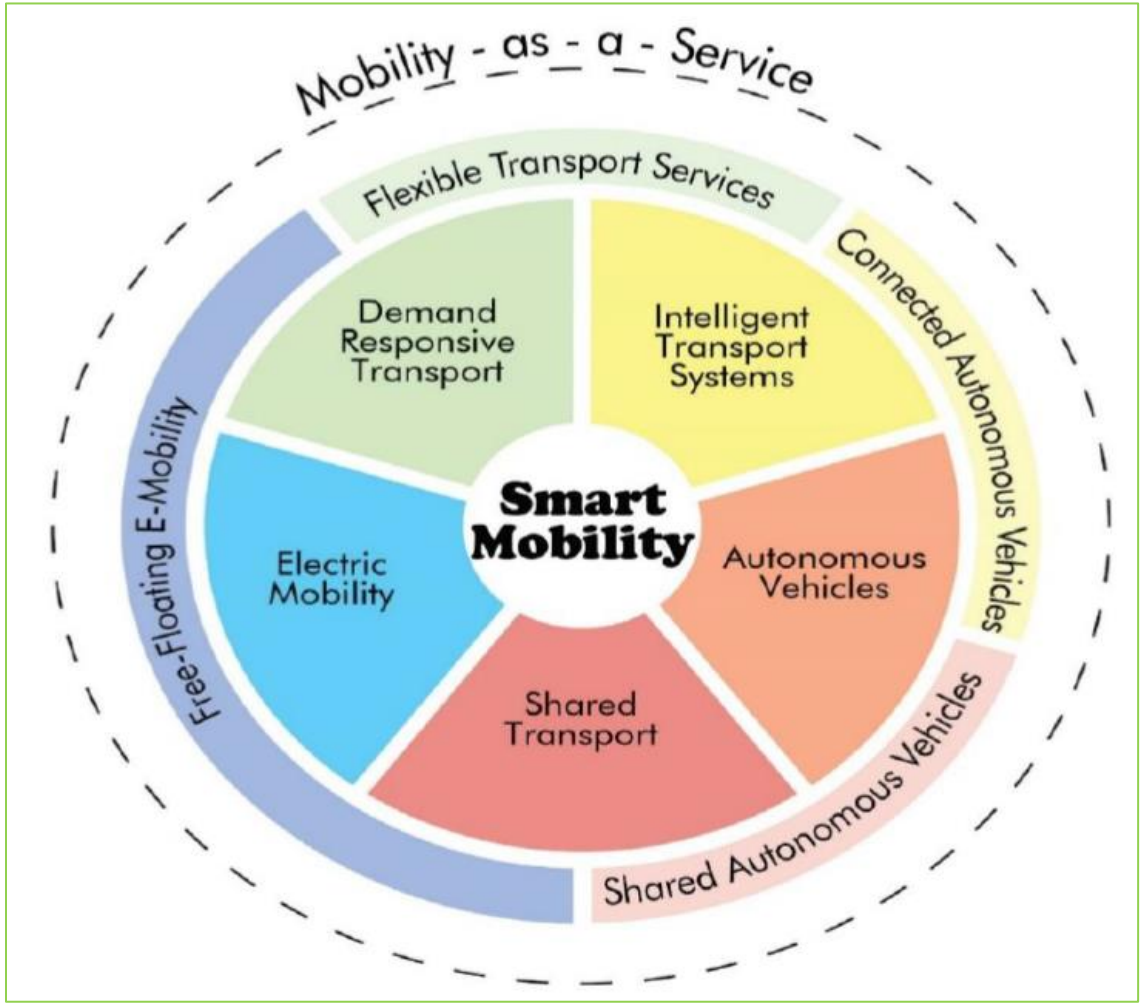
- There are cities that depend totally on tourism
- It is usual in south Europe and the Mediterranean islands. During the season period, the majority population of these cities is visitors
- **Higher user experience** can be achieved from complementary to tourism ecosystems
- Smart city solutions can lead to a radical transformation of **three urban ecosystems** that in turn affect tourism

Smart tourism layers



Source: Gretzel, U., & Scarpino-Johns, M. (2018). Destination resilience and smart tourism destinations. Tourism Review International, 22(3-4), 263-276.

I. MaaS (Mobility-as-a-Service): a perfect choice for tourism-led cities



Source: Butler, L., Yigitcanlar, T., Paz, A. (2020). How Can Smart Mobility Innovations Alleviate Transportation Disadvantage? Assembling a Conceptual Framework through a Systematic Review. *Appl. Sci*. 10, 6306

MaaS

Mobility as a Service (MaaS) integrates various forms of transport services into a single mobility service accessible on demand. A MaaS operator offers a menu of transport options, public transport, ride-, car- or bike-sharing, taxi or car rental/lease, or a combination thereof. For the user, MaaS offers added value by using a single application to provide access to mobility with a single payment channel. (MaaS alliance)

Why MaaS in tourism-led cities?

- Visitors do not dispose own vehicles
- Areas of heritage limit private car access
- An urban space of higher quality, without cars, noise and pollution

Cities under MaaS: a total transformation

Source: Smart City Expo https://twitter.com/SmartCityexpo/status/1438444049195802625

MaaS platforms

Bird

Save

Write a Review

Bird wants to provide eco-friendly transportation for everyone. This app reaches 300+ cities worldwide.

Squire

Save

Write a Review

$ Starting Price $30

Squire is a booking and payment platform that connects people with great barbers nationwide. Squire makes it easy to discover and book the best barbers in major US cities and Canada. Squire is also the premier management platform for barbershops. Barbers are able to engage their…

Mobilleo

Save

Write a Review

Mobilleo is presented as an integrated, scalable, secure and highly customisable MaaS platform from the company in Shipley (or Fleetondemand Limited), that aims to bring connected mobility to cities and businesses anywhere in the world.

Moovit

Save

Write a Review

Moovit's iOS, Android, and Web app guides people in getting around town using any mode of transport. Introduced in 2012 it now boasts over 950 million users in more than 3,200 cities across 112 countries. Moovit is an Intel company (acquired 2020). Moovit amasses up to six billion…

Whim

Save

Write a Review

Whim is a Finnish mobility application from MaaS Global in Helsinki, that allows users to book and pay for trips one trip at a time or with a convenient seasonal order. The vendor states Whim has already made more than 16 million trips, and is designed to liberate people from timetables,…

UbiGo

Save

Ubigo, from the company of the same n… Public transport, car rental and car sha… …car.

Trafi MaaS Suite

Save

The Trafi MaaS Suite, from Trafi in Vilni… …an not only check itineraries but also book their tickets and trips.

Reach Now

Save

Write a Review

The Reach Now mobility app, from the moovel Group in Berlin, is presented as the construction kit for company-owned mobility benefits.

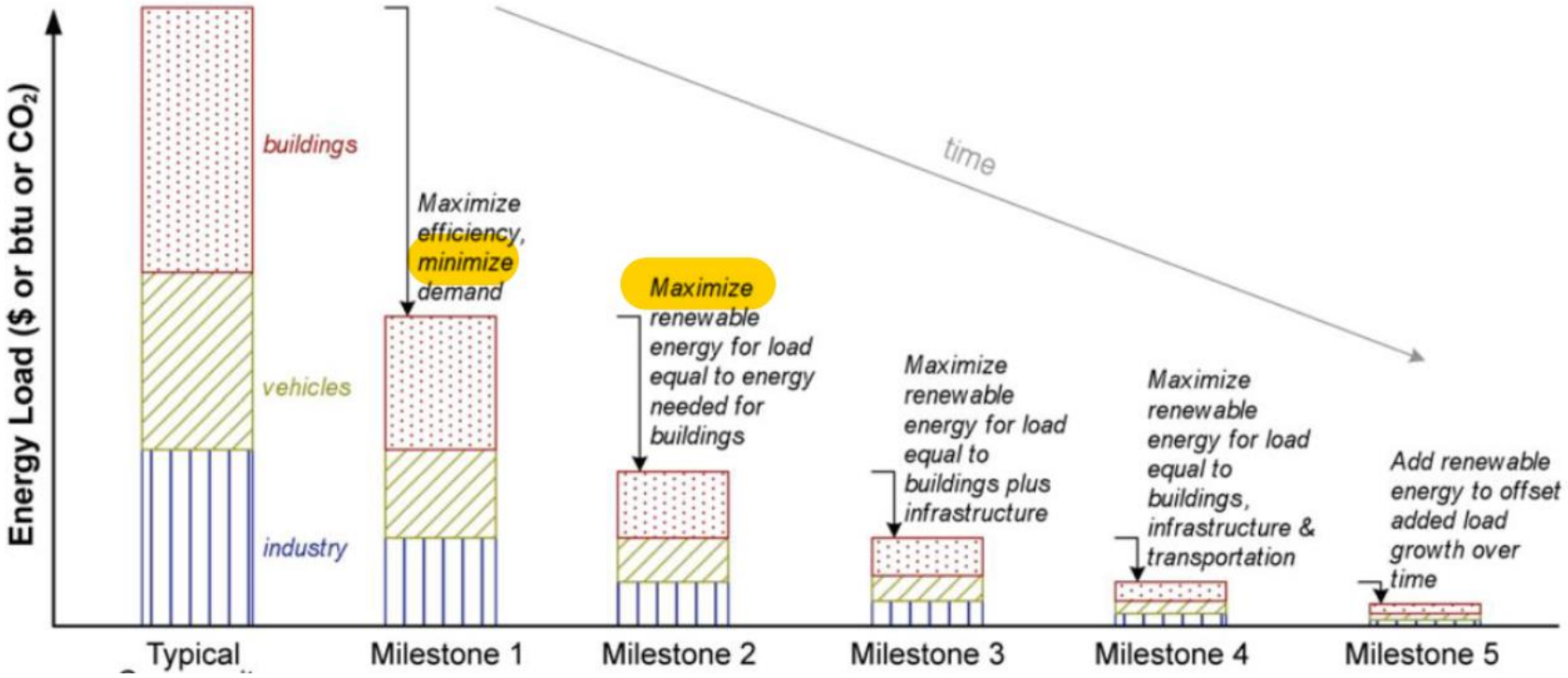
Mobility as a Service Platforms Features

MaaS platforms share these identifiable features:

- Journey planner
- Public, private, and micro transportation options
- User preferences
- Integrated ticketing and seamless payment
- Pay-as-you-go, bundled, monthly, or seasonal payment options
- Real-time updating of transportation options and schedules
- Record and track itineraries
- Real-time trip status updates
- Information on stations, airports, ports, micro transport sharing locations, vehicle storage, and parking
- Geo-location flexibility and support
- Reputation management of providers and users
- Privacy safeguards
- Consumer intelligence and analytics
- Mobile app and web platforms

Source: https://www.trustradius.com/mobility-as-a-service

II. Zero energy districts: tourism-led cities work as housing districts



Source: Carlisle, N., Van Geet, O., & Pless, S. (2009). *Definition of a'Zero Net Energy'Community* (No. NREL/TP-7A2-46065). National Renewable Energy Lab.(NREL), Golden, CO (United States).

NZEDs refer to any group of buildings (e.g., city district, community, village, cluster of buildings, or campus), with a stated goal of achieving zero or positive energy, that produces at least the same amount of energy as it demands, and whose reduced energy demand is met by RE generated, preferably, on-site or nearby.

Why NZED in tourism –led cities?

- It is feasible
- Can be based on locally produced renewable energy
- Cleaner environment

Net zero energy districts: tourism-led cities are close to housing districts

Energy usage and CO2 emissions: Baseline

E1: Housing electricity

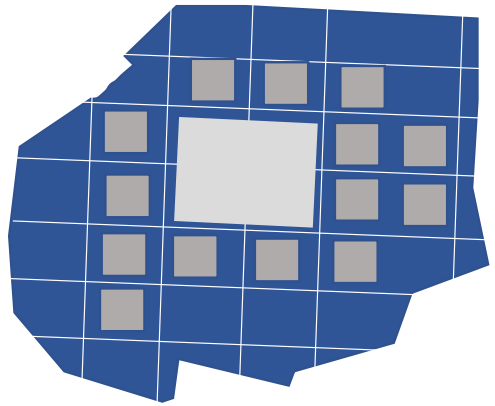
E2: Housing heat-natural gas

E3: Housing heat-diesel

E4: Mobility by private cars-Diesel

E5: Mobility, street lighting, Electric.

E6: Other energy (tbd)



The district: Key features

- District surface
- Land use: housing
- Population
- Number of households
- Buildings floor surface
- Buildings roof surface
- Public plaza surface
- Road length
- Road area surface
- Green areas surface
- Unbuilt area surface
- Smart grid connecting building blocks

Net Zero Energy District: Components

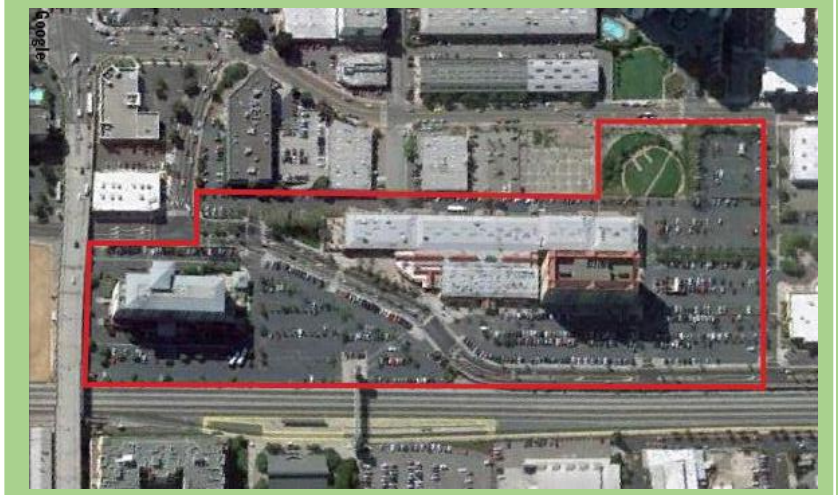
1. Home-Energy saving-smart home
2. Home-Energy saving-refurbishment
3. Mobility-Energy saving -Maas
4. Mobility-Energy saving-Smart city lights
5. Mobility-Electric car ownership
6. Energy conversion-Heat natural gas to electricity (heat pumps)
7. Energy conversion-Heat diesel to electricity (heat pumps)
8. Local RES-Photovoltaic deployment space
9. Other local RES
10. CO2 offset: Tree planting
11. CO2 offset: CO2 capture technologies

MODEL of NZED: **Minimize RES import for Net Zero CO2**

Energy usage sub-model
Σ CO2 E1-E6

Energy saving sub-model	Mobility saving sub-model	Energy conversion sub-model	Local RES sub-model	CO2 offset sub-model
CO2 [1 +2]	CO2 [3+4+5]	CO2 [6+7]	CO2 [8+9]	CO2 [10+11]

Net zero energy districts make the compact city model obsolete



Smart location?

- Encourage redevelopment of existing cities, suburbs, and towns, limiting the expansion of the development footprint
- Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels
- Adjacent sites with connectivity

Compact development???

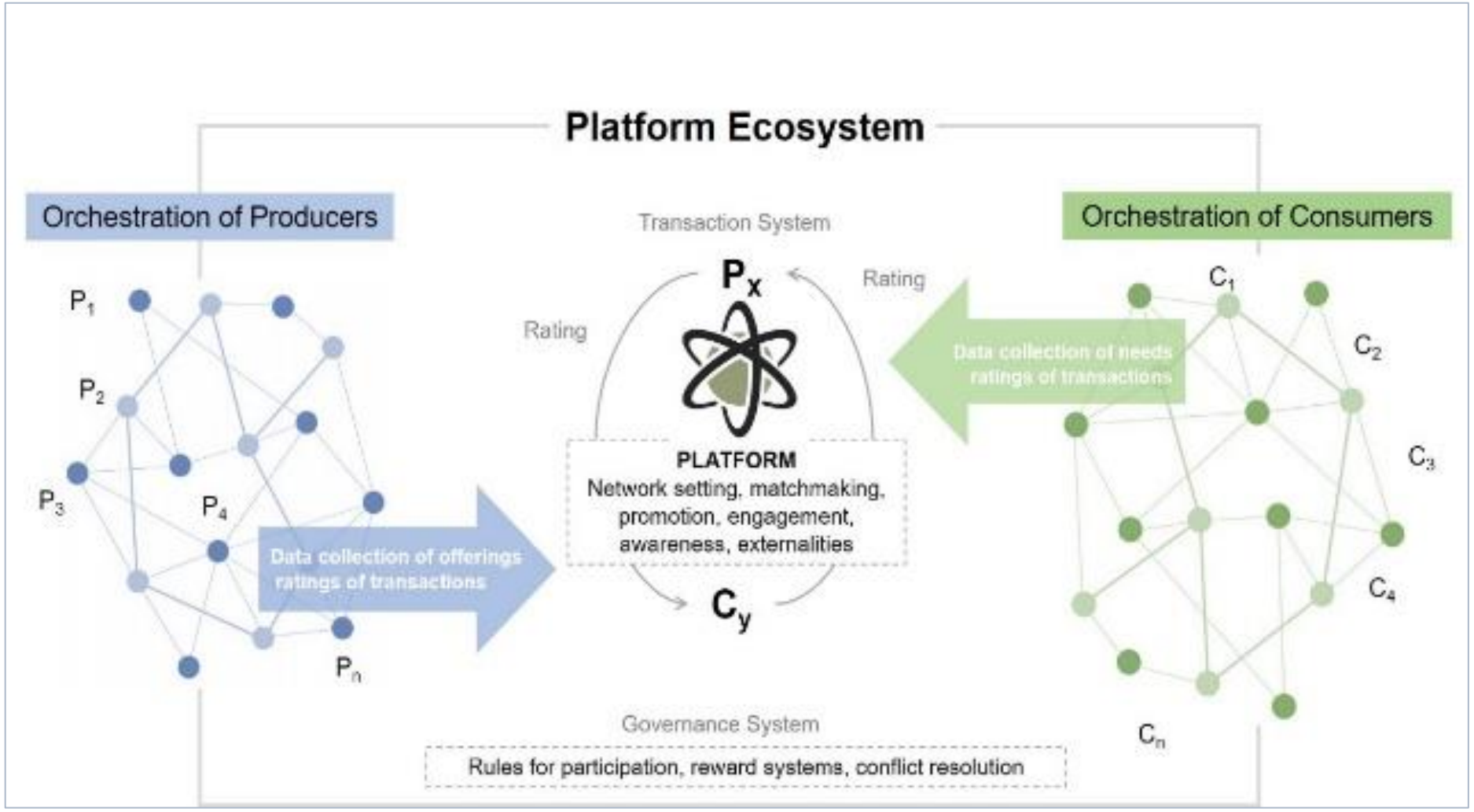
High density development

- Residential, 12 or more dwelling units per acre or 7 DpA for components outside walk distances
- Nonresidential, 0.80 floor-area ratio (FAR), or 0.50 FAR or greater for components outside the walk distances

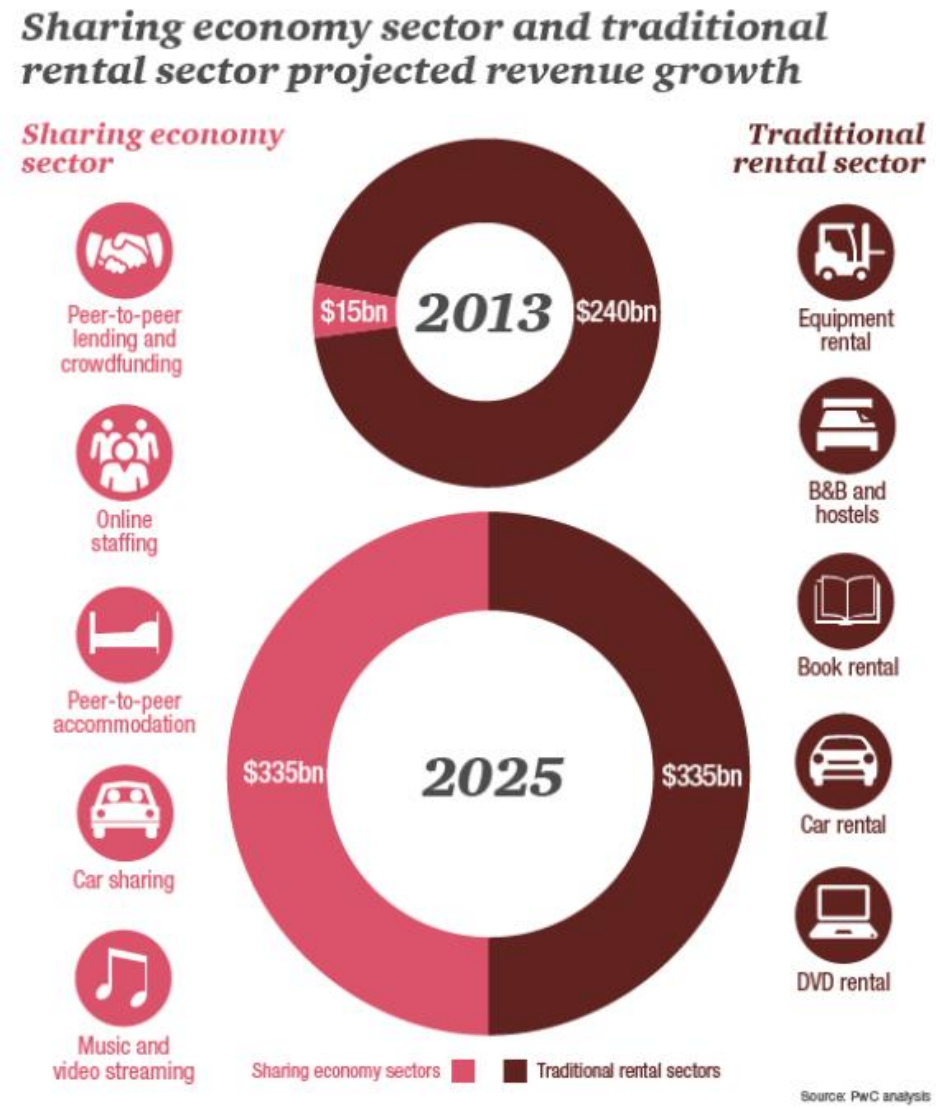
Brownfield development???

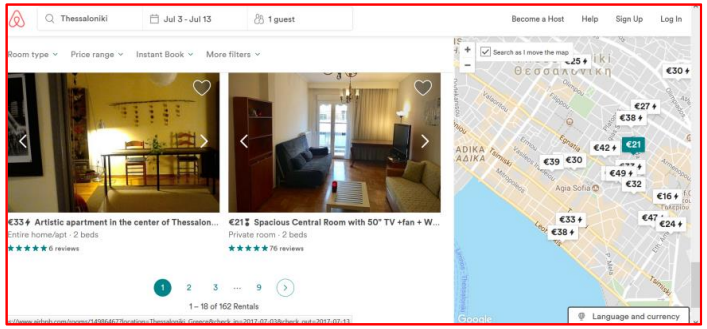
- Encourage the reuse of land by developing sites that are complicated by environmental contamination, thereby reducing pressure on undeveloped land.

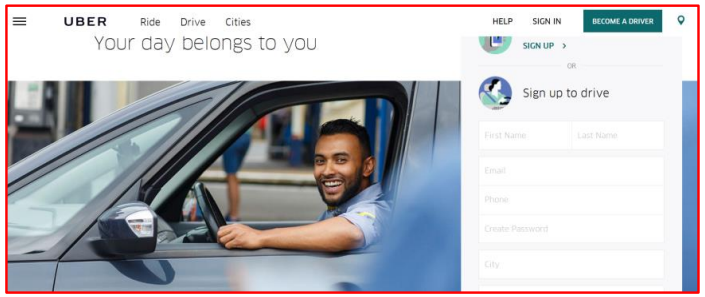
III. Platform-based business development



2-sided platforms in every sector: an array of technologies & analytics







AI & Data Analytics
T1. Clustering
T2. Classification
T3. Prediction / forecasting
T4. Natural language processing/ Chatbots
T5. Facial recognition / Image recognition
T6. Analytics
T7. Data visualisation
T8. Detect or match data against patterns

Conclusion: higher user experience by related ecosystems

Smart city technologies for tourism ecosystems

Cities in which tourism is just another vertical market

- Smart tourism solutions take the form of e-services and data analytics offered by public and (mainly) private organisations.
- The design of applications, platforms and e-services prevail over the technologies used. Even most advanced technologies do not guarantee successful e-services.
- Besides the significance of tourism for economic growth, **digital applications and e-services fall behind**, and the gap is covered by big global platforms.
- Going beyond the state of the art in smart tourism asks for localized strategies and e-services design under a S-D logic.

In cities totally depending on tourism

Smart city systems can offer a more comprehensive user experience based on complementary to tourism ecosystems.

Opportunity for a radical transformation of the entire urban system based on smart districts:

- MaaS and places without cars
- Net-zero energy districts and clean environment
- Platform-based economies, and active engagement of the population in all sectors of the local economy
- Smart thematic parks and entertainment and others

In the near future, highest user experience, which is the main goal of tourist cities, **can be achieved by the digital transformation of complementary to tourism ecosystems.**

Thank you!
Glad to discuss any questions