Technological pillars to enable Smarter (Collaborative + Inclusive) Environments: Internet of Things, Web of Data and Citizen Participation

Workshop Co-Creating of Inclusive and Mediated Public Spaces
13-16 February, Lisbon, Portugal

Dr. Diego López-de-Ipiña González-de-Artaza
dipina@deusto.es
http://paginaspersonales.deusto.es/dipina
http://www.morelab.deusto.es
Agenda

1. Introduction: Technological and methodical pillars for Smarter Environment Enablement
2. Part I: Smarter Environments Theoretical Grounding
   - What is a Smart Environment?
   - Technological enablers: IoT, Web of Data and Persuasive Technologies
   - Technology mediated Human Collaboration: need for co-creation
   - Killer application domains: Open Government & Age-friendly cities
3. Part II: Review of core enablers for Smarter Environments
   - Co-creation methodologies: Service Design and Design for Thinking
   - Internet of Things and Web of Things
   - Web of Data: Linked Data, Crowdsourcing & Big Data
   - Persuasive technologies and Behaviour Change
4. Part III: Implications for CyberParks
   - European projects on enabling Smarter Environments: WeLive, City4Age, GreenSoul
   - Reflections on the need for collaboration among stakeholders mediated with technology to realize CyberParks
5. Conclusions and practical implications
Smarter Public Open Spaces

• Smarter Spaces ➔ spaces that do not only manage their resources more efficiently but also are aware of the citizens’ needs.
  
  – Human/space interactions leave digital traces that can be compiled into comprehensive pictures of human daily facets
  
  – Analysis and discovery of the information behind the big amount of Broad Data captured on these smart spaces deployment

Smarter Places = Co-Creation/Citizen Participation + Internet of Things + Broad Data + Analytics
Smart Environments

- **Smart City** is a place where urban services are improved in efficiency by applying ICT, for the benefit of its inhabitants and economic development

- **Smart Territories** innovative geographic areas, able to build their own competitive advantages taking into account their context

- **Smart Places** → balance among economic competitiveness, social cohesion, innovative creativity, democratic governance and environmental sustainability
  - Satisfying the basic and self-fulfilment needs in the Maslow pyramid

---

**Maslow's Hierarchy of Needs**

- **Physiological needs:** food, water, warmth, rest
- **Safety needs:** security, safety
- **Belongingness and love needs:** intimate relationships, friends
- **Esteem needs:** prestige and feeling of accomplishment
- **Self-actualization:** achieving one's full potential, including creative activities

---

**cyberparks**

www.cyberparks-project.eu

**Universidad de Deusto**
Deustuko Unibertsitatea
Challenges for Smarter Cities

- **Enable life, work and leisure environments** which allow our self-fulfilment without disregarding basic needs and their development in welfare society
- **Answer to the urbanization demands** in an economically feasible, socially inclusive and sustainable manner
  - BUT... apply **traditional solutions** to the needs of urban development → **unsustainable urban ecology footprint**
    - Generate more electricity or new water resources not addressing inefficiencies in distribution
ICT as levers of Smarter Cities (I)

- ICTs will help in the urbanization and ageing problems associated to cities **iff the following 3 premises** are fulfilled:
  1. Social equity
  2. Economic feasibility and
  3. Environmental sustainability

- ICTs are key to leverage the existing urban infrastructure and maximize the socioeconomic throughput
  - A **more rational and extensive usage of ICT in cities and places** \( \rightarrow \) a quicker and more economic fulfilment of urban challenges
ICT as levers of Smarter Cities (II): Big | Open | Personal Data

• Big potential for enterprises, social entities and governments if there is a **better usage of infrastructure and information** (IoT + Open + Personal data) **in urban environments**:
  – **Big Data**: extensive analysis of heterogeneous urban data to **offer answers, indicators and visualizations** to help improving the decision criteria upon the challenges of cities and territory management

• It will allow us to **progress towards more disruptive approaches**
  – All agents should benefit from a more efficient usage of data processing technology to give place to **Urban or Physical Spaces Analytics**
    • **Great potential but huge difficulty associated!**
ICT as levers of Smarter Cities (III): Open Collaboration

• Smarter environments cannot only be reached through technological solutions
  – We have to take advantage of the huge potential of collective intelligence – citizenship capacity to generate knowledge through crowdsourcing techniques and co-creation – where ideation and production are socialized
  • Citizens are increasibly becoming prosumers & makers!
Social Open Innovation

• Novel solution to a social problem that is more effective, efficient, sustainable, or just than current solutions (CAPS).
  – New ideas (products, services and models) that simultaneously meet social needs and create new social relationships.
ICT as levers of Smarter Cities (V): Ethical Implications

• **Personal data are the “new petrol” of XXI century**, being exploited by big corporations such as Google, Apple (publicity + marketing) **BUT ...**
  – There are **multiple distributed personal data silos** among different Internet providers and institutions which **have to be interoperable**
  – There is a need for individuals to have a **greater control of their own personal data**

• Governments must:
  – **Regulate, protect, legislate to guarantee the rights and opportunities of such data providers (we)**
  – **Legislate and manage non-functional aspects (accessibility – technological inclusion, privacy, data protection and ethics** to achieve responsible technological solutions
Personal Data

- Defined as "any information relating to an identified or identifiable natural person ("data subject")"
Ambient Assisted Cities: Age-friendly Smart Cities

- The main attribute of a **Smart City** is **efficiency**
- An **Age-friendly city** is an inclusive and accessible urban environment that promotes active ageing
- The main attributes of an Ambient Assisted (Smarter) City are:
  - Livable
  - Accessible
  - Healthy
  - Inclusive
  - Participative

[WHO Global Network of Age-friendly Cities]
The need for Participative Cities

• Not enough with the traditional resource efficiency approach of Smart City initiatives
  • “City appeal and dynamicity” will be key to attract and retain citizens, companies and tourists
  • Only possible by user-driven and centric innovation:
    – The citizen should be heard, EMPOWERED!
      » Urban apps to enhance the experience and interactions of the citizen, by taking advantage of the city infrastructure
    – The information generated by cities and citizens must be linked and processed
      » How do we correlate, link and exploit such humongous data for all stakeholders’ benefit?
        • Demand for Big (Linked) Data for enabling Urban Analytics!!!
Broad Data Analytics

• Broad Data aggregates data from heterogeneous sources:
  – Open Government Data repositories
  – User-supplied data w/social networks or apps (OSM, Wikipedia)
  – Public private sector data or
  – End-user private data

• Huge potential on correlating and analysing Broad Data:
  – Leverage digital traces left by citizens in their daily interactions with the city to gain insights about why, how and when they do things
  – We can progress from Open City Data to Open Data Knowledge
    • Energy saving, improve health monitoring, optimized transport system, filtering and recommendation of contents and services
From Open Data to Open Knowledge

Open Broad Data
- Broad Data management
- Private Data vault

Open Knowledge
- Visualization components
- Harmonized Urban indicators/vocabulary
- Visualization wizard
- Data Workflow engine

Open Decision
- Assessment engine
- Stakeholder dashboard

Social & economic opportunities!
Agenda

1. **Introduction: Technological and methodical pillars for Smarter Environment Enablement**

2. **Part I: Smarter Environments Theoretical Grounding**
   - What is a Smart Environment?
   - Technological enablers: IoT, Web of Data and Persuasive Technologies
   - Technology mediated Human Collaboration: need for co-creation
   - Killer application domains: Open Government & Age-friendly cities

3. **Part II: Review of core enablers for Smarter Environments**
   - Co-creation methodologies: Service Design and Design for Thinking
   - Internet of Things and Web of Things
   - Web of Data: Linked Data, Crowdsourcing & Big Data
   - Persuasive technologies and Behaviour Change

4. **Part III: Implications for CyberParks**
   - European projects on enabling Smarter Environments: WeLive, City4Age, GreenSoul
   - Reflections on the need for collaboration among stakeholders mediated with technology to realize CyberParks

5. **Conclusions and practical implications**
Co-Creation of public services: service design approach through Design Thinking

Stakeholders Assessment

Requirements Definition

Conceptual Development

WeLive Framework Development

Evaluation

Business Model Development & Exploitation Plan

Empathize

Define

Ideate

Prototype

Test

Implementation

Inspiration

Ideation
THE
INTERNET OF THINGS
Explained
10 THINGS YOU NEED TO KNOW

WHAT IS IT?
A global network of connected people and devices

WHAT IS IT ENABLED BY?
Increasing technology costs, sensors, connectivity, APIs, and more...

WHAT DEVICES ARE INVOLVED?
- Artificial limbs
- Parking spaces
- Toothbrushes
- Kitchen appliances
- Wearable devices
- Jet engines
- Thermostats
- CARS
- Personal appliances
- Medical devices
- Lights
- Curling irons
- Home security systems
- Anything that has an on and off switch

WHAT ARE WAYS TO CONNECT?
- Human to Human
- Human to Device
- Device to Device

WHAT INDUSTRIES WILL BE IMPACTED?
- Virtually all including manufacturing, retail, transportation and logistics, healthcare, energy, agriculture, financial.
Internet of Things ... connecting information, people and things
6 facts about IoT

1. IoT is the term used to describe any kind of application that connected and made “things” interact through the Internet.

2. IoT is a communication network connecting things which have naming, sensing and processing abilities.

3. IoT is the next stage of the information revolution, i.e. the inter-connectivity of everything from urban transport to medical devices to household appliances.

4. Intelligent interactivity between human and things to exchange information & knowledge for new value creation.

5. IoT is not just about gathering of data but also about the analysis and use of data.

6. IoT is not just about “smart devices”; it is also about devices and services that help people become smarter.
Value of IoT

- Information within the Internet of Things creates value in a never-ending value loop consisting of 5 stages (CREATE ... to ACT):

  **ANALYZE**
  The discernment of patterns or relationships that leads to descriptions, predictions, or prescriptions for action

  **CREATE**
  The use of sensors to generate information about a physical event or state

  **AGGREGATE**
  The gathering together of information created at different times or from different sources

  **ACT**
  Initiating, maintaining, or changing a physical event or state

  **COMMUNICATE**
  The transmission of information across networks, from one place to another
Evolution of the Web

- Semantic technologies help to regain
- Productivity in the face of overwhelming
- Information growth...

The Intelligent Web
Web 4.0
2018
- Web scale reasoning
- Intelligent agents
- Natural language search
- Automatic semantic tagging (Ontologies)

The Semantic Web
Web 3.0
2009
- Human social tagging
  “folksonomies”

The Social Web
Web 2.0
1998
- Keyword search

The World Wide Web
Web 1.0
1998
- Databases
- Files & Folders
- Directories

The Desktop
PC Era
1979
- 1989

- As amount of data grows, keyword search
  - Is becoming less productive…
Linked Data Example

http://.../reviewer

Awesome Book

http://.../reviewer1

Juan Sequeda

http://juansequeda.com/id

hasReview

description

sameAs

http://.../isbn n978

title

author

isbn

publisher

sameAs

http://dbpedia.org/Austin

livesIn

name

Juan Sequeda

Programming the Semantic Web

Toby Segaran

978-0-596-15381-6

O’Reilly

http://.../publisher1

name
Google Knowledge Graph

Vitruvian Man - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Vitruvian_Man

The Vitruvian Man is a drawing created by Leonardo da Vinci circa 1490. It is accompanied by notes based on the work of the architect Vitruvius. The drawing...

Vitruvius - Leonardo's robot - Mirror writing - Module

The Vitruvian Man - Worlds of Leonardo da Vinci
leonardodavinci.stanford.edu/submissions/clabough//.../leonardo.html

leonardo's vitruvian man. "We know very little about Leonardo's apprenticeship in Verrocchio's workshop, but the short account provided by Vasari confirms that it...

Da Vinci's Vitruvian Man of math - James Earle - YouTube
www.youtube.com/watch?v=maMsAFP3kgQ

Jul 11, 2013 - Uploaded by TED-Ed

BBC - Science & Nature - Leonardo - VITRUVIAN MAN
www.bbc.co.uk/science/leonardo/gallery/vitruvian.shtml

An introduction to Leonardo da Vinci's 'Vitruvian Man' sketch with bbc.co.uk's guide to

Vitruvian Man

Art work

The Vitruvian Man is a drawing created by Leonardo da Vinci circa 1490. It is accompanied by notes based on the work of the architect Vitruvius. Wikipedia

Artist: Leonardo da Vinci

Dimensions: 34 cm x 26 cm
Data has changed

• 90% of the world’s data was created in the last two years
• 80% of enterprise data is unstructured
• Unstructured data growing 2x faster than structured
Analytics in the Smart City: Data-driven decision making
Big Data’s 4 Vs

Ingest massive volumes of data – with parallelization

Bring analytics to data – and vice versa

Elastically execute on large-scale requirements

Innovative analytics models

Various data sources
- Enterprise (operational and business) Data,
- Industrial Data & External Data
IoT & Big Data enabling Smart Spaces

• The more data that is created, the better understanding and wisdom people can obtain.
Types of Analytics (I)

Degree of business impact represents the shift from post-mortem analysis to informed future planning based on past experiences. The shift in the basis of decision making from hindsight to insight and foresight could help companies move closer to a business objective.

Complexity of analytics applications refers to the algorithmic sophistication of analytics tools used and characteristics (for example, scale, scope, and frequency) of data sets used.

The shift from descriptive to predictive and prescriptive analytics requires increasingly complex analytics applications (data scientists, large and clean data sets, big data tools); however, the higher degree of business impact should prompt companies to ascend the analytics stack and leverage the copious amount of data to aid decision making and action.
Agenda

1. Introduction: Technological and methodical pillars for Smarter Environment Enablement

2. Part I: Smarter Environments Theoretical Grounding
   – What is a Smart Environment?
   – Technological enablers: IoT, Web of Data and Persuasive Technologies
   – Technology mediated Human Collaboration: need for co-creation
   – Killer application domains: Open Government & Age-friendly cities

3. Part II: Review of core enablers for Smarter Environments
   – Co-creation methodologies: Service Design and Design for Thinking
   – Internet of Things and Web of Things
   – Web of Data: Linked Data, Crowdsourcing & Big Data
   – Persuasive technologies and Behaviour Change

4. Part III: Implications for CyberParks
   – European projects on enabling Smarter Environments: WeLive, City4Age, GreenSoul
   – Reflections on the need for collaboration among stakeholders mediated with technology to realize CyberParks

5. Conclusions and practical implications
IES Cities Project

• The IES Cities project promotes user-centric mobile micro-services that exploit open data and generate user-supplied data
  – Hypothesis: Users may help on improving, extending and enriching the open data in which micro-services are based

• Its platform aims to:
  – Enable user supplied data to complement, enrich and enhance existing datasets about a city
  – Facilitate the generation of citizen-centric apps that exploit urban data in different domains

European CIP project 2013-2016, Bristol, Majadahonda, Trento & Zaragoza involved

http://iescities.eu
Bristol’s Democratree App
What’s WeLive (I)

A novel We-Government ecosystem of tools (Live) that is easily deployable in different PA and which promotes co-innovation and co-creation of personalised public services through public-private partnerships and the empowerment of all stakeholders to actively take part in the value-chain of a municipality or a territory.

Open Data

Open Services

Open Innovation

http://welive.eu
WeLive proposes...

Transform the current e-government approach into...

WeLive Open and Collaborative Government Solution = We-government + t-government + l-government + m-government

- **We-**
  - All stakeholders are treated as peers and prosumers

- **t-**
  - Providing Technology tools to create public value

- **l-**
  - To do more with less by involving other players and the PA as orchestrator

- **m-**
  - Utilisation of mobile tech. for public services delivery
How? (I)

Stakeholder Collaboration + Public-private Partnership → IDEAS >> APPLICATIONS >> MARKETPLACE

1. WeLive offers tools to transform the needs into ideas

2. Tools to select the best Ideas and create the B. Blocks

3. A way to compose the Building Blocks into mass market Applications which can be exploited through the marketplace
How? (II): WeLive Service co-creation approach

- Challenge and Idea Generation
- Idea Evaluation and Selection
- Idea Refinement

Inspire and involve

Communities

Open Innovation Area

- Suggested collaborators list
- Suggested BBs and Datasets list to realize the PSA

Decision Engine

- Suggested PSAs list to user

Visual Composer

- Get required BBs list
- Publish PSAs

WeLive Marketplace

- Get required Datasets list

Query mapper

Open Data Stack

PSA Deployment

Open Service Layer

BBs and PSAs Registry and Execution environment

Public service App

WeLive Player

Research Query

WeLive

Core BB
Scenario-driven Artefact Definition per City

1 – Agree a common methodology for stakeholders involvement and scenarios definition (benchmarking)

2a – Activities execution for insights gathering – stakeholder consultation process

2b – Deep analysis of city strategy and pilot focus, current IT and open data infrastructure

3a – Scenario #1 definition

3b – Scenario #2 definition

4a – New public service #1

4b – New public service #2

4g – New public service #7

4h – New public service #8

5 – Set of building blocks
WeLive Vision/Architecture

Open Innovation Area
- Citizen
- Public Administration
- Open Innovation Layer
- Browse Apps
- Manage Profile
- Manage Ideas
- Check Analytics

Open Data Layer
- Citizen Data Vault
- Open Data Stack
- Social Network Data
- Open Data
- Private Data

WEB Controller
- API
- Marketplace
- Visual Composer
- Decision Engine
- Analytics Dashboard
- Building Block Hosting Environment
- Standard BB Hosting Env.
- High Performance BB Hosting Env.

Researcher
- Local Businesses & Companies
Un concepto de administración pública basado en servicios móviles co-creados por el ciudadano.

Ecosistema de Herramientas WeLive

Open Innovation Area
Es un entorno de co-creación social donde necesidades, ideas y posibles "soltuiones" pueden ser revisadas y solicitadas a las Administraciones Públicas para su implementación. Este es el lugar donde las solicitudes encuentran posibles ofertas. Ofrece:
- herramientas para elicitar, analizar y mejorar las ideas;
- herramientas para votar y seleccionar las mejores Ideas para una determinada necesidad;
- herramientas para permitir a las empresas ofrecer soluciones técnicas a las ideas seleccionadas y ser subvencionadas por los ciudadanos interesados o la Administración Pública.

Marketplace
El Marketplace es el repositorio donde consultar las apps, building blocks y datasets disponibles. En él, los datasets, building blocks y apps de servicios públicos pueden ser examinados, seleccionados y adquiridos por los diferentes usuarios de la solución WeLive.

Open Data Stack
Open Data Stack es la herramienta WeLive a cargo de la gestión de datasets de Bilbao, Novi Sad, Helsinki-Uusimaa y Trento. En particular, este componente se encarga de:
- Combinación de datos sociales, datos públicos del gobierno e incluso datos generados por el usuario.
- Acceso, integración, consulta y verificación de datasets heterogéneos.
- Gestión de entidades de datos relacionadas: datasets, recursos, producciones de datos, generadores de datos, etc.
WeLive REST API

This page contains an interactive representation of the WeLive project’s API using Swagger.

The API manual can be accessed [here](#).

<table>
<thead>
<tr>
<th>Method</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST</td>
<td>/ods/dataset</td>
<td>Creates a new dataset.</td>
</tr>
<tr>
<td>GET</td>
<td>/ods/dataset/all</td>
<td>Returns all datasets stored in the Open Data Stack.</td>
</tr>
<tr>
<td>DELETE</td>
<td>/ods/dataset/{datasetID}</td>
<td>Deletes a dataset.</td>
</tr>
<tr>
<td>GET</td>
<td>/ods/dataset/{datasetID}</td>
<td>Returns metadata about a dataset.</td>
</tr>
<tr>
<td>PUT</td>
<td>/ods/dataset/{datasetID}</td>
<td>Updates an existing dataset.</td>
</tr>
<tr>
<td>GET</td>
<td>/ods/dataset/{datasetID}/rating</td>
<td>Adds a rating to a dataset.</td>
</tr>
<tr>
<td>PUT</td>
<td>/ods/dataset/{datasetID}/rating</td>
<td>Adds a rating to a dataset.</td>
</tr>
<tr>
<td>POST</td>
<td>/ods/dataset/{datasetID}/resource</td>
<td>Creates a new resource.</td>
</tr>
<tr>
<td>DELETE</td>
<td>/ods/dataset/{datasetID}/resource/{resourceID}</td>
<td>Deletes a resource.</td>
</tr>
<tr>
<td>GET</td>
<td>/ods/dataset/{datasetID}/resource/{resourceID}</td>
<td>Returns a resource.</td>
</tr>
</tbody>
</table>
WeLive Apps: Bilbozkatu

All WeLive apps available at: https://play.google.com/store/search?q=welive_project
• Addresses the need to offer a more efficient and more effective experience to companies and citizens in their daily interaction with Public Administration (PA)
  – Providing a personalized delivery of e-services based on advanced cognitive system technologies and by promoting an active engagement of people for the continuous improvement of the interaction with these services.

http://www.simpatico-project.eu/
PA traditional e-services vs. SIMPATICO approach
Conclusion

• We need **cooperative cities and territories** which are inclusive, participative, aware and responsive to the needs of all societal sectors
  – ICT intertwined with co-creation through multi-stakeholder involvement are key to achieve smarter environments
    • To do more with what we have, without having to invest big amounts, but taking advantage of information that is already available, transforming knowledge, democratizing its access and usage, protecting and regulating its usage, and easing decision making among different actors
Learning Goals

1. Know about the key methodologies and technological enablers of Smarter Environments
2. Realize why the right technology is not enough to enable acceptable Smarter Environments
3. Understand how to democratize technology usage so that it serves to empower users in an inclusive manner to foster better more acceptable Smart Environments
4. Gain an understanding on how stakeholder engagement and participation approaches are being successfully combined with technology
5. Learn what technologies and user involvement methods are available and how to bring them together to pursue CyberParks goals
Technological pillars to enable Smarter (Collaborative + Inclusive) Environments: Internet of Things, Web of Data and Citizen Participation

Workshop Co-Creating of Inclusive and Mediated Public Spaces
13-16 February, Lisbon, Portugal

Dr. Diego López-de-Ipiña González-de-Artaza
dipina@deusto.es
http://paginaspersonales.deusto.es/dipina
http://www.morelab.deusto.es
References

• Innovating the Smart Cities, Syam Madanapalli | IEEE Smart Tech Workshop 2015, http://www.slideshare.net/smadanapalli/innovating-the-smart-cities


References


References

• Internet of Things towards Ubiquitous and Mobile Computing

• 5 key questions to ask about the Internet of Things

• Internet Connected Objects for Reconfigurable Eco-systems

• Internet of Things and Big Data – Bosch, August 2015

• The internet of things and big data: Unlocking the power
References

• Deconstructing the Internet of Things
  – https://jenson.org/deconstructing-the-iot/

• Mobile in IoT Context ? Mobile Applications in "Industry 4.0"

• Inside the Internet of Things (IoT) – A primer on the technologies building the IoT – Deloitte

• Internet of Things (IoT) - We Are at the Tip of An Iceberg – Dr. Mazlan Abbas

• Infographic: What are Beacons and What Do They Do?
  – https://kontakt.io/blog/infographic-beacons/

• iBeacon
References

• ITU News – What is a smart sustainable city?,

• Frost & Sullivan's Predictions for the Global Energy and Environment Market,

• Fog Computing with VORTEX
  – http://www.slideshare.net/Angelo.Corsaro/20141210-fog

• What Exactly Is The "Internet of Things"? – A graphic primer behind the term & technologies
References

• The Big 'Big Data' Question: Hadoop or Spark?

• Hadoop vs. Spark: The New Age of Big Data

• Comparing 11 IoT Development Platforms
  – https://dzone.com/articles/iot-software-platform-comparison

• Moving from Descriptive to Cognitive Analytics on your Big Data Projects, Gene Villeneuve, IBM,
  http://www.slideshare.net/ibmsverige/gene-villeneuve-moving-from-descriptive-to-cognitive-analytics

• Virtualisation and Validation of Smart City Data. Dr Sefki Kolozali. Dr Payam Barnaghi