Efficienza energetica e comfort abitativo
Tecnologie non invasive e sicurezza
Sostenibilità economica e ambientale

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BOLZANO SMART CITY

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OUTLINE:

- WORLD URBANIZATION TRENDS
- CITY EVOLUTION
- CITIES AS COMPLEX SYSTEMS
- SMART CITY PLANNING
- SINFONIA: BOLZANO SMART CITY
WORLD URBANIZATION TRENDS

1950: 30% World population in cities
2008: 50% World population in cities
TODAY: 54% World population in cities
North America: 82%; South America: 80%; EU: 73%
BY 2100: 80% World population in cities

50% in medium/small cities (< 500000 inh)
12.5% in the 28 mega-cities (>10 Mln inh)

TOKYO 38 Mln
DEHLI 25 Mln
SHANGAI 23 Mln
MEXICO CITY; MUMBAI
SAO PAULO 21 Mln
First cities: tight, bound, compact
Last 200 years: first walls went off, then suburbs came, finally national transportation
London first reached 1 Mln inh

Today’s cities: more people living in cities, more connections, faster information flow. Cities as connected graphs, hyperlinks in space/time

Future cities: when all the world is a city. WILL WE STILL SPEAK OF CITIES?
Defining density and connectivity
CITIES ARE COMPLEX ADAPTIVE SYSTEMS:
- Heterogeneity of people
- Circular causality feedbacks
- Everything is interconnected
- Cities develop in open-ended ways
- Human development is about INFORMATION
- Evolution of information
**FACTS ABOUT CITIES:**

- When a city doubles in size, per capita **ECONOMIC PRODUCTIVITY INCREASES BY 15%**
- Cities rely on **INFRASTRUCTURES**
- Cities are **SOCIAL NETWORKS**

- There is a set of scaling relations for average social spatial infrastructural properties common **to all CITIES**

- A city is a **dynamical system**: It needs to evolve around you and you around the city
- Cities are general purpose **social reactors**

- **URBAN PLANNING STRATEGIES:**
  average **global properties** of cities set by a few **key parameters**
Building a SMART CITY

A slew of initiatives are taking place islandwide, the goal of which is to sharpen the Government's response to city issues and hence improve people's day-to-day lives.

**TOWN PLANNING**
What: A modelling system to simulate a city’s built environment and its impact on the natural environment, people, resources and costs
Who: HDB, Electricité de France, Veolia
Uses: Among other things, show how different land uses affect amenities and transport networks; how to design new housing blocks to get ideal wind flow; where best to build cycling paths
Status: Research collaboration / prototype stage

**WATER QUALITY AND LEAKS**
What: A network of wireless sensors that monitors water quality and detects leaks in real time
Who: PUB, Singapore-MIT Alliance for Research and Technology, Visenti
Uses: Allows PUB to repair leaks faster and reduce water loss
Status: About 300 sensors installed by end-2015

**3D MAPPING**
What: Mapping the country in 3D from the air by using light planes equipped with lasers and cameras
Who: Singapore Land Authority
Uses: PUB could use the map to model flood patterns, while the Civil Aviation Authority of Singapore could plan more efficient landing paths for planes
Status: Expected to be completed by 2016

**DISEASE AND HYGIENE**
What: Computer models that use sensors and mobile apps to help detect and forestall dengue and food poisoning outbreaks
Who: National Environment Agency (NEA), IBM
Uses: For example, if people complain on Facebook or Twitter of being sick after eating at a particular restaurant, the system would alert NEA officers
Status: Research collaboration

**IMPROVING PUBLIC TRANSPORT**
What: Analysing CCTV video feeds and anonymised location-based data from mobile subscribers to learn commuters' travel patterns
Who: Land Transport Authority, SMRT, StarHub, IBM
Uses: Help agencies respond better to unplanned incidents on the train and bus network, such as breakdowns or emergencies
Status: Research collaboration

**PROTECTING THE SEA**
What: Eight buoys along coastline with sensors that test waters for pollutants and send real-time updates wirelessly to the NEA
Who: National Environment Agency (NEA)
Uses: Early detection of oil or chemical spills
Status: In place

**Songdo, South Korea**
$40 Bln
The Top 5 Smart Cities In The World

- Technologies
- Buildings
- Utilities
- Transportation & road infrastructure
- The smart city itself

1. Barcelona
2. London
3. New York
4. Nice
5. Singapore
The Origins of Scaling in Cities

Luis M. A. Bettencourt

Despite the increasing importance of cities in human societies, our ability to understand them scientifically and manage them in practice has remained limited. The greatest difficulties to any scientific approach to cities have resulted from their many interdependent facets, as social, economic, infrastructural, and spatial complex systems that exist in similar but changing forms over a huge range of scales. Here, I show how all cities may evolve according to a small set of basic principles that operate locally. A theoretical framework was developed to predict the average social, spatial, and infrastructural properties of cities as a set of scaling relations that apply to all urban systems. Confirmation of these predictions was observed for thousands of cities worldwide, from many urban systems at different levels of development. Measures of urban efficiency, capturing the balance between socioeconomic outputs and infrastructural costs, were shown to be independent of city size and might be a useful means to evaluate urban planning strategies.

Cities exist, in recognizable but changing forms, over an enormous range of scales (1), from small towns with just a few people to the gigantic metropolis of Tokyo, with more than 35 million inhabitants. Many parallels have been suggested between cities and other complex systems, from river networks (2) and biological organisms (3–6) to insect colonies (1, 7) and ecosystems (8). The central flaw of all these arguments is their emphasis on analogies of form rather than function, which limit their ability to help us understand and plan cities.

Recently, our increasing ability to collect and share data on many aspects of urban life has begun to supply us with better clues to the properties of cities, in terms of general statistical patterns of land use, urban infrastructure, and rates of socioeconomic activity (6, 9–13). These empirical observations have been summarized across several disciplines, from geography to economics, in terms of how different urban quantities (such as the area of roads or wages paid) depend on city size, usually measured by its population, N.

The evidence from many empirical studies over the past 40 years points to there being no special size to cities, so that most urban properties, Y, vary continuously with population size and are well described mathematically on average by power-law scaling relations of the form $Y = Y_0 N^\beta$, where $Y_0$ and $\beta$ are constants in N. The surprise, perhaps, is that cities of different sizes do have very different properties. Specifically, one generally observes that rates of social quantities (such as wages or new inventions) increase per capita with city size (11, 12) (superlinear scaling $\beta = 1 + \delta > 1$, with $\delta = 0.15$), whereas the volume occupied by urban infrastructure per capita (roads, cables, etc.) decreases (sublinear scaling, $\beta = 1 - \delta < 1$) (Fig. 1). Thus, these data summarize familiar expectations that larger cities are not only more expensive and congested, but also more exciting and creative when compared to smaller towns.

These empirical results also suggest that, despite their apparent complexity, cities may actually be quite simple: Their average global properties may be set by just a few key parameters (12, 13). However, the origin of these observed scaling relations and an explanation for the interdependencies between spatial, infrastructural, and social facets of the city have remained a mystery.

Here, I develop a unified and quantitative framework to understand, at a theoretical level, how cities operate and how these interdependencies arise. Consider first the simplest model of a city with circumscribing land area A and
SINFONIA PROJECT – FP7 8.8.1 ENERGY SCC
2014-2019
“SMART INITIATIVE OF CITIES FULLY COMMITTED TO INVEST IN ADVANCED LARGE-SCALED ENERGY SOLUTIONS”
FOCUS ON DISTRICT LEVEL REPLICABLE AND SCALABLE solutions to:

- Achieve 40 to 50% primary energy savings
- Increase the share of renewables by 20% in the district

- Retrofitting of > 37,000m² of living surface
- Optimisation of the electricity grid
- Solutions for district heating and cooling
BOLZANO

Inhabitants: 104,000
Surface: 5,240 ha
Settlement area: 900 ha
Industry: 450 ha
Agriculture: 1,300 ha
Forest: 2,600 ha
MOBILITY: AIR QUALITY

Map with the Air Quality provided by CISMA
Weather conditions: homogeneous clusters for microclimate (15 classes)
DENSITY WEIGHTED ANALYSIS OF:

- schools (with internal weights),
- bars/restaurants, stores (>= 50 workers),
- theaters/museums, parking (no hospital and >= 150 places),
- stations (bus and train),
- principal squares
SUSTAINABLE ENERGY PLAN

Bolzano Smart Energy City Plan

1. Buildings
   - 1.1 District Heating
     - 1.1.1 Extension of the existing DH net and connection to the incinerator (32.8 MWh/year).
   - 1.2 Energy retrofitting of public buildings
     - 1.2.1 Offices
     - 1.2.2 Residential buildings belonging to the Municipality
     - 1.2.3 Residential Buildings belonging to the Social Housing Programme
   - 1.3 Smart Grid
     - 1.3.1 Distribution starting from the industrial area

2. Mobility
   - 2.1 New cycle paths
     - 2.1.1 New cycle paths, added to the existing 50 km
     - 2.2 New public transport system
       - 2.2.1 New tramway Oltradige
       - 2.2.2 New tramway connection between the Industrial Area and the city centre.
   - 2.3 Parking
     - 2.3.1 14 underground parks: 2000 parking lots
   - 2.4 Promotion of electric vehicles (cars and bikes)
   - 2.5 Reorganization of goods distribution inside the city
     - 2.5.1 Test attuativo piani distribuzione organizzata
   - 2.6 Public lighting

3. Renewables
   - 3.1 Co-generation
     - New project of Cardano hydropower plant (40 mil)
   - 3.2 Hydropower

Connection to the Incinerator
SOCIAL HOUSING BUILDINGS OF 1950-70TIES

- Building envelope insulation;
- Integration of renewable energy sources for electricity, heating and domestic hot water;
- PV panels;
- Additional storeys using innovative timber construction technologies.
PASSEGGIATA DEI CASTANI
STUDIO MELLANO&ARCH+MORE
URBAN SERVICE-ORIENTED SENSIBLE GRID (USOS-GRID)

- Recharge points for vehicles and bicycles;
- Meteorological stations for local climate condition monitoring;
- Smart retrofitting of the public lighting system.

Smart points 150
Different services 6
Citizens involved 50,000
THE DISTRICT & COOLING NETWORK EXTENDED AND OPTIMISED

- Real time monitoring and forecasting of peak loads and energy demand;
- Hybrid hydrogen/methane backup system;
- Feasibility study for recovery of wasted energy in the local industrial park.

Expected reduction of

CO2eq up to 30%
NOx up to 60%
WWW.SINFONIA-SMARTCITIES.EU