Economics of sustainability

From sustainable intelligent cities, to efficient smart materials

More and more metropolitan cities are facing different types of dysfunctions, related to poor management of space, human and material resources. Energy, natural and social crises for example are the most common problems encountered, even in the most advanced and developed countries. However, there are still capitals in developing regions, facing crises in an even larger and more sever scale, connected to lack of food, water and healthcare services. Modern cities face major challenges, such as climate change, economic restructuring, the move to online retail, ageing populations, pressures on public finances, environmental degradation and overconsumption. Most of those malfunctions derived from insufficient management of resources, both within cities, as well as within entire countries or even continents. As a result, a modern city, must be sustainable, in order to be functional over time.

Sustainability is the endurance of systems and processes. Sustainable development is the key word to sustainability science, including four interconnected domains: ecology, economics, politics and culture. The survival of humans and the improvement of its natural inhabited space, depends on the preserve of healthy ecosystems. Environmentally-friendly chemical engineering, environmental resources management and environmental protection reduce human negative impact on the cities. Living sustainably is based on reorganizing living conditions, reappraising economic sectors and work practices, using science to develop new green and renewable technologies, or adjusting in individual lifestyles that conserve natural resources.

Thinking about sustainable city growth, one must take into consideration both sort and long term planning of the maximum exploitation of the available resources of the area, both natural and artificial, as well as human resources. However, in order to be able to take advantage of the local sources, in long term, they must be renewable and relatively of low cost. Resources must be treated carefully and maintained, in order to be exploitable.

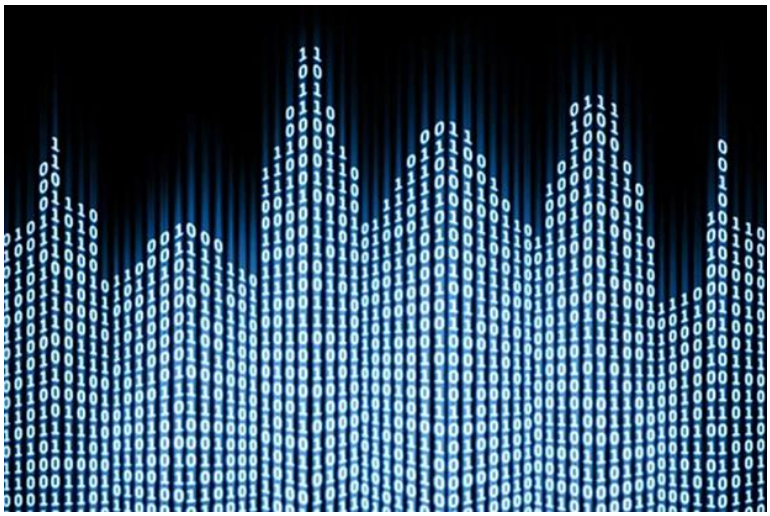
When planning spaces in an already existing city, all variables must be taken into account creating an effective circular system of production, exploitation and transports. That includes all the difficult to be estimated factors, such as human behavior and climate changes. An architectural plan must have the potential to re-adjust in different versions of plots for the same area, evolving during time accordingly to its variables. Transforming a city in a sustainable alive system, is highly related to the offering of motivations to the inhabitants. Motivations must be connected with comfort and flexibility, rather than obligation.

There are plenty of different kind of solutions referring to better organization of the natural, artificial and human resources of cities. During the last years, there is an evident attempt to organize cities in a more futuristic, interconnected, digital way, using new technologies and smart design methods. The interaction of the inhabitants and the users with their environment is essential, as well as their participation in the designing process. Improving transportation systems, delivering real time information, connecting different parts of the cities, inheriting holistic ways to regenerate innovatively urban spaces, using renewable energies and new technological systems to reduce carbon emissions and energy consumption are some of the characteristics of the modern advanced, sustainable, smart cities.

http://www.smartgridtechnology.net/smart-grid-news/

But, are smart cities the solution to malfunctions of the contemporary cities? And are they sustainable in reality? This questions can only be answered taking into account both sort and long term results in public space, facilities and daily life.

Smart cities respond to these basic axes: smart economy, smart mobility, smart environment, smart people, smart living and smart governance. They are considered to be sustainable by definition. They constitute the result of the collaboration of multiple different scientific, economic and constructive fields. They take advantage of digital technologies to improve the quality of daily life, as well as the environmental conditions. A smart city must be also able to re-transform constantly according to new data received minute by minute. Everything within the city becomes internet connected.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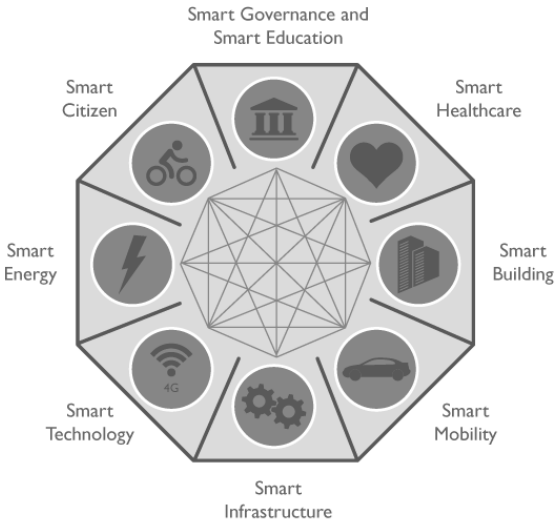
Its efficiency depends on how fast it responds in daily changes and challenges. An intelligent city focuses on the citizens, mutating them into designers of their own inhabited environment. Those data can be either information collected by nature, or data implemented to the intelligent systems by humans. An intelligent city constitutes a multi-dimensional space. It evolves in three dimensions as it occupies space, in four

dimensions as it evolves through time and in five dimensions as it includes transferring of information.

"It is defined as multi-layer territorial systems of innovation that bring together knowledge-intensive activities, institutions for cooperation in learning and innovation, and digital spaces for communication and interaction in order to maximize the problem-solving capability of the city. The distinctive characteristic of an intelligent city is the high performance in the field of innovation, because innovation and solving of new problems are main features of intelligence."

From Wikipedia, the free encyclopedia

Transport, energy, health care, social services, safety, water and waste management are the basic sectors with which a smart city interferes. Development of dynamic simulation tools, creation of new energy cycles and resources, improving mobility function, monitoring of the results, creating a system of public updating information and contribution, optimization of smart distribution, satellite observation and control, application of innovative smart grid technologies, energy storage, design lines between conservation and urban development, funds for sustainable designing, creation of logistic facilities, obtaining a new environmental culture, conserving and enhancing resources, improving health care and education systems, data transmission from city to city, from building to building, from man to man, electrically powered mobility, good use of creative industries, smart electricity distribution and production are only some of the possibilities offered by an intelligent city's design. Smart grids enable urban energy networks that respond dynamically to human mobility and behavioral patterns.

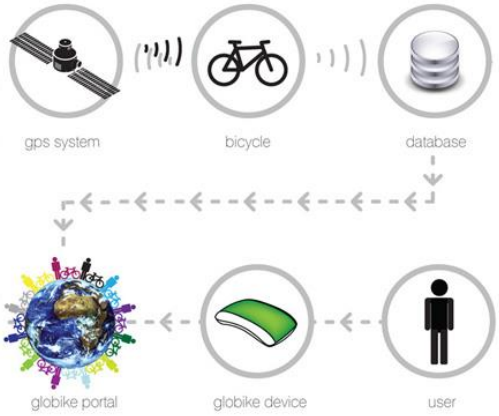


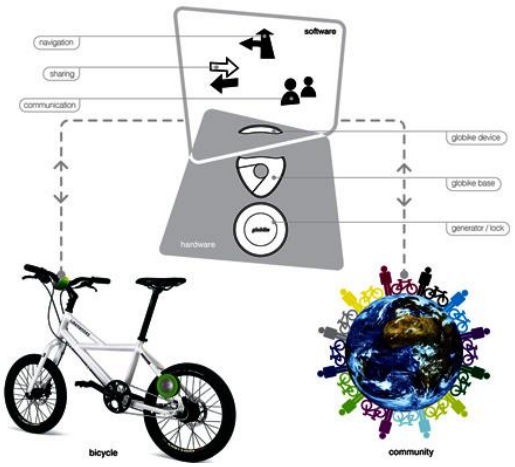
Many countries such as Germany, Sweden, Netherlands, Spain, United Kindom, Brazil, etc embrace that smart cities principles. There are plenty examples in cities using smart systems and design to become more efficient and sustainable. Some of them are mentioned below.

The Smart Cities platform from Libelium, is a system of integrators that monitor noise, pollution, structural health and waste management, combined with sensor boards for gas monitoring, radiation detection and Smart Parking.

Masdar City, designed by the British architectural firm Foster and Partners, relies on solar energy and other renewable energy sources. Its design was considered to be friendly to pedestrians and cyclists. In this green city, automated electric-powered vehicles are used for transports.
“Masdar is powered by a 22-hectare field of 87,777 solar panels with additional panels on roofs. There are no light switches or water taps in the city; movement sensors control lighting and water to cut electricity and water consumption by 51 and 55 percent respectively. Besides photovoltaics, concentrated solar power (CSP) plants are being explored. For example, so-called "beam down" CSP plants have been constructed to test the viability of use in the city. Water management has been planned in an environmentally sound manner as well. Approximately 80 percent of the water used will be recycled and waste water will be reused "as many times as possible", with this greywater being used for crop irrigation and other purposes.”

From Wikipedia, the free encyclopedia
Bicycle sharing systems are very common in European capitals. Through this smart system that consist of different public stations, citizens are encouraged to use bicycles for their daily transportations. This system allow you to borrow a bicycle for a specific time from point A and return it to a station in point B. This allows each bike to serve several users per day. For many systems, smartphone mapping apps show nearby stations. They consist of a data base that allow you to follow constantly how many bikes and how many open docks are available at each station. A system like that has been developed also in Barcelona. The largest one are located in China (Wuhan and Hangzhou Public Bicycle bike-share systems)



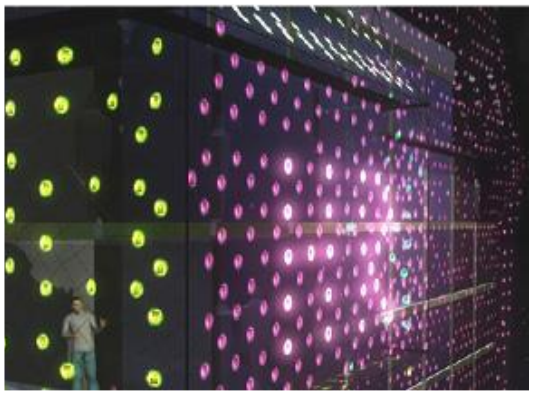


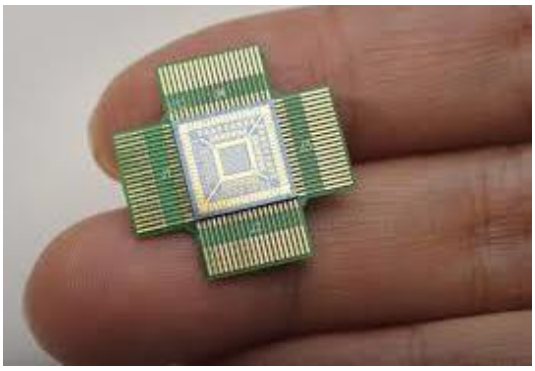
As soon as intelligent cities became reality, they have been searching out for equal structural elements, sustainable building blocks to consist of. The development of smart materials came as a response to the advanced city’s needs for new, innovative components that are capable of fulfilling the tomorrow’s world possible needs and ambitions. Smart materials are materials that are capable of interacting with their environment, both natural and artificial one. They have the ability to perceive stimulus derived from their environments and produce a result as a respond to it. Their efficiency depends on their degree of adaptability in terms of practical, social and economic performance. They constitute a new kind of materials, especially designed to react in a very specific and programmed way. Smart materials are used to simplify complex

technical systems by integrating new properties and functionality. The development of advanced materials can play an important role to sustainable economic growth.

Some of the most important categories of smart materials are chromics that have the ability to change color according to a specific stimulus, phase changing materials that produce energy by changing from liquid to solid and vice versa, conducting polymers, rheological materials responding to electric or magnetic fields, light emitting materials, semiconductors, piezoelectric and shape memory materials. Those categories can be used in innovative ways to create sustainable, interactive, self-evolving environments.

There are numerous different examples of smart materials use in city design, improving its sustainability. One of them is energy producing pavements in Tokyo, using piezoelectric materials to produce energy from the passengers' motion. Smart facades are also very common examples of smart materials used in design of smart cities. For example, the building of Chanel in Tokyo that has a smart façade-screen consisted of LEDs, Prestige Forest Hotel that imitates the function of leaves by harvesting energy during the sunlight and return it to the environment at night, SmartWrap designed for energy management, GlassX that uses phase changing materials to reduce energy consumption for heating, self-cleaning materials used in Japan and Austria and a lot more.





New technological achievements, such as smart materials and intelligent cities, can be used to improve daily life and increase sustainability. However, not all of them are easily and environmental friendly produced. Some of them might also be used in an unhealthy or insufficient way. Thus, no matter how helpful those technologies are, we must always consider their effect in the environment. Their disappearance or spread out depends on the comparison of their advantages and their disadvantages according to the modern city's needs.