

MASTER IN COLLECTIVE HOUSING

MODULE IN CITY SCIENCES

2021 SYLLABUS



ETH zürich

Master of Advanced Studies in Collective Housing
Edition 2021

CALENDAR**SESSION 1****May 18th****Present & Future Cities / ICT in Cities**

15:00 to 16:30

Intro /P&FC

Alejandro de Miguel

17:15 to 18:45

ICT I

Daniel Sarasa

19:00 to 20:30

ICT II

Gustavo Romanillos

SESSION 2**May 19th****Energy in Cities**

15:30 to 17:00

Energy I

Oscar Garcia

17:15 to 18:45

Energy II

Oscar Garcia

19:00 to 20:30

Energy III

Oscar Garcia

SESSION 3**May 20th****Transport in Cities**

15:30 to 17:00

Transport I

Andres Monzon

17:15 to 18:45

Transport II

Andres Monzon

19:00 to 20:30

Transport III

Andres Monzon

SESSION 4**May 21st****Sustainability in Cities**

15:30 to 17:00

Sustainability I

Javier Rubio de Urquia

17:15 to 18:45

Sustainability II

Rafael Borge

19:00 to 20:30

Sustainability III

Rafael Borge

SESSION 5**June 2nd****Review session**

15:30 to 20:30

Review

Alejandro de Miguel



Alejandro de Miguel Solano
Present & Future Cities / ICT
Module Coordination



Daniel Sarasa
Present & Future Cities / ICT
Innovation in Cities



Gustavo Romanillos
Present & Future Cities / ICT
Innovation in Cities



Oscar Garcia
Energy in Cities



Andres Monzon
Transport & Mobility in Cities



Javier Rubio de Urquia
Sustainability in Cities



Rafael Borge
Sustainability in Cities



SESSION 1: PRESENT & FUTURE CITIES / ICT

Present & Future Cities / ICT Lecture 1

Alejandro de Miguel Solano

Module Coordinator

Architect (B.Arch) (M.Arch, hons) (ARB). Urban Designer (M.Sc). Prince 2 Project Manager.

Alejandro has developed his activity as an Architect and Urban Designer in award-winning offices in China, Madrid and London. His experience in architectural and urban projects ranges from bespoke single-family dwellings to city-wide strategic masterplans.

In his research activity, further to his education on City Sciences, he has coordinated several research projects for the Ministry of Development of Spain on topics as diverse as European energy strategies, performance of city services and quality of life indicators.

Currently, he holds a Senior Urban Designer position in the London branch of AECOM, an American firm that provides design, consulting, construction, and management services globally.

Straight off the bat, some figures. More than 50% of the world's population lives in cities and this figure is expected to increase by 10% by 2030, according to World Bank data. Cities are responsible for 67% of the total energy consumption in the world and more than 70% of greenhouse gas emissions. Every month, around the world, a constant flow of 5 million people moves from the countryside to the city.

Urban areas have become the basic environment for personal and social development, engines of economic activity, spaces for innovation and centres for the provision of services, yet they are also an energy-devouring beast, where rampant segregation and poverty spread. Their rapid expansion sometimes means that health, education, entertainment, or security are met with greater difficulties, as the growing population specially demands energy, proper waste management and transport services, as well as housing. Cities are a global phenomenon, with global impacts.

In trying to approach the issues that affect cities and their future development worldwide, a careful characterization of the cities of our time must be taken into account when trying to address some of their challenges.

One consideration is related with the complexity of the urban context. The city is made up of a myriad of different elements, both concrete -such as citizens and built elements- and abstract- such as services and regulation. The specific combination of these pieces determines the behaviour of each city, and they react, sometimes unexpectedly, against asymmetries and perturbations.

When tackling complexity, the difficulty of describing and predicting patterns in a given city is one of the challenges that scientists must face daily. When studying the urban context, it is a challenge to find a one-fits-all viable model. Even if cities are ubiquitous, these approximations must be site-specific to respond to the morphological and typological conditions of each city. With all these caveats in place, a systematic approach is paramount in order to be able to understand anything.

Another consideration. We are progressively moving towards a more 'sensitive' society: we have access to instant information on our smart phones 24/7 and more collective connectivity via our social networks than ever. Smart meters are deployed in most of the supply chain. Sensors can measure pollutant concentration at virtually any point of the city and they can monitor the saturation of urban roads in real-time. While the availability of data is shaping cities with new products and unexpected business opportunities, we are also more paralised and confused than ever.

A well-informed and integrated discipline is needed to combine the tools of sciences to be a guiding compass under the storm of complexity and data. Only such a multi-faceted discipline will be able to tackle urban planning, energy, mobility or services with mindful considerations to their interferences. Only then can designers, politicians and stakeholders take educated decisions that can improve cities.

It is the time of cities. It is the time for City Sciences.

How will cities of the future be? Can we begin to imagine them? Is it possible to build them or, on the contrary, are they and will they remain a utopia?

Where many people are, there are many ideas, so our job is to connect them with the digital infrastructures of the city. In this way, we can aspire to design public services not from bottom to top, but in a collaborative fashion.

Another feature of the future digital cities as an innovation platform: open source. Open source infrastructures, whether software, electronics, networks, data, laboratories, public space or buildings have 4 distinctive features: being understandable, accessible, reconfigurable and community-based.

There is much talk about energy sources: oil, renewable ... but we often forget to consider the new raw material of the digital economy: the data. Cities are based on a great gold mine: our data, those who give us power as consumers and those whose loss also leads to the loss of our privacy. Linked to the above, we think that there is no innovation and no common good if we do not launch the "innovation of the common good".

Cities, and our way of living in them, are undergoing a radical transformation. The digital revolution, climate change and many other factors are bringing about transformations in the social, economic and environmental spheres at an unprecedented rate. New technological tools are necessary to respond to the challenge of analysis and planning of the cities of the future.

In this context, Big Data has begun to create significant impacts in urban contexts. In the assessment of housing, the rental market, transportation and accessibility to community facilities, among others, big data has a big role to play. This class will cover the explosion in data-driven research on these aspects, with a particular focus on its effect on cycling and other sustainable modes of transportation, most of which has occurred in the last ten years.

The class will also dive into the use of new mapping technologies to understand the underlying urban problems, such as spatial and social imbalances and the impact of population density in Europe, the integration of immigrant population in world cities, or the eruption of Airbnb in tourist cities.

Present & Future Cities / ICT Lecture 2

Daniel Sarasa

Daniel Sarasa holds a Master of Telecommunications Engineering (MEng) by the Universidad de Zaragoza, and a Master in City Sciences by the Universidad Politécnica de Madrid (UPM).

Daniel Sarasa manages the Business and Innovation area of Zaragoza's Milla Digital innovation district. His responsibilities include managing Zaragoza's Open Urban Lab and the city WiFi network. He also coordinates the vision of the three start-up incubators of Milla Digital's ecosystem and led the European Projects team.

Approaching urban design from the IT and Telecom angle, Daniel Sarasa's role so far has been to architect some of the foundations of the city's innovation strategy.

Present & Future Cities / ICT Lecture 3

Gustavo Romanillos Arroyo

Architect, urban planner and PhD in Geography, his work focuses on the visualization, spatial analysis and modeling of urban and social dynamics, based on the application of Geographic Information Systems and other emergent technologies, and the use of new and unconventional data sources.

He teaches at the Complutense University of Madrid, where he coordinates the Master in Smart and Sustainable Cities. He also teaches at the Architectural Association School of Architecture of London and has been guest lecturer at several universities in Europe and Latin America. As an architect, he has developed a wide range of projects, some of which has been awarded in several international competitions of architecture and urbanism; as a researcher, he works in the tGIS research group at the Complutense University of Madrid and, as a consultant, he has worked or is working for different institutions and companies, such as the United Nations Development Programme, the Department of Urbanism of Madrid City Council or Distrito Castellana Norte in Madrid.

SESSION 5: ENERGY IN CITIES

Energy in Cities Lectures 1, 2 & 3

Óscar García Suarez

Óscar García holds a PhD in Electrical and Electronics Engineering from the Universidad Politécnica de Madrid (UPM) in 1999, where he is also a Full-Professor.

He is the Director of the Escuela Técnica Superior de Ingenieros Industriales (ETSII-UPM). He is the Vice-president of the Center for Industrial Electronics (CEI-UPM). He has participated in several international technical committees and he has been the Chairman of the SAAEI'13 conference.

His main area of research is power electronics. In this area, he has been involved in more than 70 research projects, he holds 8 patents and he has published more than 180 technical papers in scientific journals. His expertise in energy conversion has been applied to various sectors such as medical, industrial, telecommunication, defense and aerospace.

SESSION 2: TRANSPORT & MOBILITY IN CITIES

Transport & Mobility in Cities Lectures 1, 2 & 3

Andrés Monzón de Cáceres

Andrés Monzón is Professor of Transport at the Escuela de Caminos, Canales y Puertos of the Polytechnic University of Madrid. Currently, he is the Rector's Delegate for the Coordination of Activities between Campus, Teaching Structures and R&D&I, and Director of the International Doctoral School. He has been, for 13 years, Director of the Transport Research Centre. All this at the Polytechnic University of Madrid.

He is also President of the Transport Engineering Forum, Co-Chair of the Urban Mobility Working Group of ERTRAC and member of other scientific committees such as the International Highway and Urban Pollution, the Pan-American Transport Congress and the World Conference on Transport Research, the Congress of Transport Engineering, NECTAR Association.

He has worked as an expert in international institutions such as the European Commission, the European Investment Bank, the World Bank and the Inter-American Development Bank.

In the global effort to fight climate change, cities have some of the greatest potential -and the greatest imperative- to make a difference. With an increasing global migration into the world's urban areas, which are expected to support at least two-thirds of the total human population by 2050, most experts agree that cities have no choice but to transition toward low-carbon systems if they're going to remain viable.

Energy will need to be a primary focus of that effort. From the expansion of renewable energy sources to the adoption of cutting-edge energy efficiency and storage technologies, cities have the opportunity to drastically reduce their carbon footprints.

Energy is crucial for our lives. Modern society and quality of life are based on the extensive use of energy. Today, the objective of reducing the power consumption without losing quality of life is at stake. Therefore, a proper exploitation of clean energy resources is becoming more necessary with each passing day. A handful of conventional electrical generative sources (gas, hydroelectric, nuclear...) together with a wide generation based on wind, solar, bio-mass and other sources will provide our future energy.

This lecture will focus on the world-wide production of energy, extracted or captured directly from natural sources. Later, it will deal with the conversion or transformation process for the final consumption by the end-user. In this class, students will also learn about the war of electric generation portrayed by Edison and Tesla, and the progressive shift from AC to DC grids, amongst others.

Satisfying current needs without compromising the needs of future generations, is a key motto of modern sustainable mobility. This model enables movement with minimal environmental and territorial impact.

On average, people make 3,5 trips and spend 1 hour per day in commuting. Depending on external and internal features people choose a specific transport mode to move around the city. Being able to predict and influence on the mobility choice can have a large impact at a city-scale.

This session aims to provide an overall perspective on the mobility cycle in cities. The session will cover from the modal decision phase based on route choice to mobility modelling and management and the effects of mobility in shaping cities.

SESSION 4: SUSTAINABILITY IN CITIES

Sustainability in Cities Lecture 1

Today, cities are confronted with the task of minimizing their energy, water and food consumption, while keeping their excess heat production and air and water pollution at low ranges at the same time. This class discusses the relationships between climate change and urbanization and presents new trends and paradigms to maximize synergies and minimize trade-offs.

With Javier Rubio de Urquía we will learn that science-driven knowledge is a critical component of sustainable development, taking into account the importance of managing resources, increasing systemic synergies and effective waste management for the development of a successful city.

Javier Rubio de Urquía

Javier Rubio de Urquía holds a degree in Biology from the Universidad Complutense de Madrid (UCM).

He was the General Subdirector for Inspection and Technical Assistance of Foreign Trade in the Secretary of State of Commerce for 13 years, the Area Coordinator for Air Quality and Air Pollution in the Ministry of Environment for more than 8 years and the General Coordinator of Sustainability and Mobility in Madrid Council for another 8 years.

He has represented Spain's environmental efforts in several international committees, such as The Geneva Convention on Long-Range Transboundary Air Pollution, or the Environment and Transport Olympic Games Proposal for the city of Madrid in the 2016 and 2020 contests before the Olympic Committee.

He is currently a Chair Advisor for the National Parks Commission.

Air quality is an important issue with direct implications on urban planning, mobility and public management in general. Meeting air quality standards in urban environment is essential but also very challenging since both population and emissions concentrate on urban environments.

Effective measures and strategies to improve air quality in the city must take into account the influences of most of the pollutant emission sectors. Additionally, potential negative impacts on productive activities as well as social and economic costs play an important role.

While traditional information networks allow very accurate concentration levels of major pollutants regulated at the level of air quality (RD 102/2011), its complexity, infrastructure requirements and high cost make high density monitoring virtually impossible.

This hints the need to ensure the representativeness of the readings in relatively large areas of the city. Given the lack of homogeneity in the distribution of broadcasts, the existence of parameters affecting the dispersion of pollutants and the uneven population distribution it becomes very difficult to ensure that the measured values are representative. By contrast, the use of simple devices incorporating electrochemical sensors based on metallic or low-cost technologies and open as Arduino code oxides, allow to significantly increase the density monitoring, opening interesting possibilities.

Sustainability in Cities Lectures 2 & 3

Rafael Borge

Rafael Borge holds a degree on Forestry and Environmental Engineering from the Universidad Politécnica de Madrid (UPM) and a PhD on atmospheric modeling from UPM. He leads the Laboratory of Environmental Modelling at the Department of Chemical and Environmental Engineering of the Universidad Politécnica de Madrid.

Being an Associate Professor at this same University, he runs courses on environmental engineering, air quality and environmental modeling.

Currently, he coordinates the research project TECNAIRE, that aims at the development and integration of new technologies and methods for multiscale modelling and measuring of urban air pollution.

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