RESICITIES
Education for Resilient Cities

Funded by the
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Ipag Business School
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ONLINE COURSE ON CIRCULAR ECONOMY
IPAG Business School, Paris

An extra-curricular offered within the European project
RESICITIES: RESILIENT, SMART AND SUSTAINABLE CITIES

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Overview

This **online extra-curricular course** has been developed within the project "Building resilience through education for Sustainable, Collaborative and Smart Cities (RESICITIES), a project funded by the Erasmus Strategic Partnerships in the field of higher education.
Undergraduate and postgraduate students from any university can register for this course.

RESICITIES is an education-oriented project funded by Erasmus+ aiming at the design and delivery of a set of extra-curricular courses for graduate and postgraduate students and also courses for academic staff undertaken by a group of four European universities.
More information can be obtained at **https://www.resicities.eu.**

Registration to this course is FREE OF CHARGE.

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Course description

Today, economic growth depends primarily on increasing resource consumption. In this linear economic approach, companies harvest or extract materials, use them to grow or make products, and then sell these products to consumers. The waste materials are then burned or landfilled. As the population grows and resources become scarcer, this 'extract-produce-discard' approach is rapidly reaching its limits. Increasingly attracting attention, the circular economy philosophy is an emerging field of study that favours a systemic and transdisciplinary approach. The circular economy is an economy that is restorative and regenerative in nature, and aims to keep products, components and materials at their highest utility and value at all times[1].

Cities worldwide are facing several challenges including resource depletion, climate change and degradation of ecosystems. If cities do not adapt their current

[1] UNDP-Handbook-on-Smart-Urban-Innovations-V2.pdf

infrastructure and resource management, they will not be able to cope with these challenges. Nature-Based Solutions (NBS) or Green Infrastructure (GI) solutions are one element that can help to achieve this transition. NBS and GI can provide mutual ecosystem services such as regulation of micro-climates, flood prevention, water treatment and food provision which are beneficial for the urban environment[2]

Applied to urban context, a circular city is where we apply the concepts of circular economy, i.e. waste management, commodities and energy used in smarter and more efficient ways. A circular city results in less pressure on the environment, new business models, innovative designs and new alliances and cooperation between different stakeholders. It is also a new economic model for distributing resources equitably without harming the functioning of the biosphere. It decouples economic growth from resource consumption. In this course, we will introduce (1) Circular Economy in the context of resilient, smart and sustainable cities, then we will cover the (2) Digital Transformation in the circular economy. We will see how (3) eco-design is a condition to circular economy and finally we will present (4) the circular urban metabolism, in a systemic approach to smart and sustainable cities.

Course Objectives

Knowledge

- Explain the fundamental principles, technologies, current applications and future trends in circular, sustainable and smart cities.
- Introduce the concepts, framework and key technologies of smart city in different fields.
- Understand the role and functions of various technologies for circularisation (IoT, 3D Printing, sensors, RFID, Cloud computing) that can be used for implementing smart and circular cities.
- Describe the concept of a smart city and key challenges/problems facing professionals in cities around the world.
- Understand how the smart city is managed from an urban governance perspective.
- Understand how digitalization support circular economy models implementation.

SKILLS

- Familiarise with key technologies in designing and implementing solutions for circular, smarter, and more sustainable cities.
- Analyse the city as a metabolism.
- Study circular business models.
- Propose managerial recommendations based on an empirical case study.
- Conduct a detailed study on how to make a circular, sustainable and smart city.

[2] Microsoft Word - CA17133_Deliverable-2_State-of-the-art_v3.docx (circular-city.eu)

Course programme

The course is composed by four modules:

- Module 1- Circular economy in the context of resilient, smart and sustainable cities
- Module 2 - Digital transformation in the circular economy
- Module 3 - Eco-design and circular economy principles
- Module 4 - Circular urban metabolism

Module 1: Circular economy in the context of resilient, smart and sustainable cities

As the population grows and resources become scarce this "extract-produce-discard" approach is rapidly reaching its limits. Many argue that the time has come to explore the circular economy concept further, to analyse its promises for business and economies and to lay the groundwork for its adoption. Increasingly attracting attention, the circular economy philosophy is an emerging field of study that favors a systematic and transdisciplinary approach. The circular economy is an economy that is restorative and regenerative in nature and aims to keep products, components and materials at their highest utility and value always. It is also a new economic model for distributing resources equitably without harming the functioning of the biosphere. It decouples economic growth from resource consumption. Attracting increasing attention, the circular economy is an emerging field of study in the context of smart, sustainable, circular cities. In this module we will cover all the latest development in both research and management in circular economy applied to urban context. Furthermore, the sustainable urban ecosystem must be resilient i.e., able to recompose itself to maintain its identity in the face of rapid environmental fluctuations including crisis and disasters. Finally, we will present the institutional framework: the European Union funded COST (COoperation in Science and Technology) Action Circular City[3].

Content:

- **Introduction to the Circular Economy**. In this session, we'll begin to investigate the limitations of our current linear economy. We'll discuss the risks of continuing the current trajectory and start to explore what an alternative -a circular economy- could look like.
- **Circular Economy at the City and Region Level**. Cities will contain most of the world's population by 2050. We'll discuss how circular economies could be created in cities and regions, including the idea of industrial symbiosis, where "waste" materials from one industry become input materials for an entirely different industry.

[3] Implementing nature-based solutions for creating a resourceful circular city www.cost.eu/actions/CA17133

- **Supply Chains**. The technical cycles include the reuse, repair, and recycling of products, parts, and materials. This session will review how these cycles are sometimes more challenging than initial product production and shipment and discuss the difference between closed and open loop material flows.
- **Business Models**. The circular economy philosophy promotes a reconsideration of business models, including offering products "as a service" instead of selling products and transferring ownership to consumers. We'll explore some of the opportunities and challenges of these circular business models.

Module 2: Digital transformation in the circular economy

By 2050, it is estimated that nearly 70% of the world population will live in cities. Cities all around the world are already facing more complex challenges due to widespread urbanization, climate changes, energy crisis, air pollutions, traffic congestions and economic pressure. This pressure may be mitigated through the adoption of information and communication technologies (JCT) to encourage sustainable development, increase efficiency and improve quality of life. Therefore, the concept of smart and sustainable city is emerging as a new approach to city operations[4].

The purpose of this module is to provide a deep understanding of the digital technologies, infrastructure, and social political forces shaping the future of our urban environments. We begin by defining Smart Cites through lectures and cases and study the technologies shaping new and existing cities. We introduce the concept, framework, and key technologies of smart cities in different fields (e.g., transportation, buildings). We will explore various technologies that can increase circularity such as the Internet of things (IoT) and additive manufacturing (3-D printing). We will see how technologies can contribute through these application models to the circular economy.

All around the world, many digital city experiments are underway: Masdar in Abu Dhabi, Songdo in South Korea, Issy-les-Moulineaux near Paris. These experiments are being conducted by digital industries players (Cisco, Accenture, IBM, etc.) Their project is more to digitise the city than to "urbanise technology". The aim is to demonstrate the ability to design urban systems by interconnecting all possible digital technology. While these experiments are useful laboratories for what digital technology can do in urban planning, the obvious danger is that they conceive of the city dweller as a balance whose behaviour is dictated by technology, rather than the other way around. The model assumes an ideal type of city dweller living in sociologically, and economically homogeneous urban spaces, which is the opposite of the evolutionary model of the sustainable city, which assumes rich interactions, creating innovative synergies that allow – and have allowed sustainable cities in the past to evolve. A project such as Masdar, apart from not being duplicable due to its cost, cannot be a reference because it does not consider the anthropological characteristic of the place. The Issy-les -Moulineaux project in Paris is different. It aims to urbanize technology based on a classic reflection on urban functions in a changing

[4] Digitalisation for the transition to a resource efficient and circular economy 6f6d18e7-en.pdf (oecd-ilibrary.org)

environment. The “digital engine” must therefore be capable of operating the “service oriented” urbanism and architecture.

Content:

- Introduction to urban environment: facts, figures, digital technologies, infrastructure, and social political forces.
- Definition of Smart Cities through case studies, particularly the French case study of Issy-les-Moulineaux.
- Concepts, framework, and key technologies of smart cities in different fields.
- Critical analysis of technologies shaping new and existing cities.

Module 3: Eco design and circular economy principles

Design sits prominently at the heart of the circular economy. It requires to redesign everything: products, business models, cities, and the linear systems that have lasted for the past centuries. This learning path covers the role of design in creating a circular economy, examining the four-stage circular design process and highlighting six strategies for incorporating the principles of the circular economy into your designs[5]. Solutions for end-of-life management versus circularity by design look into recovery of secondary resources once they become waste. In this sense, they try to solve problems only at the end of the life cycle and must consider that many or most of the actual urban resource stream systems are not designed to be recovered. If you design a system from scratch with circular design in mind, the resource recovery would also be designed to happen with as little energy input as possible. The process can then even be designed to keep the resource value at the highest possible level (Bocken et al. 2016). By mixing resources with others, one must apply more energy to again recover the value of one resource. In this sense, separation at or close to the source can be favourable for resource recovery purposes, although we should take into consideration the additional infrastructure needs and their associated grey energy (Larsen 2011). Direct metabolisation of organic nutrients from waste streams in agricultural systems can be one of the most favourable options (Capodaglio 2017). The use of stored solar energy in organic resources for decentralised energy generation can also be a good approach, especially in combination with recovery processes. Appropriate logistics and a combination of zero km conversion of nutrients into food and exchange with the surrounding areas can be a good approach for cities. Cities can become “major circular bioeconomy hubs” (European Commission 2018a).

Content:

- Definition, process and strategy for eco-design.
- Circular economy with eco-design.
- Some case studies.
- Cities as circular bio economy hubs.

[5] Circular Design (ellenmacarthurfoundation.org)

Module 4: Circular urban metabolism

While only occupying 2% of the earth's landscape, the urban environment consumes around 80% of the energy generated worldwide, while producing 75% of the global CO2 emissions. Global material consumption has grown eight-fold over the past 100 years and is expected to have tripled by 2050 (Krausmann et al., 2009; UNEP, 2011; Koop and van Leeuwen, 2017). With 75% of global natural resources being consumed in cities, an increasing scarcity of resources such as fertile land including nutrients, clean water and air as well as raw materials (metals, wood and plastics) is expected (EMF, 2012). This generates more and more pressure on rural areas and natural ecosystems to secure the supply of water, energy, food as well as the removal of waste. The challenge of urban resilience is not a single sector or discipline solution. It therefore seems crucial to invest on finding interdisciplinary solutions addressing the urban metabolism pushing the frontier of the urban biosphere (Dong et al., 2016; Fujii et al., 2016; Kennedy et al., 2009). The Circular Economy philosophy based on the 3Rs: Reduce, Reuse and Recover (EC, 2014; Winans et al., 2017), has emerged as an alternative to the wastefulness of the current linear "take-make-use-dispose" practices of urban areas. The principle of CE is to create a closed loop for each natural or man-made product by transforming the linear resource flow into a circular flow. It targets all kinds of industrial processes and products. Regarding the urban environment, the scale of thinking is rather global to address the urban metabolism as a whole, and create not only specific CE systems, but also an overall resource management system for the urban biosphere[6]. We will discuss how circularity is connected to the neighborhood and city level. We will deduct the most important flows that enter, circulate and leave the urban environment every day: water, energy and waste. We will explore different circular solutions depending on the scale (household, neighborhood, city) and the various ways in which solutions can be organized (individually, collectively, or centrally). Finally, we will discuss how the various aspects are impacting the implementation of the circularity in the city, sum up and come to an integrated view on the future of the Circular city.

Content:

- Designing an urban ecosystem, global architecture of the subsystems.
- Subsystems: water, energy, urban transport, interurban transport, housing, health, living environment, among others.
- Urban metabolism.
- Behavioral criteria of the humans who live in this ecosystem.

[6] REFLOW WEBINAR #1: Urban metabolism for circular cities – REFLOW (reflowproject.eu)

Course Registration

Registration to this course is FREE OF CHARGE.

All candidates can register to this course through the online form here.

Candidates can also simultaneously register to other courses of RESICITIES consortium that are already available online.

Learning mode – how to access

This course is now offered on an ongoing basis entirely online through the innovative Pocket Learning app Ryze (https://ryze.org.uk/). Registered students can download the app FREE of charge and will receive the access code to claim all modules of this course in their Ryze library of courses. The modules of this course available through Ryze app are composed by nicely designed content with recorded lectures in embedded videos and self-assessment assignments.

Certificate of conclusion and ECTS credits

The graduate students who will accomplish the course successfully will be awarded with a digital certificate issued by the RESICITIES consortium.