







Ordine degli Ingegneri
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Society AEIT Scienze e Tecnologie
per la Ricerca e l'Industria

Facoltà di Ingegneria Civile ed Industriale

“Sustainability” 2021

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ITALY SECTION CHAPTER
R8 AREA CHAPTER

**Advances on the technology of
Smart Lighting Systems**

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Today, artificial light is everywhere

Multiples Usages:

- Monument Lighting
- Street Lighting
- Indoor Lighting
- Signage & displays
- Vehicles & transport
- Non-lighting Applications



Toulouse by night

Multiples Functions:

▶ See & be seen	▶ Make secure	▶ Appreciate
▶ Locate	▶ Make feel secure	▶ Enhance & fancy
▶ Identify	▶ Communicate	▶ Create ambiance

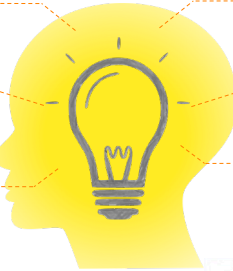
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Some global figures

13-14%
2 900 TWh of annual electricity world-production for generating artificial light

~2%
2% of world annual energy primary resources used

1 150 000 000 metric tons CO₂
5% of the world CO₂ annual emissions = 230 million people CO₂ emissions

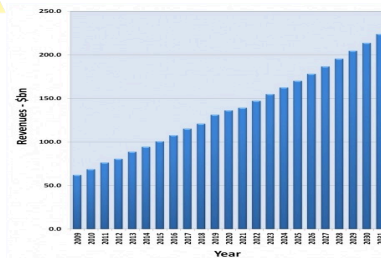


30 000 000 000
More than 30 billion electric lamps operate everyday worldwide

40-45%
LED market revenue share

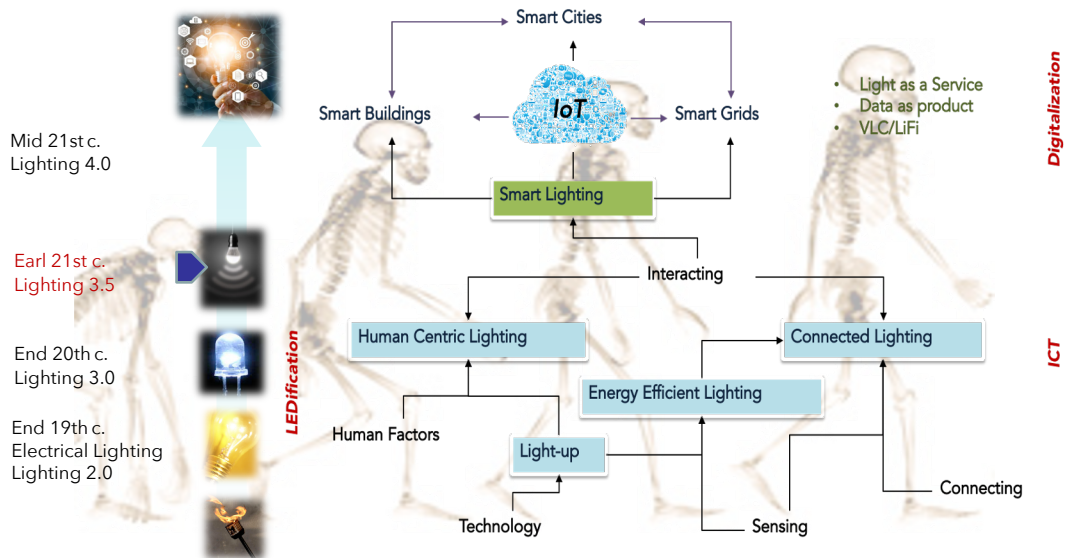
\$120 000 000 000
Lighting industry annual turnover US\$ 120 billion and still growing.

Artificial lighting has a large impact on energy, environment but also on every day's life and world's economy



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The way forward to Lighting 4.0 era



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What is a smart lighting system?

A **smart lighting system** principal function is to **produce, at any moment, the right light**: where it is needed and when it is necessary. It should **adapt the quantity and quality of light to enhance visual performance** in agreement with the type of executed tasks. It must **guarantee well-being, health and safety of the end-users**. It should **not squander passively the resources of our planet and limit actively the effects of light pollution on the biotope**, or, any other impacts on the environment. Ideally, the system could **offer additional services** (geo-localisation, data connectivity...) to the end-users through Visual Light Communication protocols.

Smart Lighting Functions

- Adapt dynamically the light quantity, light distribution in space and light quality (CCT, IRC, spectrum...) to optimise visual performance and respect any normative requirements
- Avoiding any visual disturbance (glare, light flicker, strobe effects, shadows...) that can compromise end-user's security and well-being at any moment.
- Always reduce energy consumption of the installation without compromising the above conditions
- Actively limit the effects of light pollution on the eco-system and biotope, respecting that new sky-protection legislations/standards.
- If necessary, relay information via VLC methods (e.g. provide geolocalization reference) .

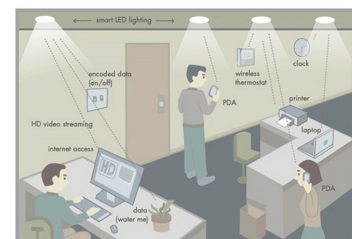
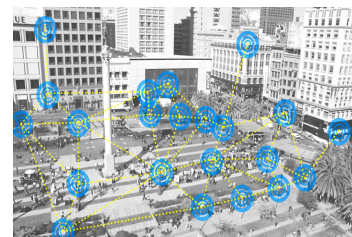


"I installed an awesome smart light. It turns off when my parents enter my room so they can't see the mess."

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Lighting, an IoT system's component...

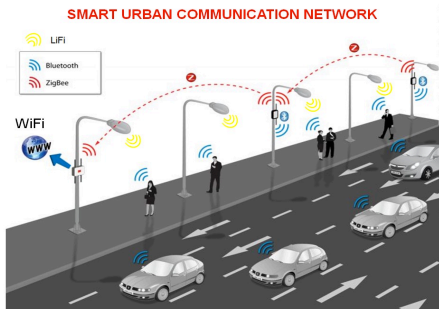
- ▶ A connected lighting system can be used as basis for connecting **communicating objects** thanks to visual light communication (VLC) and LiFi functionalities. Objects can communicate between them or/and a central system. VLC/LiFi offer a large band-pass to allow large data flows. A lighting network forms a dense mesh that can be used for various applications & services
- ▶ Illumination will become a sub-function of a more complex ICT (Information Communication Technology) system, which will be a sub-system in the Internet-of-Things (IoT) global system. Light will be the vector of new services and carrier of dataflows that will spawn additional products
- ▶ According to market research, Li-Fi and in general VLC are expected to **gamer US\$ 115 billion by 2022**, registering a CAGR of 116,8% during the forecast period 2016 – 2022. US host important national lighting and ICT related industries that smart lighting technologies development will contribute in consolidating world leader position in that segments



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Smart Lighting for Smart Cities

- ▶ In smart cities, so-called **smart urban objects** can be used in public areas to increase the sense of security of people. Safety in everyday life is improved by overcoming barriers such as dark areas at night without being in obligation to squander energy for illuminating empty spaces. For instance elder people, which can enhance their participation in public life.



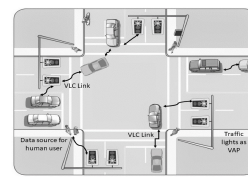
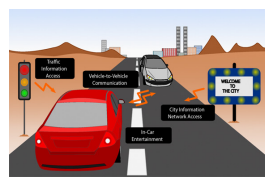
- ▶ Connected smart lighting can reduce vulnerabilities as it can recognize social alarms, hazardous citations, accidents and broadcast information to vulnerable public space users (i.e. elder or disable people).



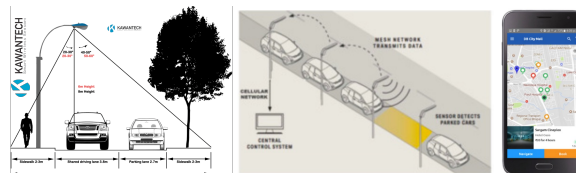
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Additional services that system can offer

- ▶ A communicating lighting system can be used to regulate traffic. VLC/LiFi can be used for communicating from car to car or/and from city to car. Information can be used to adjust trajectories, reduce speed, prevent collisions. Transfer signals information to cars (traffic lights, speed limits...).



- ▶ A communicating lighting system can reducing car roaming for parking. Locate a parking spot in a city is time consuming and polluting action. Smart lighting poles can locate available parking spots and broadcast information to driver's mobile phones or direct to smart cars.



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The ultimate solution:

▶ The "Sustainable Smart Lighting" concept

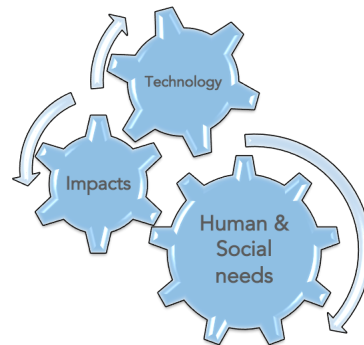
- ✓ Light-up smart, where it is needed, when it is necessary and as best as possible!
- ✓ Use technology to a smart way to make a 'smart' system Sustainable, Scalable & Affordable!



Illuminate doesn't mean "flood" objects, people or buildings with light!

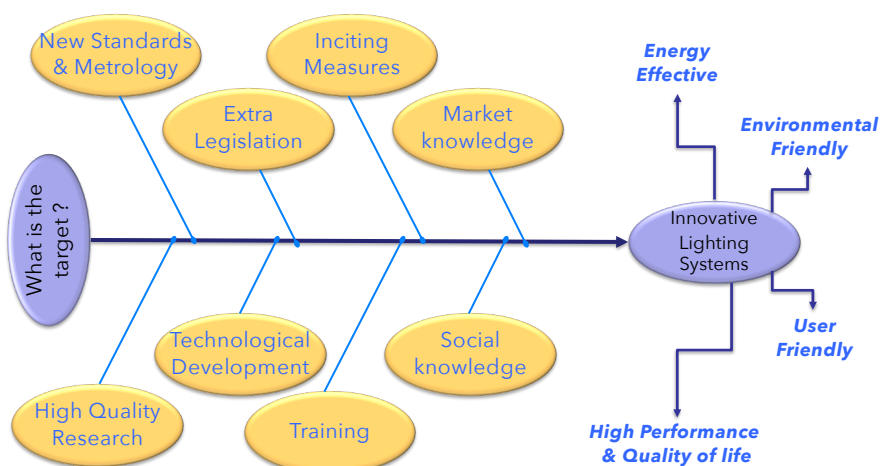
Smart Lighting development contributes to several world's grand challenges

- ▶ Contribute to Energy savings
- ▶ Contribute to Healthy working environments and high task performance
- ▶ Contribute to Silver Economy
- ▶ Contribute to Lighting and IT industry rise



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To achieve that objective cross-discipline efforts are required



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Thank you!



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R2P2 - Networking for Research and Development of Human Interactive and Sensitive Robotics Taking Advantage of Additive Manufacturing



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LS17 important dates

December 31st, 2021	Deadline for online contributed paper submission (new papers only) -
February 1st, 2022	Notification of paper acceptance
February 1st, 2022	Opening of registration & payment
April 30th, 2022	Deadline for early registration
June 1st-3rd, 2022	LS17 & EEDAL in Toulouse

Website : <https://eedal-ls21.sciencesconf.org/>

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