

# Construction Industry 4.0 for inclusive Smart City Development



**PROFESSOR WELLINGTON DIDIBHUKU THWALA**

**17 JULY 2023**

Define tomorrow.

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# **JOURNEY BEHIND THE CONSTRUCTION 4.0 AND SMART CITY WORK WORK**

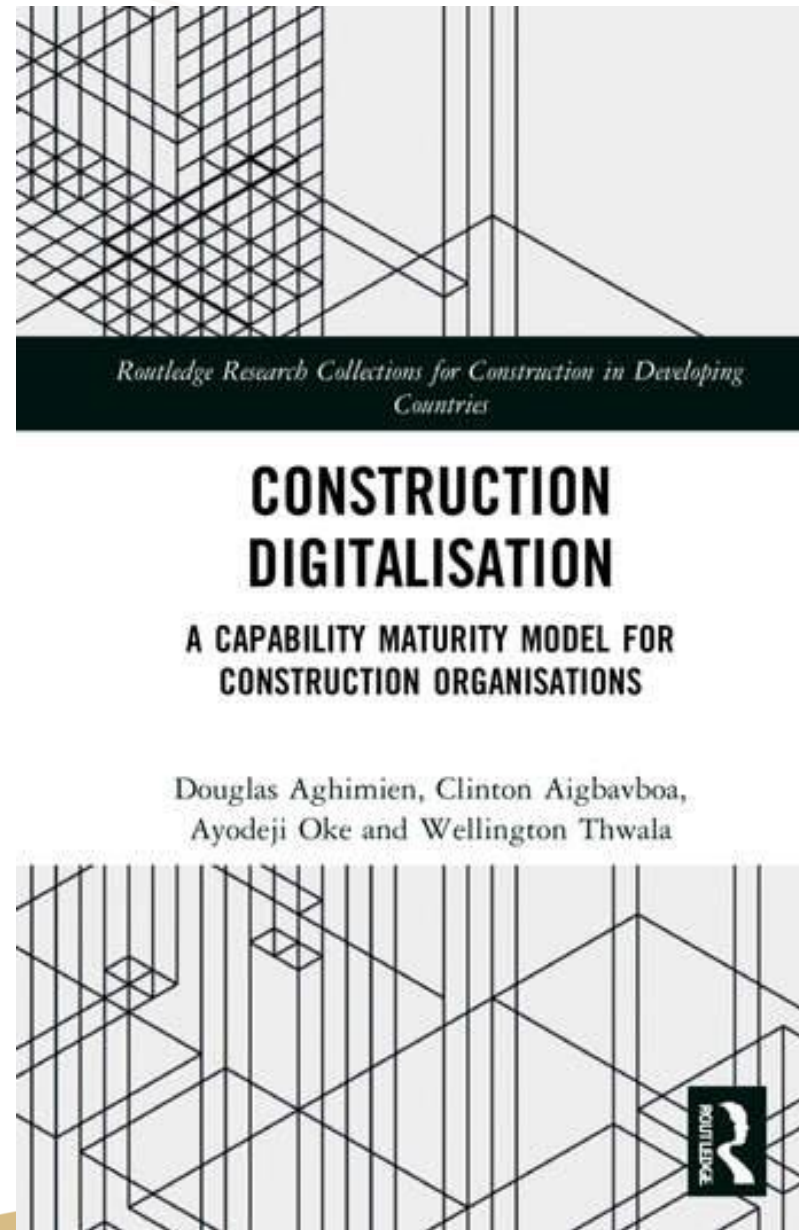
- **BOOKS PUBLISHED**
- **JOURNALS**

Clinton Aigbavboa  
Wellington Thwala  
Douglas Aghimien *Editors*

# Towards a Sustainable Construction Industry: The Role of Innovation and Digitalisation

Proceedings of 12th Construction  
Industry Development Board (CIDB)  
Postgraduate Research Conference

Aghimien DO, Aigbavboa CO, Oke AE and Thwala WD (2021). *Construction Digitalisation: A Capability Maturity Model for Construction Organisations*; London: Routledge Taylor and Francis. ISBN 9780367758547; ISBN 9781003164654 (eBook), <https://doi.org/10.1201/9781003164654>





# **SUSTAINABLE CONSTRUCTION IN THE ERA OF THE FOURTH INDUSTRIAL REVOLUTION**

Ayodeji Oke, Stephen Segun, Clinton Aigbavboa  
and Wellington Didibhuku Thwala



Oke AE, Stephen SS,  
Aigbavboa CO and Thwala  
WD (2021). *Sustainable  
Construction in the Era of  
the Fourth Industrial  
Revolution*; London:  
Routledge Taylor and  
Francis. ISBN-13: 9781032012155,  
ISBN-10: 1032012153,  
[https://doi.org/10.1201\\_9781003179849](https://doi.org/10.1201_9781003179849)

# **CONSTRUCTION SUPPLY CHAIN MANAGEMENT IN THE FOURTH INDUSTRIAL REVOLUTION ERA**

**TEMIDAYO OLUWASOLA OSUNSANMI  
CLINTON OHIS AIGBAVBOA  
WELLINGTON DIDIBHUKU THWALA  
AYODEJI EMMANUEL OKE**



The background of the top section is a dark teal color with a complex technical drawing or blueprint pattern in a lighter teal shade. The drawing includes various geometric shapes, lines, and circular patterns, typical of architectural or engineering plans.

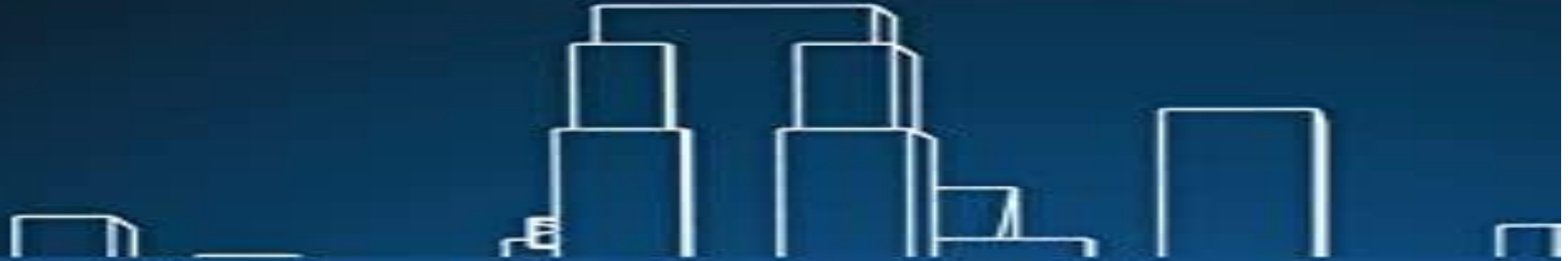
*Routledge Research Collections for Construction in Developing Countries*

# **A 21ST CENTURY EMPLOYABILITY SKILLS IMPROVEMENT FRAMEWORK FOR THE CONSTRUCTION INDUSTRY**

John Aliu, Clinton Aigbavboa  
and Wellington Thwala

The Routledge logo is located in the bottom right corner of the bottom section. It consists of the word "ROUTLEDGE" in a small, white, sans-serif font, positioned above a stylized white graphic element that resembles a curved line or a partial circle.

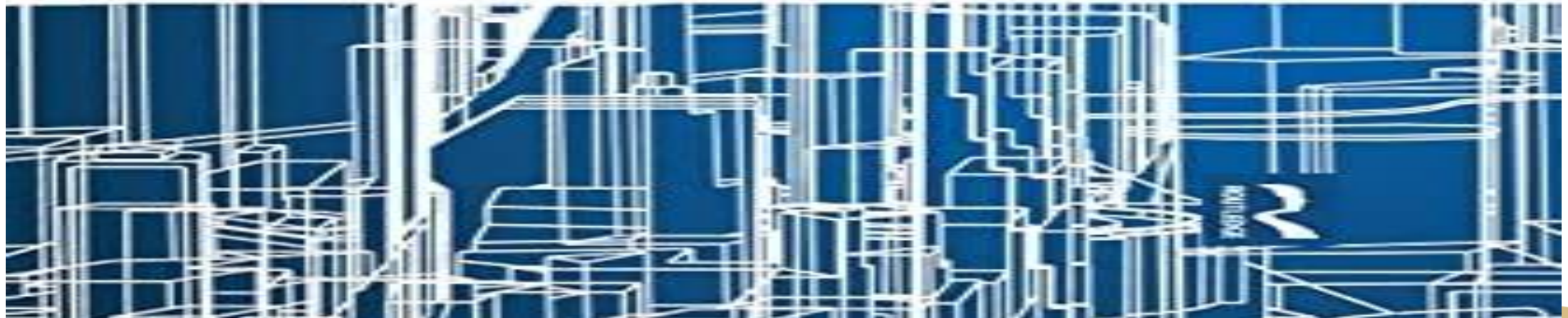
ROUTLEDGE



*Routledge Studies in International Real Estate*

# **RESIDENTIAL SATISFACTION AND HOUSING POLICY EVOLUTION**

Clinton Aigbavboa and Wellington Thwala





# RESEARCH PUBLISHED

1. "Digital transformation in the construction industry: a bibliometric review", *Journal of Engineering, Design and Technology*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/JEDT-08-2021-0442>
2. "A bibliometric evaluation and critical review of the smart city concept – making a case for social equity", *Journal of Science and Technology Policy Management*, Vol. 14 No. 3, pp. 487-510. <https://doi.org/10.1108/JSTPM-06-2020-0098>
3. "Dynamic capabilities for digitalisation in the AECO sector – a scientometric review", *Engineering, Construction and Architectural Management*, Vol. 29 No. 4, pp. 1585-1608. <https://doi.org/10.1108/ECAM-12-2020-1012>

# RESEARCH PUBLISHED

4. Training needs of built environment professionals: the role of fourth industrial revolution", *Engineering, Construction and Architectural Management*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/ECAM-03-2022-0212>

# WHAT CONSTRUCTION 4.0

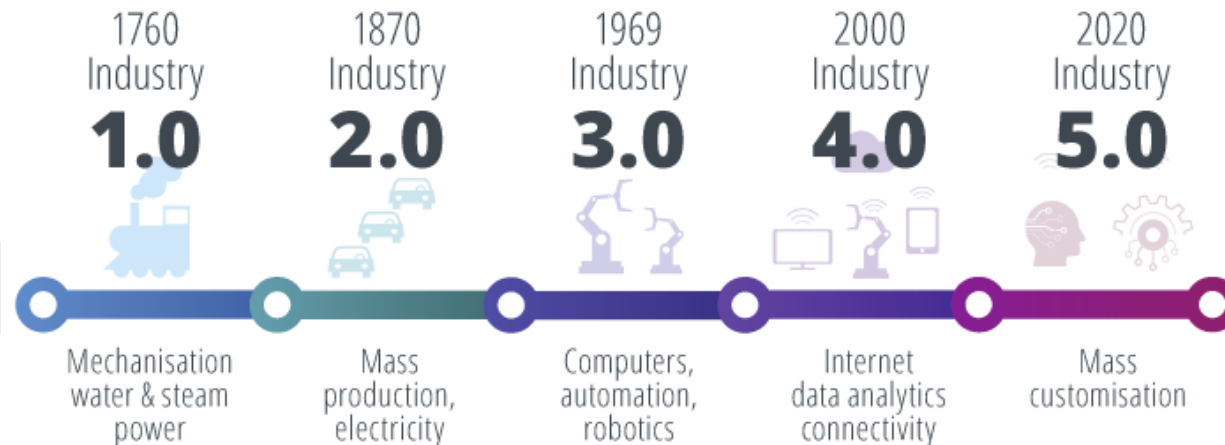
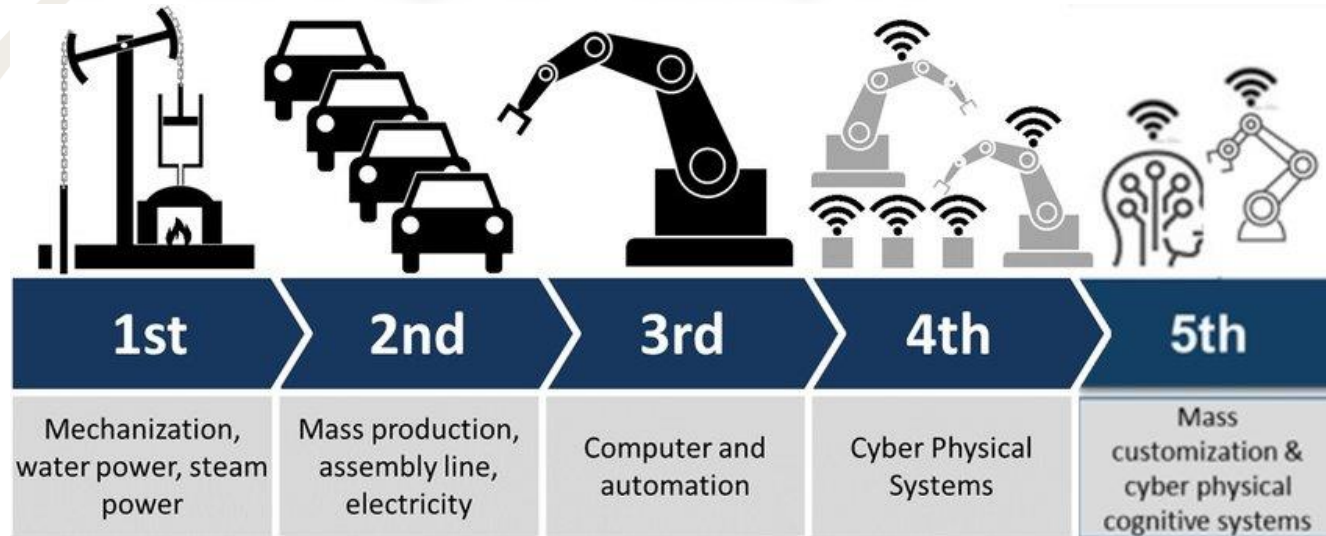
**Construction 4.0 is a variety of interdisciplinary technologies, methodologies and concepts that digitize, automate and integrate the construction process at all stages of the value chain.**

## **What is Construction 4.0?**

**Construction 4.0 involves implementing advanced technologies in construction projects to achieve higher productivity, safety, and sustainability. However, architecture, engineering, and construction (AEC) professionals are reluctant to adopt Construction 4.0 technologies.**

# Construction Revolutions

## From stone age to industry 5.0

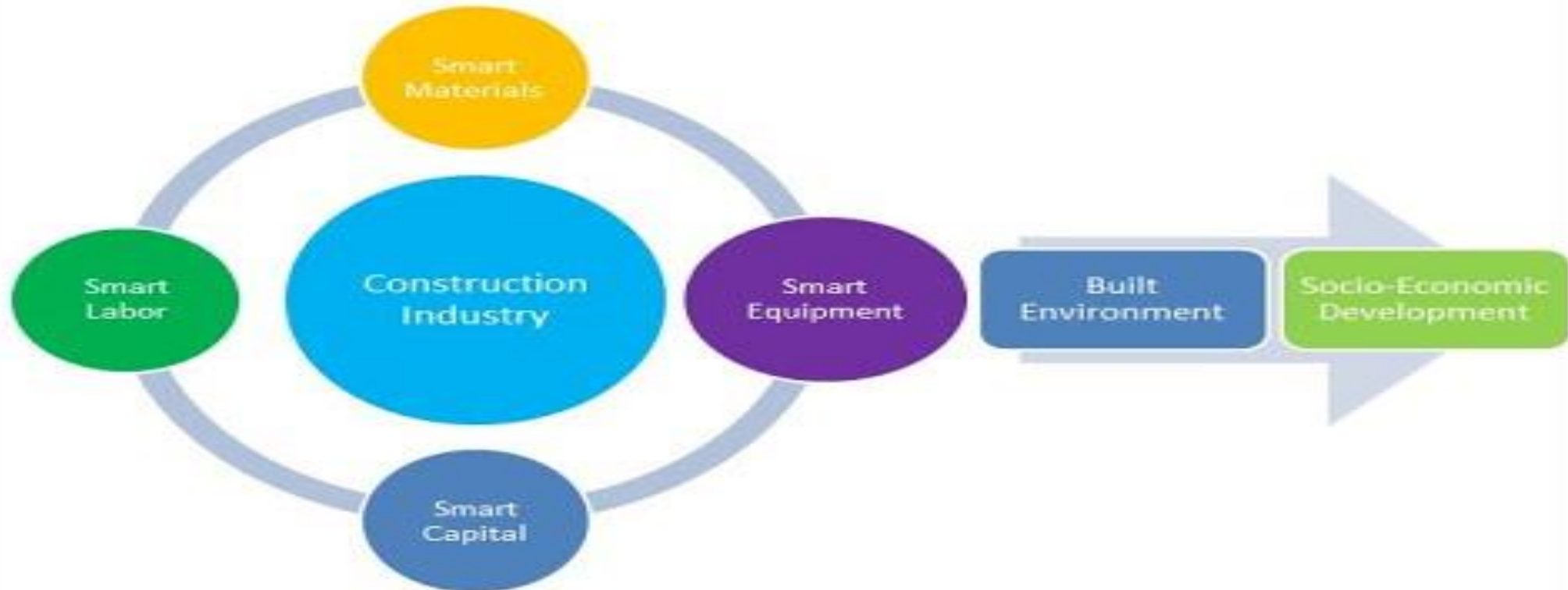


# CONSTRUCTION 4.0

## Construction 4.0



LOVELY  
PROFESSIONAL  
UNIVERSITY



## **What are Industry 4.0 dimensions?**

**Industry 4.0 is based on the use of cyber-physical systems (CPS) production and heterogeneous data and knowledge integration, and its main features are: digitization, automation, optimization, customization, and adaptation of production; human machine interaction (HMI); value-added services and businesses**

# **What are the Industry 4.0 methods in construction**

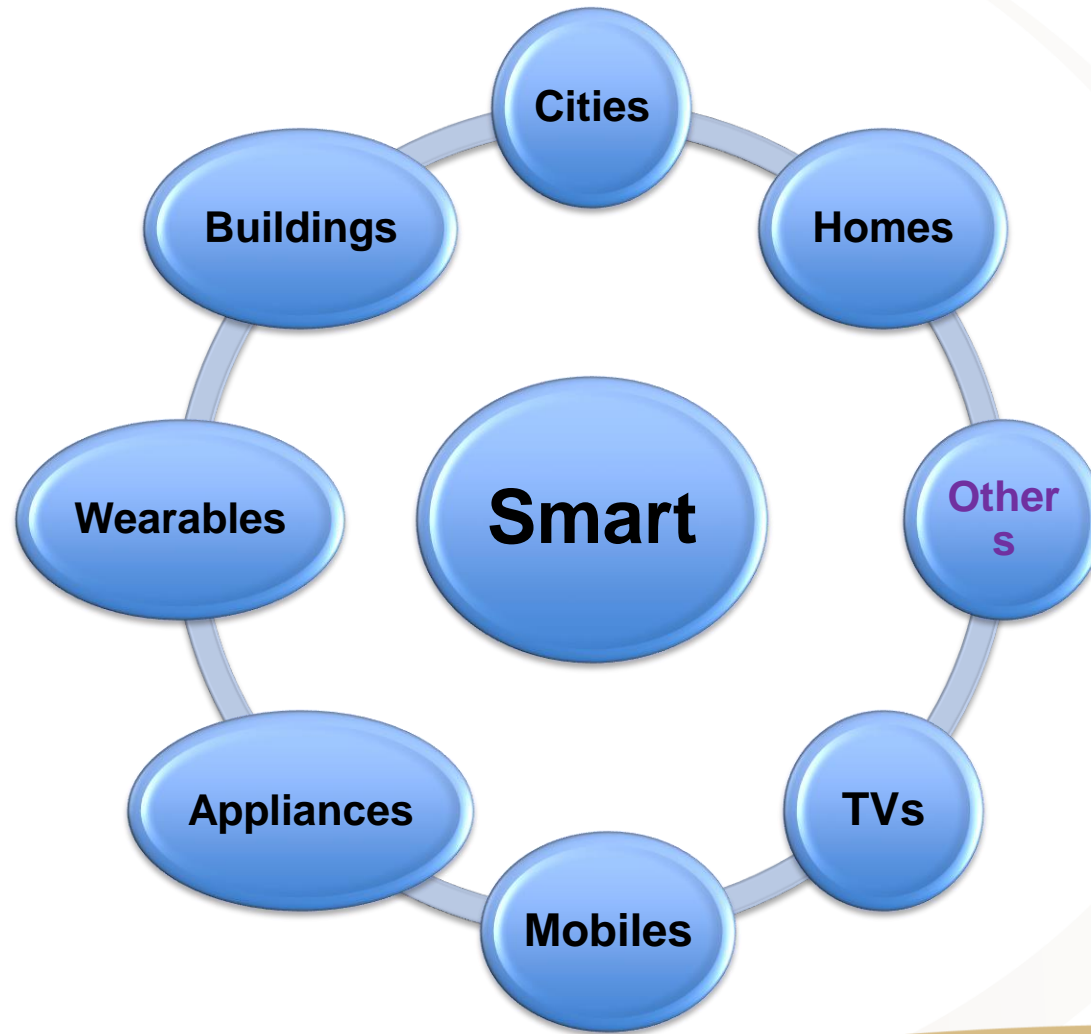
**Digital techniques such as building information modelling (BIM), laser scanning, cloud computing and artificial intelligence (AI) are transforming the ways new structures are planned and designed**



# CONSTRUCTION 4.0 PROCESS



# Smart concept



# What is SMART CITY?

**A city is said to be smart when there is a cordial and relatable relationships between components (human and social capital) with the aid of digitalized tools targeted at creating an enhanced economy channelled towards improving whole life cycle of the building, structures and the quality of life all at once in respects to proper governance and effective resources management policies.**

# Top Growing Smart Cities



Singapore's Smart Nation Vision is a framework for development. Photo: NRF



Dubai is working to digitize all government services and building a hyperloop. Image: Hyperloop One

# Top Growing Smart Cities



Oslo (Norway) is building a sustainable city on 260 acres from the ground up, powered only with renewable energy. Photo: Carlos Bryant, Flickr



Copenhagen's system (Denmark) monitors and analyzes traffic and other data in real time. Photo: Niels Quist, Alamy

# Top Growing Smart Cities



Boston (USA) wants to implement “participatory urbanism.” Photo: Gustav Hoiland, Flagship Photo



Amsterdam (Netherlands capital) has an open data base with 12,000 datasets from every district. Image: BIG

# Top Growing Smart Cities



New York (USA) is installing online kiosks for people to stay online.  
Image: Getty



London (UK) emphasizes 5G connectivity.  
Photo: Getty

# Top Growing Smart Cities



Barcelona (Spain) was one of the first cities to embrace smart systems. Photo: Solaris



Hong Kong launched more than 70 smart city initiatives. Photo: Hong Kong Smart City Blueprint



# Principles of Smart Cities

- ❖ Artificial intelligence
- ❖ Automation
- ❖ Innovation
- ❖ Big and open data
- ❖ Internet of things, service, people, data...**Internet of everything**
- ❖ Virtual, augmented, mixed....**connected reality**
- ❖ Cyber physical system
- ❖ Customisation
- ❖ Globalisation
- ❖ **Metaverse**

# Smart City Framework

## Technology Framework

- ❖ Digital city
- ❖ Virtual city
- ❖ Information city
- ❖ Intelligent city

## Human Framework

- ❖ Creative city
- ❖ Learning city
- ❖ Humane city
- ❖ Knowledge city

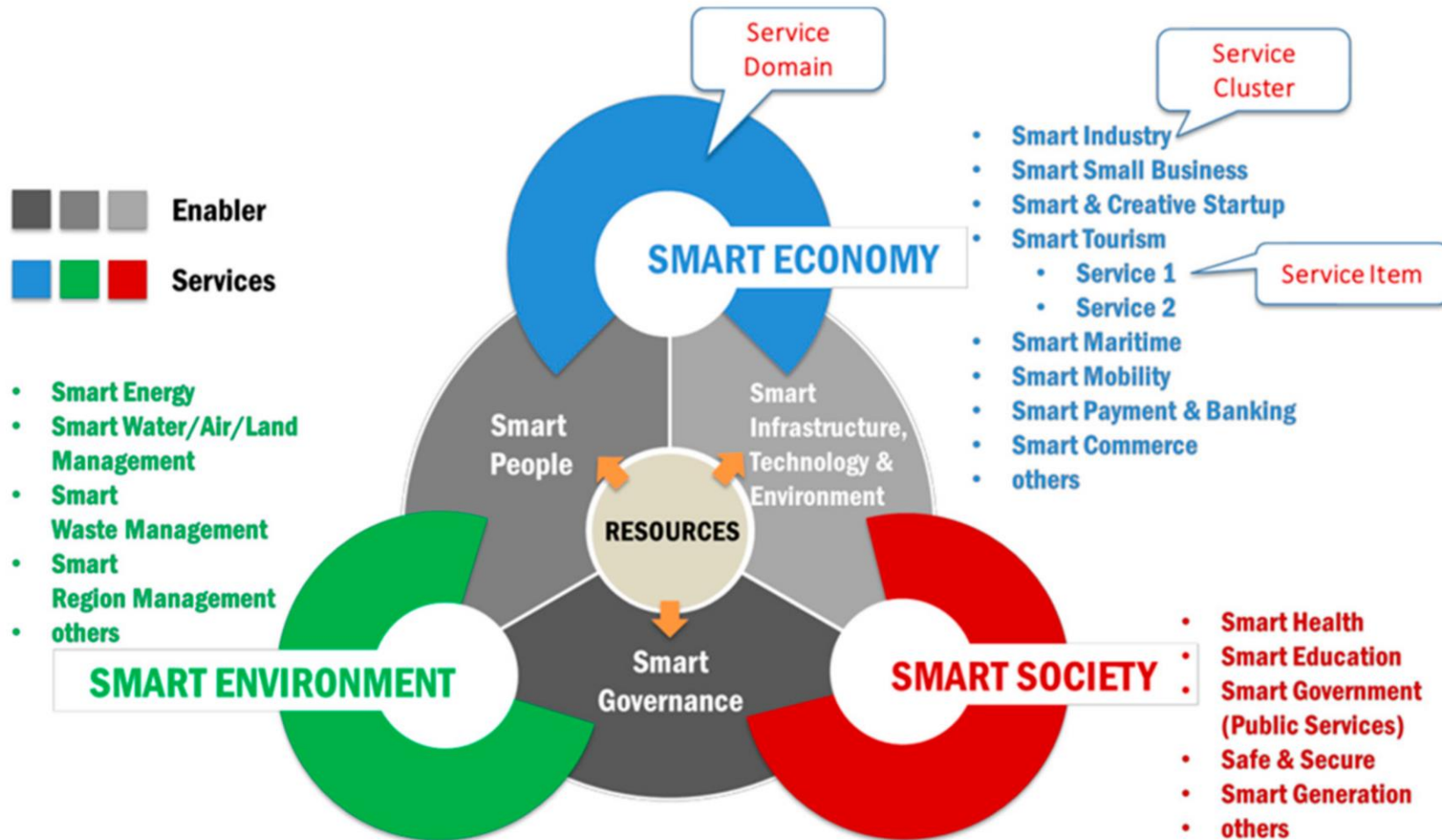
## Institutional Framework

- ❖ Regulated city

# Smart city Components



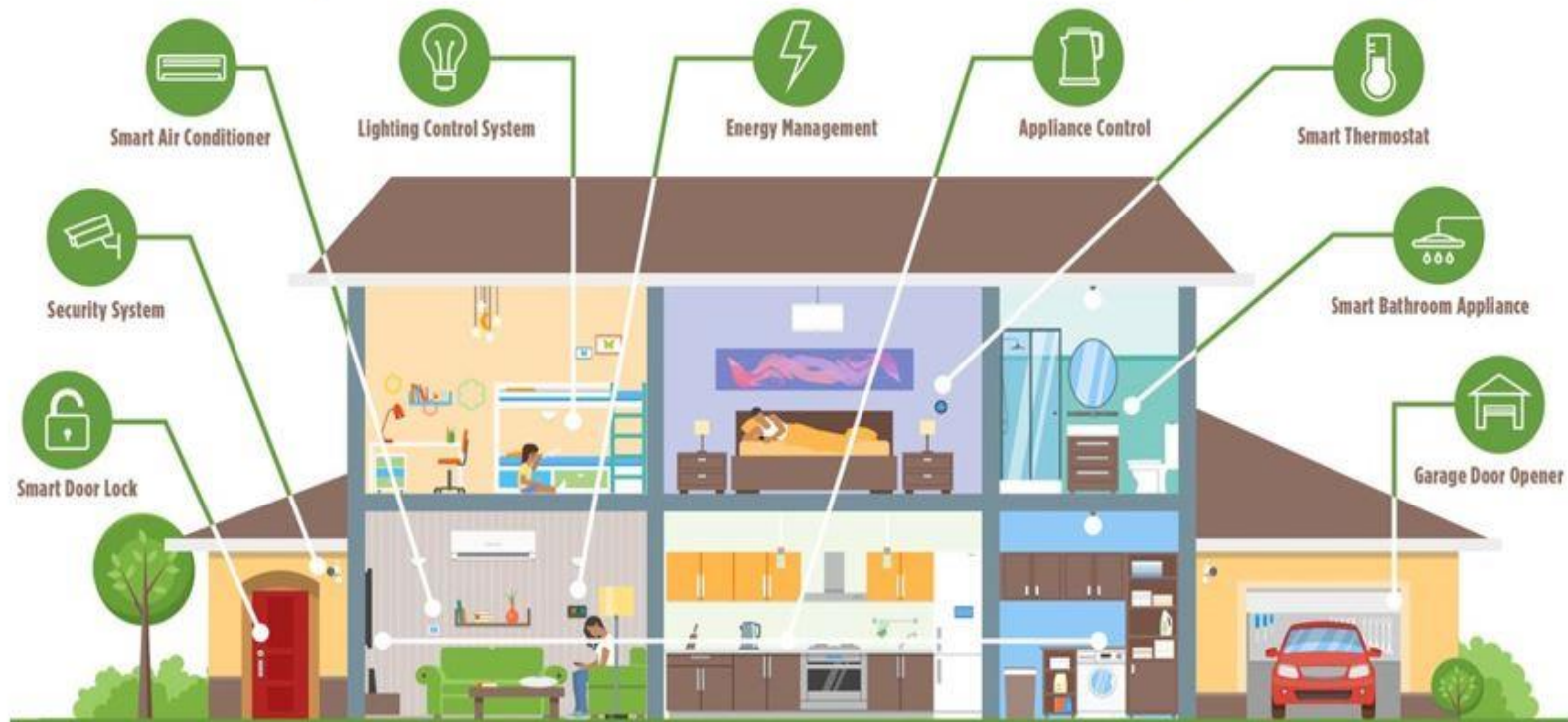
# Smart city Components



# Smart Homes

## HOME, SMART HOME

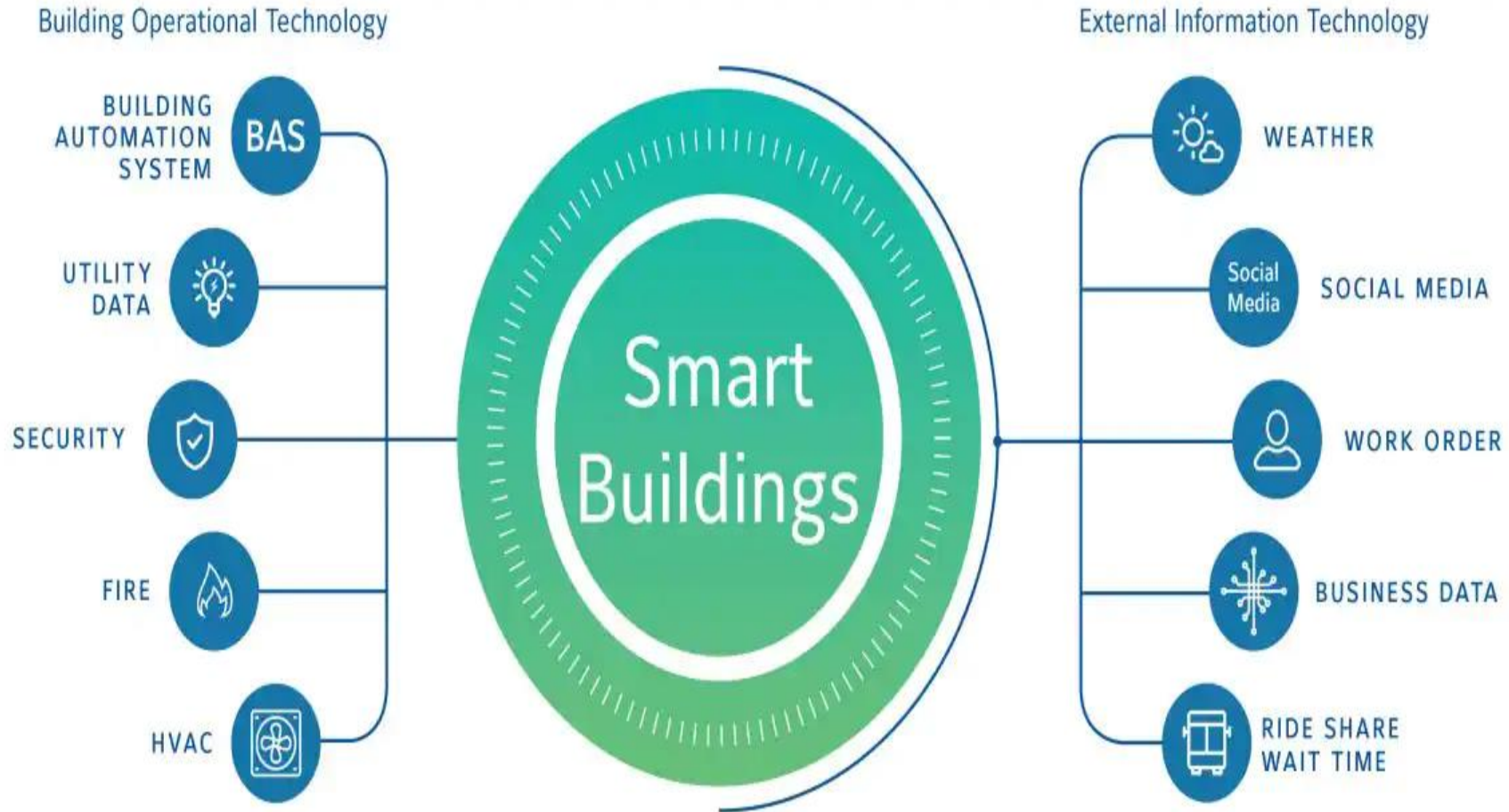
Cool gadgets, practicality drive trend in residential lifestyle technology



# Smart Buildings



# Smart Building Techs.



# Drivers of Smart Cities

- ❖ **Inadequate infrastructure**
- ❖ **Growing stress**
- ❖ **Growing urbanization**
- ❖ **Growing environmental challenges**
- ❖ **Growing economics competition**
- ❖ **Growing expectations**
- ❖ **Rapidly improving technology capabilities**



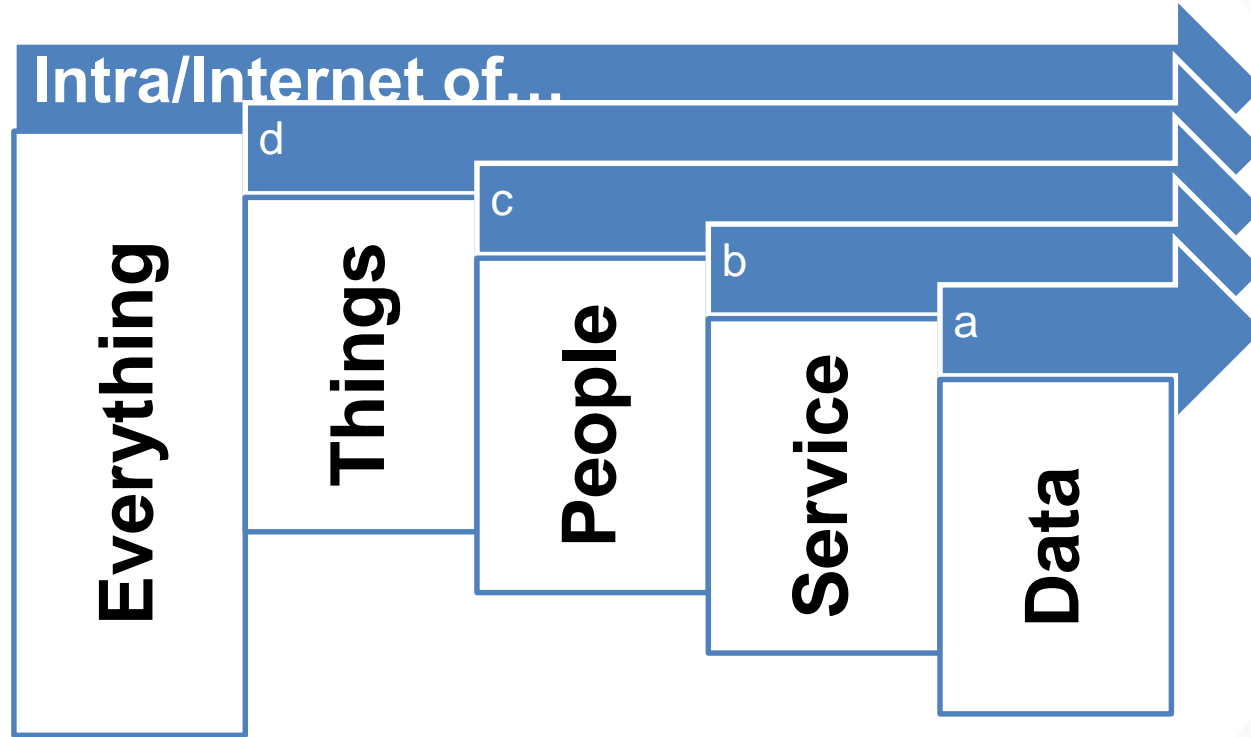
# Challenges of Smart City

- ❖ **Information Technology (IT) infrastructure**
- ❖ **Security and privacy**
- ❖ **Big Data management**
- ❖ **Cost**
- ❖ **Digital technology know-how**
- ❖ **Efficiency, Availability and Scalability**
- ❖ **Social adaption**
- ❖ **Application development**

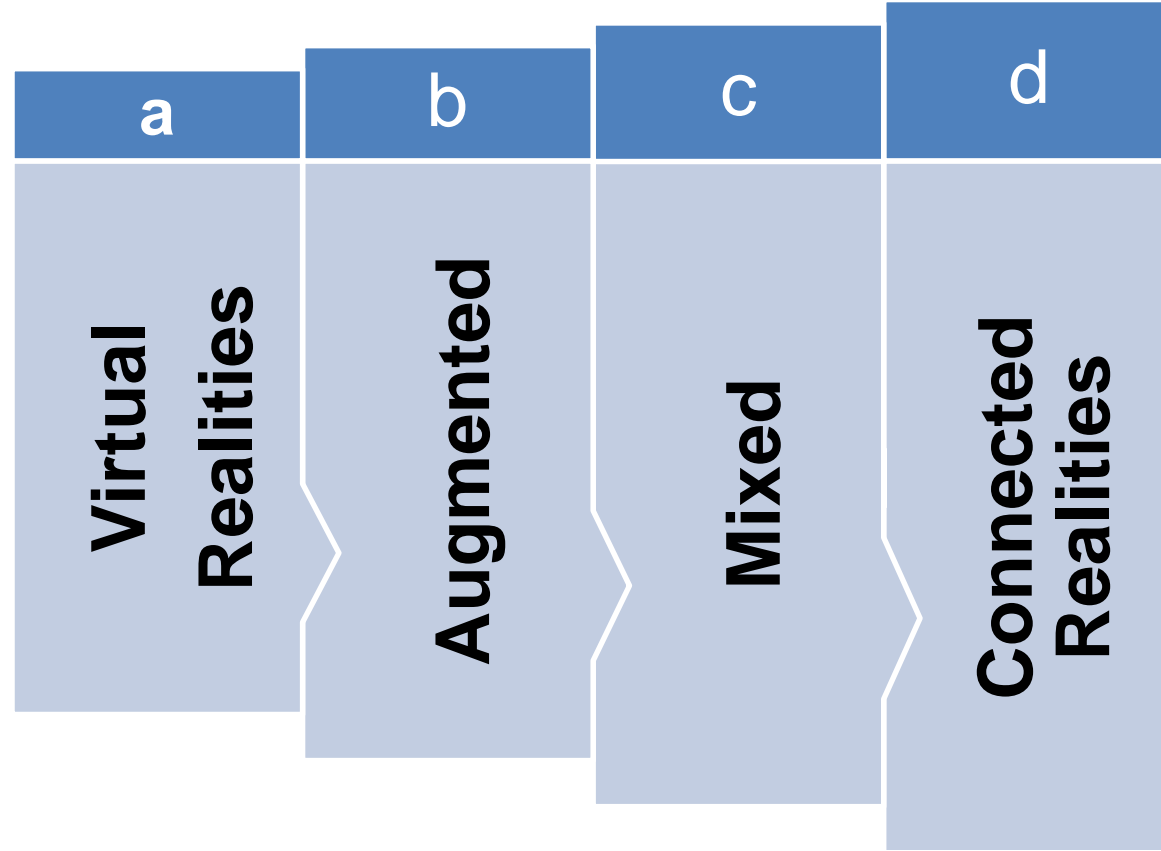
# Technologies

- ❖ 3D printing
- ❖ 3G/4G/5G Network Evolutions
- ❖ Artificial Intelligence
- ❖ Augmented Reality
- ❖ Automation
- ❖ Big Data
- ❖ Blockchain
- ❖ BIM
- ❖ Cloud Computing
- ❖ Cognitive Radio
- ❖ Connected Machines
- ❖ Cryptocurrency
- ❖ Cyber physical system
- ❖ Cyber Security
- ❖ Cyber technology
- ❖ Data Analytics
- ❖ Digital transformation
- ❖ Digital twin
- ❖ DLT
- ❖ Drone
- ❖ Gamification
- ❖ Grid Computing
- ❖ Internet of Things
- ❖ Machine Learning
- ❖ Machine to Machine
- ❖ Mechatronics
- ❖ Metaverse
- ❖ Mixed reality
- ❖ Mobile Applications
- ❖ Mobile Computing
- ❖ Nanotechnology
- ❖ Quantum Computing
- ❖ RFID
- ❖ Robotics
- ❖ Segmentation
- ❖ Techniques
- ❖ Smart computing
- ❖ Smart contract
- ❖ Social Computing
- ❖ Surveillance
- ❖ Virtual Reality
- ❖ Extended reality
- ❖ Internet of things

# Advancing Technologies



# Advancing Technologies



# TECHNOLOGIES

## Conclusion

- ❖ The world globally is witnessing transitions in every area.
- ❖ Cities are made smart through the innovations made possible by technological advancements.
- ❖ The notion of SC is to execute specific projects, implement strategies that are accepted globally and that can mitigate challenges faced by an ordinary city.

## Conclusion

- ❖ **Technologies are shaping the present and of course, the future.**
- ❖ **Projects that will be smart and sustainable for the present and future generations must adopt relevant and appropriate technologies.**

**THANK YOU!**

**Define tomorrow.**

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