Toolkit on Digital Transformation for People-Oriented Cities and Communities

10

Module 10:
Fourth Industrial Revolution (4IR) and Smart Manufacturing

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

8 DECENT WORK AND ECONOMIC GROWTH

11 SUSTAINABLE CITIES AND COMMUNITIES

Jointly developed by: ITU, UNIDO, UN-Habitat, UNDP

Module 10 – 4IR and Smart Manufacturing

This Module of the Toolkit on Digital Transformation for People-Oriented Cities and Communities focuses on how Fourth Industrial Revolution (4IR) technologies can be leveraged to address various manufacturing challenges in the context of a smart sustainable city.

Cities and communities that are starting on their digital transformation journey will find the resources highlighted within this Module useful toward encouraging the use of smart technologies, devices and systems to promote enhanced manufacturing, e-commerce and retail outcomes.

This Module is also useful for cities and communities that have already made some headway into their digital transformation process but would like to validate the effectiveness of fourth industrial revolution technology in their process.

Module 10 – 4IR and Smart Manufacturing

This Module will cover the following topics:

1. Challenges in Manufacturing
2. Opportunities for 4IR and Smart Manufacturing
3. Key Tools for 4IR and Smart Manufacturing
    1. Tool #1: 4IR and value chain development
    2. Tool #2: E-Commerce platforms
    3. Tool #3: Big Data Analytics/Artificial Intelligence (AI)/Machine Learning (ML)
    4. Tool #4: Automation/Robots
    5. Tool #5: Internet of Things (IoT)
    6. Tool #6: 3D Printing
    7. Tool #7: Cloud Computing
    8. Tool #8: Blockchain

1. Challenges in Manufacturing

Manufacturing Challenges

Uncertain demand

Controlling inventory

Reducing inefficiency

Ensuring ROI

Innovation and digitalization policies and frameworks

Skilled labor shortage

Sales leads' identification and prioritization

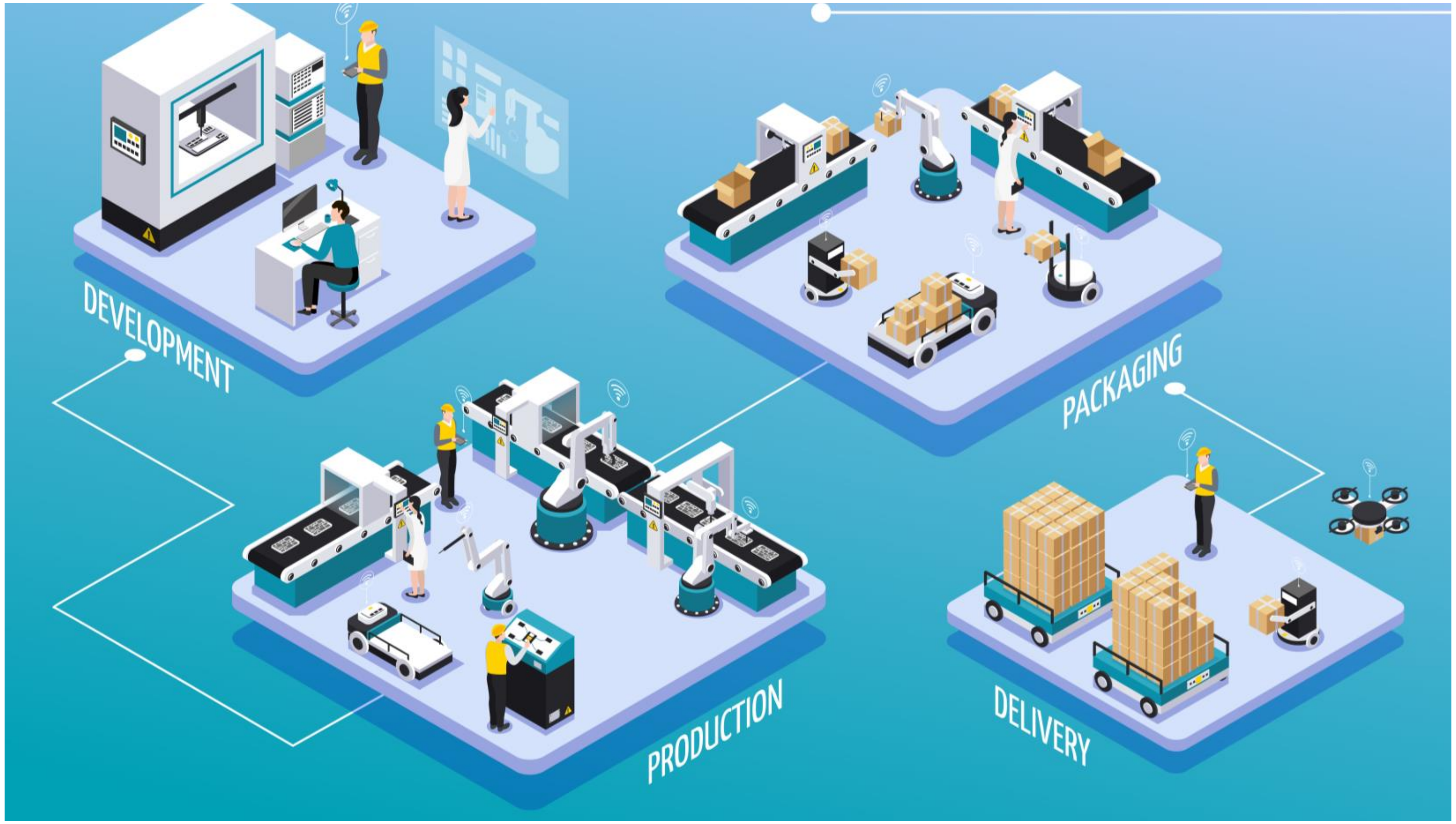
Ensuring inclusivity, sustainability and resilience

Data and cybersecurity

Access to finance

2. 4IR and Smart Manufacturing Opportunities

4IR and Smart Manufacturing



Smart Manufacturing Opportunities using ICTs, Digital and Operations Technologies

Forecasting demand:
Big Data analytics, AI

Managing inventory:
Digitalization, sensing tech, automation, IM software, cloud

Improving efficiency:
AI, automation, robotics

Increasing ROI:
Digital marketing, automation, data analytics

Skilled labor:
LMS, automation, robotics

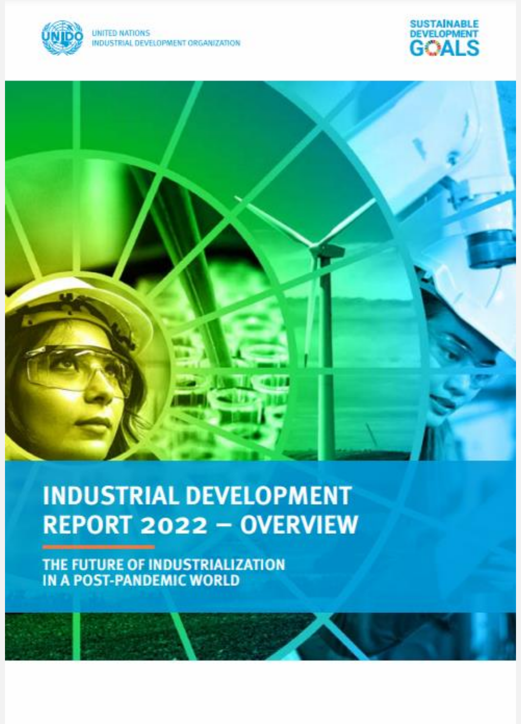
Managing sales leads:
Digitalization, data mining, Big Data, data analytics

Investing in new technologies:
Decision analytics

How Digitalization can Facilitate the Introduction of Response Strategies to the COVID-19 Pandemic Crisis

Channels of impact	ADP technologies-enabled response strategies
Supply	**Digital strategic response**
Domestic factories partial/total closure	▪ Remote factory management through connected machines and IoT
Disruptions in domestic and international value chains	▪ Increased flexibility of supply chains through increased traceability of parts and products (i.e. use of RFID) ▪ In-house realization with 3D printing of unavailable inputs and components ▪ Increased options of providers through digital platforms
Shortage of staffing, leading to reduced processing capability	▪ Labour-substituting automation (i.e. advanced robotics, integrated factory automation) ▪ Use of digital technologies to minimize physical contact and allow for remote working (i.e. remote monitoring, remote working arrangements, virtual meetings) ▪ Digitalization of activities (business processes, administration, finance) ▪ Development of digital skills
Restricted access to specialist service to attend machinery	▪ Real-time remote technical assistance through augmented and virtual reality ▪ Fewer unnecessary interventions thanks to predictive maintenance
Demand	**Digital strategic response**
Reduced consumer spending power	▪ Improved demand monitoring via integration with online platforms ▪ Expanded online sales and digital channels of distribution ▪ Advanced logistics and contactless delivery to minimize physical contact with customers ▪ Increase digital customer relations ▪ Diversify towards higher-value added customized digital products (i.e. servitization, smart and connected products, 3D printed tailored solutions) ▪ Improved storage of perishables with smart sensors; improved stock management
Increased demand for medical equipment	▪ Faster time-to-market of new (or converted) products due to faster modelling, prototyping, and testing with the help of AR and/or VR, digital twins and 3D printing

Source: UNIDO elaboration based on the background materials prepared by Calza et al. (2021) and Andreoni et al. (2021).
Note: ADP = advanced digital production; AR = augmented reality; IoT = Internet of Things; RFID = Radio Frequency Identification; VR = virtual reality.



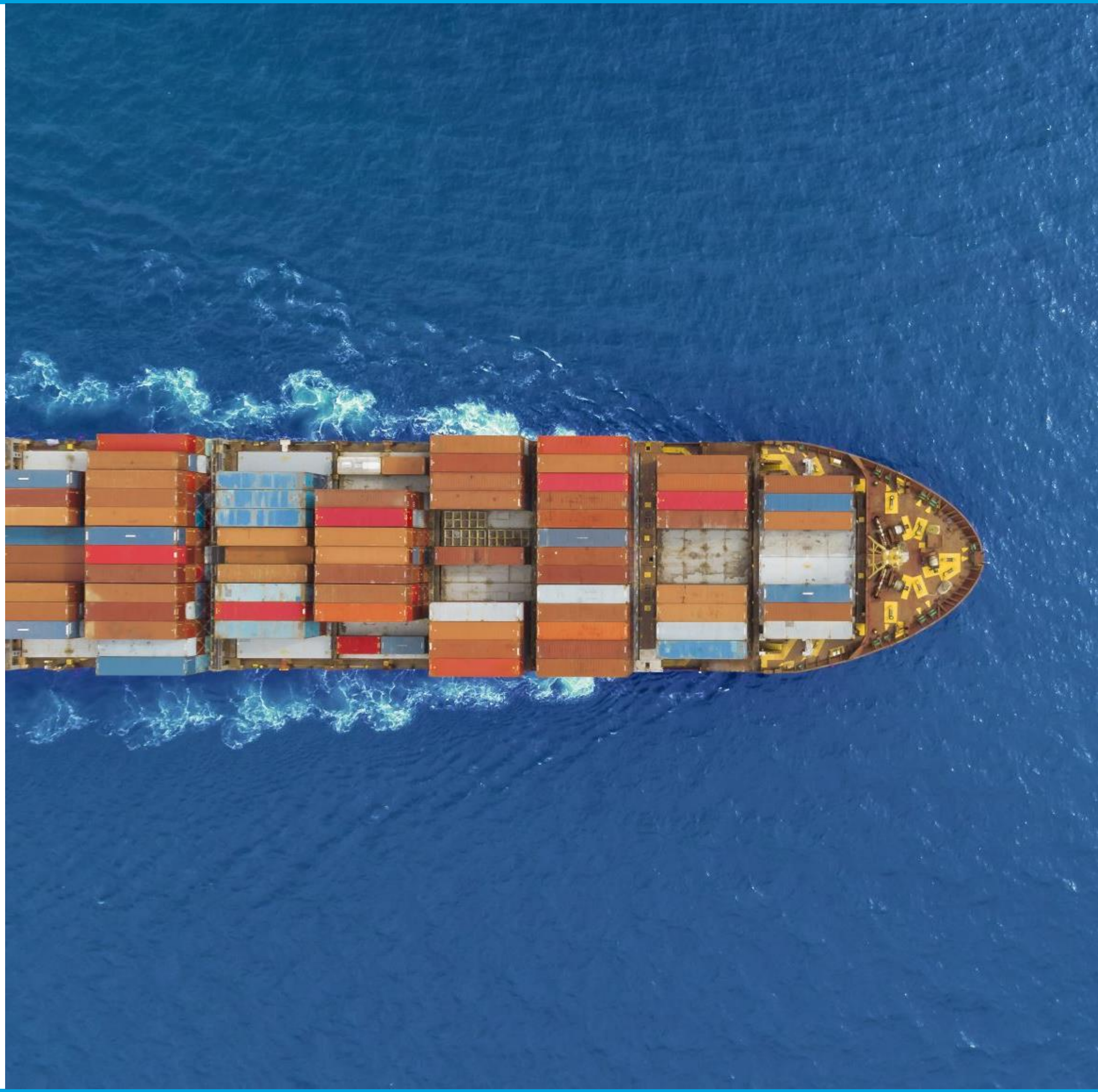
3. Key Tools for 4IR and Smart Manufacturing

Introduction to Tools for 4IR and Smart Manufacturing

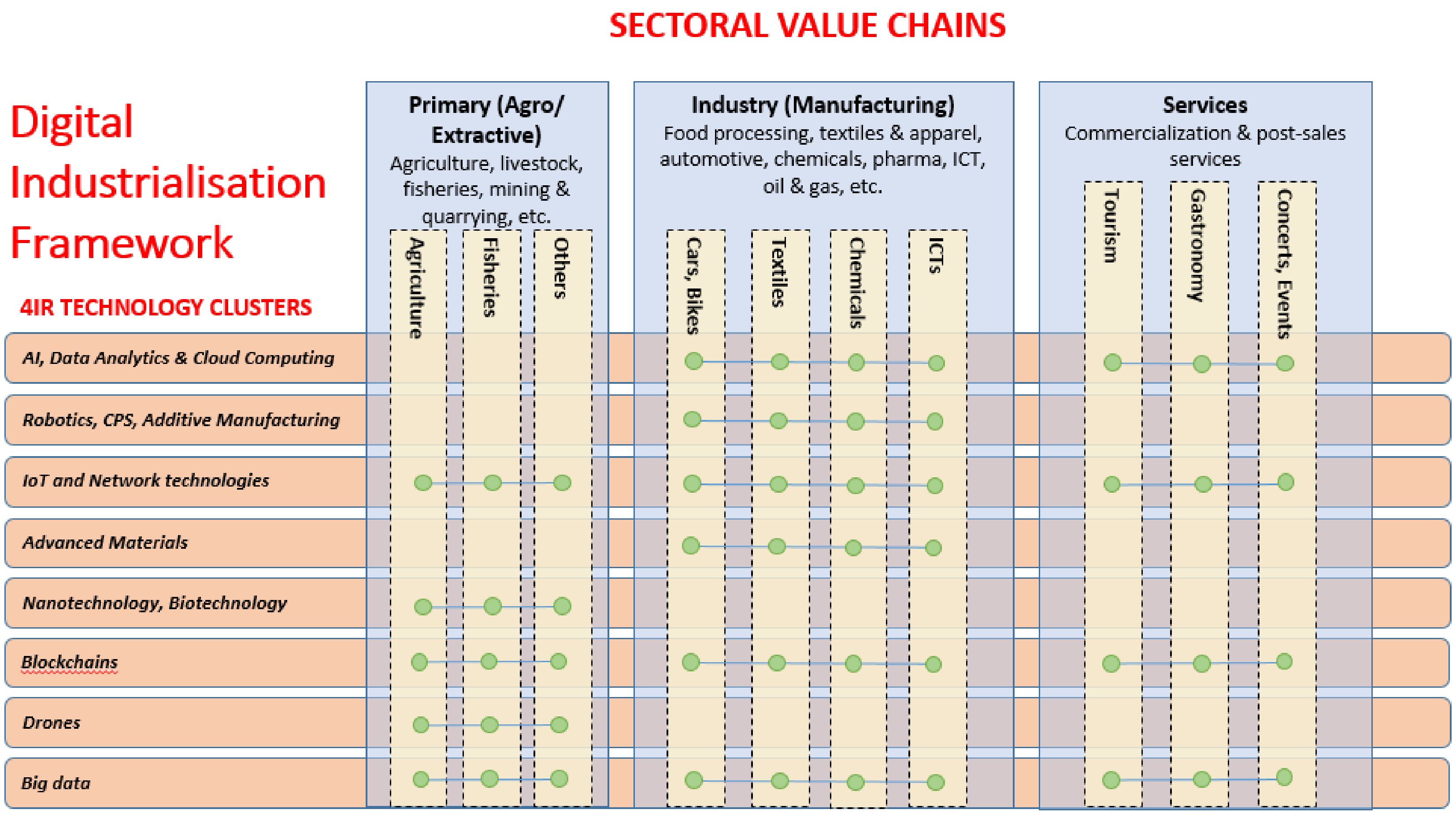
Tool #1: 4IR and value chain development	Tool #2: E-Commerce platforms	Tool #3: Big Data Analytics/Artificial Intelligence (AI)/Machine Learning (ML)	Tool #4: Automation/Robots
Tool #5: Internet of Things (IoT)	Tool #6: 3D Printing	Tool #7: Cloud Computing	Tool #8: Blockchain

Tool #1

4IR and value chain development

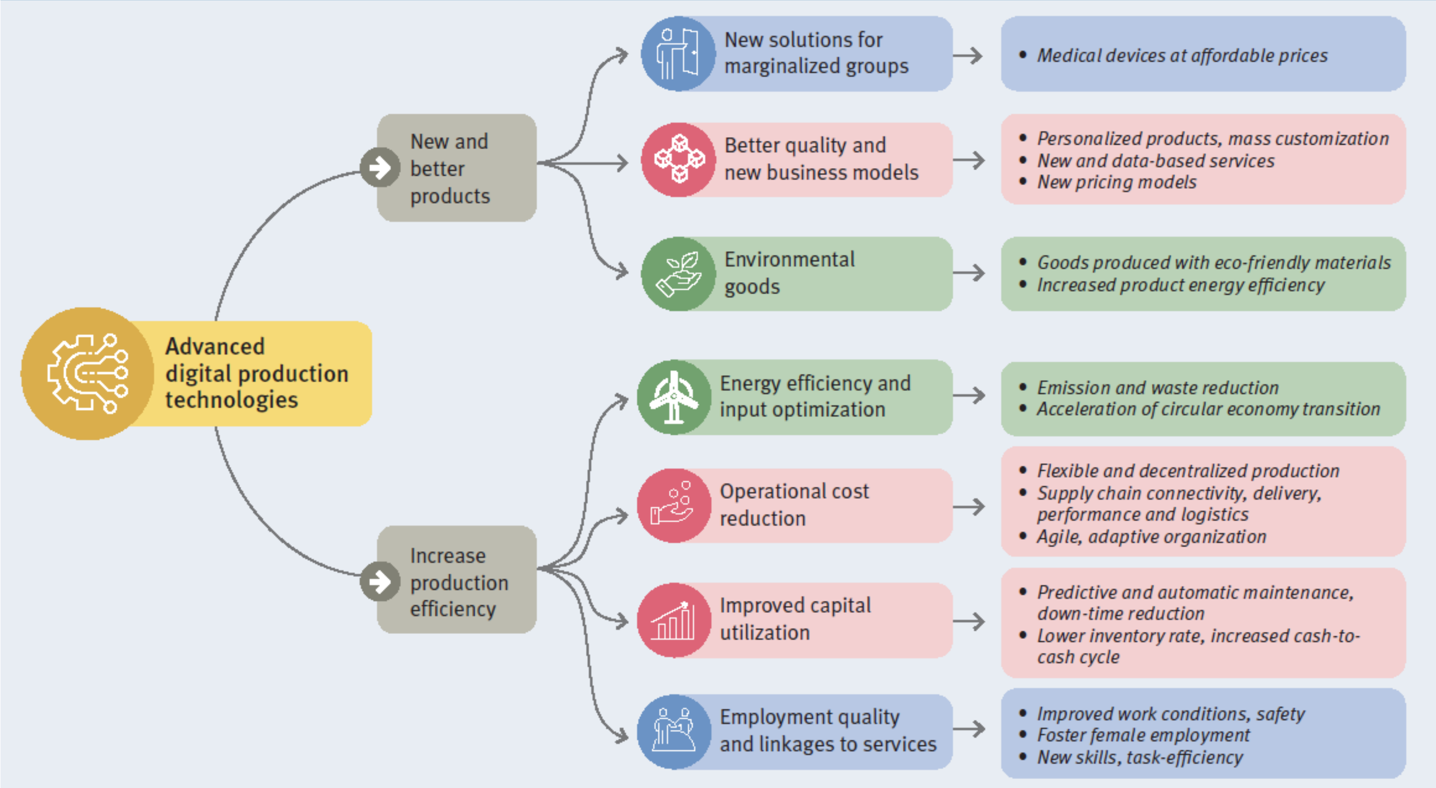


4IR and Value Chain Development

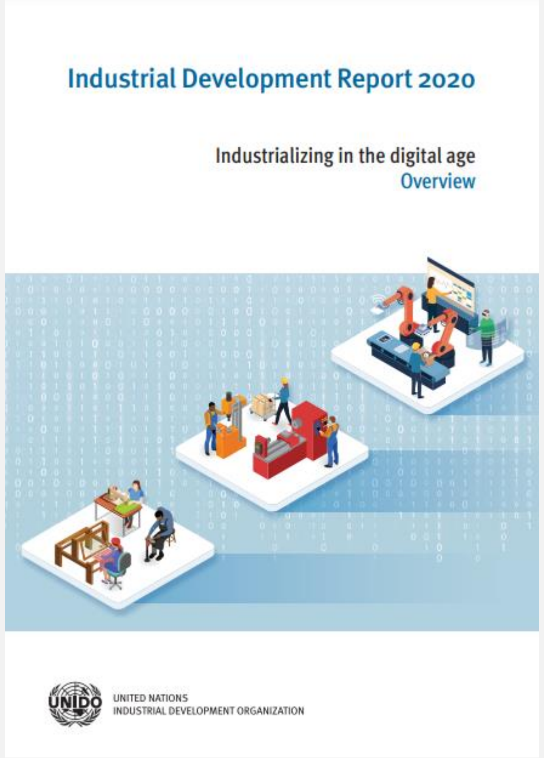


Challenges Addressed and Benefits

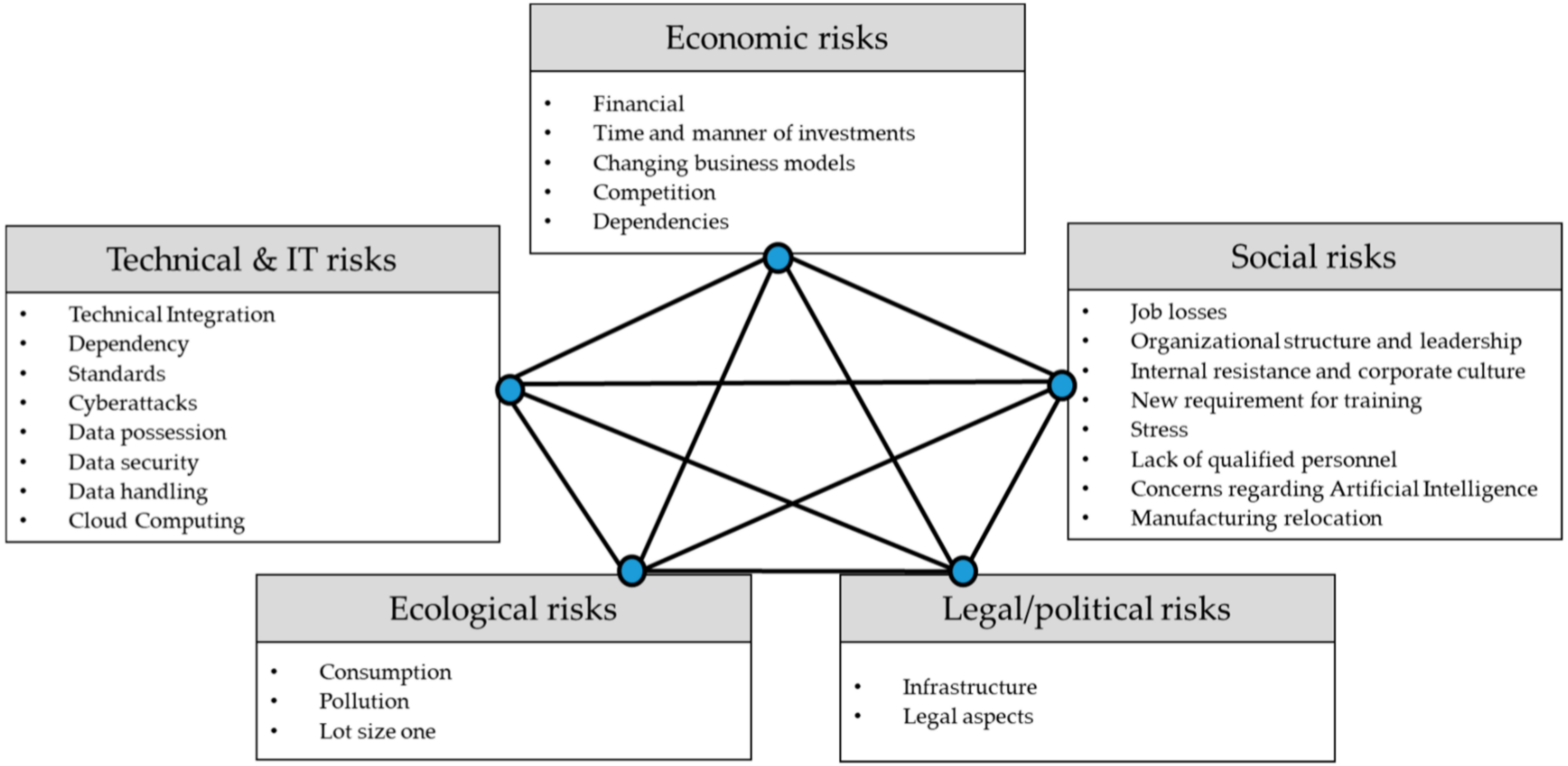
Expected dividends from ADP technologies



Source: UNIDO elaboration based on Andreoni and Anzolin (2019).



4IR and Value Chain Development Risks



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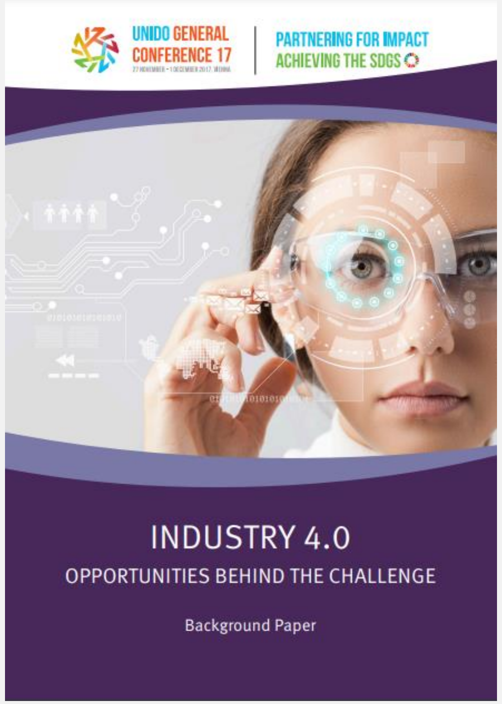
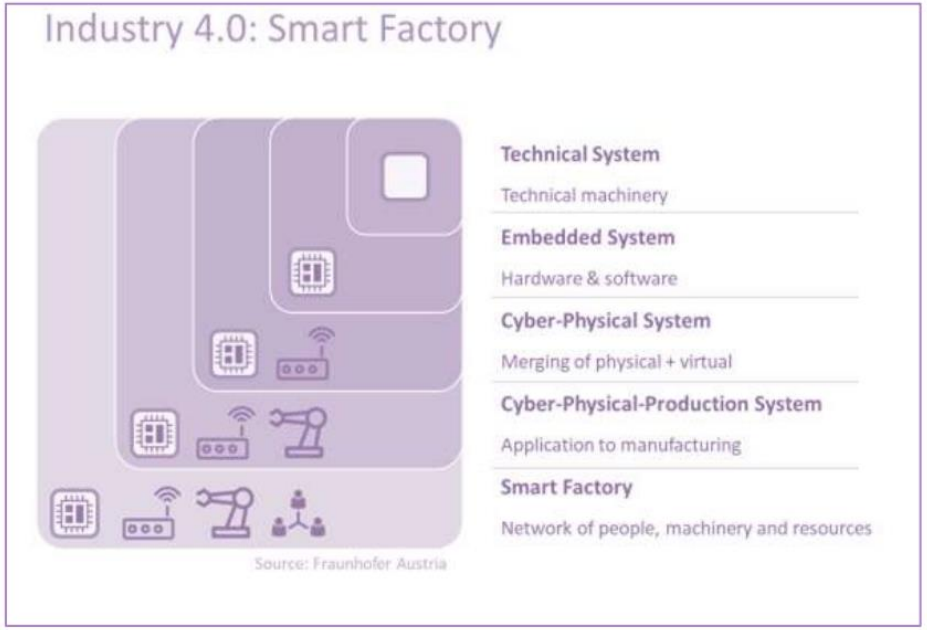
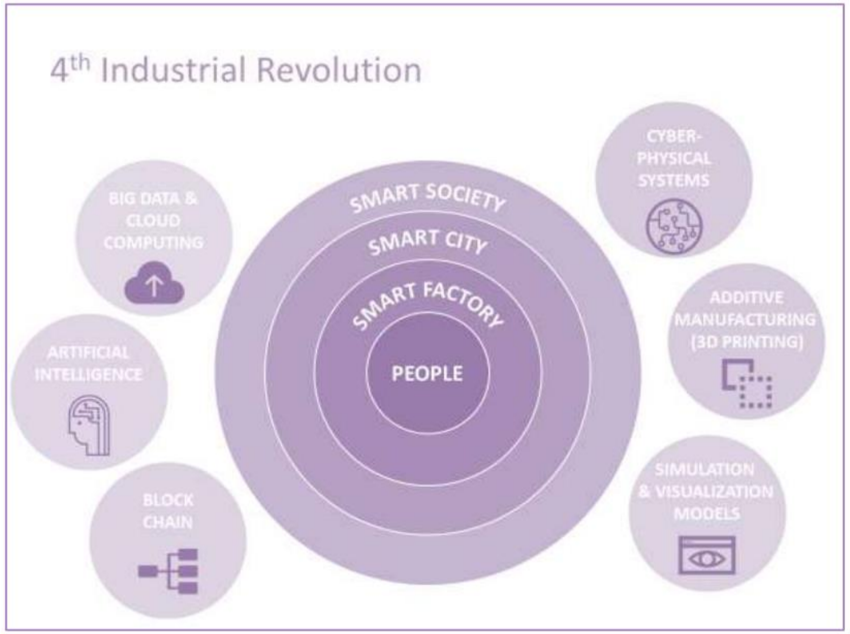
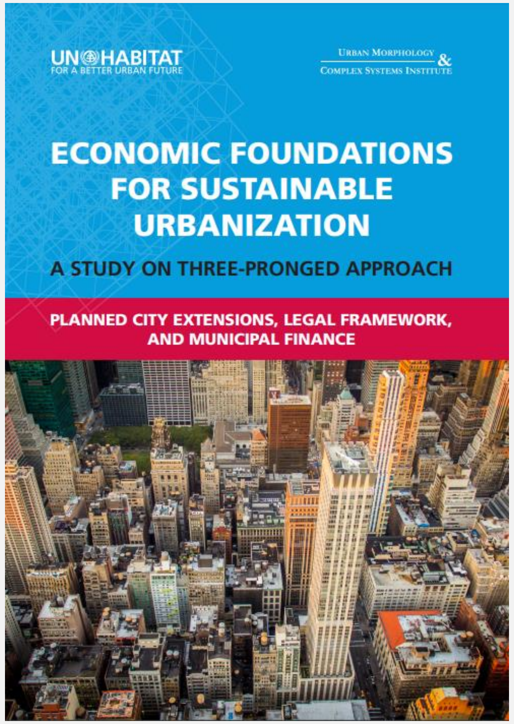


How Does it Contribute to a Smart Sustainable City?







Example of Successful Implementation

MAKING INDONESIA 4.0

10 National Priorities

1 Reform Material Flow
- Enhance **domestic upstream material production**; e.g. 50% of petrochemical is imported

2 Redesign Industrial Zones
- Build **a single nationwide industry zoning roadmap (e.g. industry belts)**; resolve zoning inconsistency challenges

3 Embrace sustainability
- Grab **opportunities under global sustainability trend**; e.g. EV, biofuel, renewables

4 Empower SMEs
- Empower **3.7 million SMEs[1] by technologies;** e.g. build SME e-commerce, technology bank

5 Build Nationwide Digital Infrastructure
- Advance **network and digital platform;** e.g. 4G to 5G, Fiber speed 1Gbps, Data center and Cloud

6 Attract Foreign Investments
- Engage **top global manufacturers** with attractive offers and accelerate **technology transfer**

7 Upgrade Human Capital
- Redesign **education curriculum** under 4IR era
- Create professional **talent mobility programme**

8 Establish Innovation Ecosystem
- Enhance **R&D&D[2] centers** by government, private sector and universities

9 Incentivize Technology Investment
- Introduce **tax exemption/subsidies** for technology adoption and **support funding**

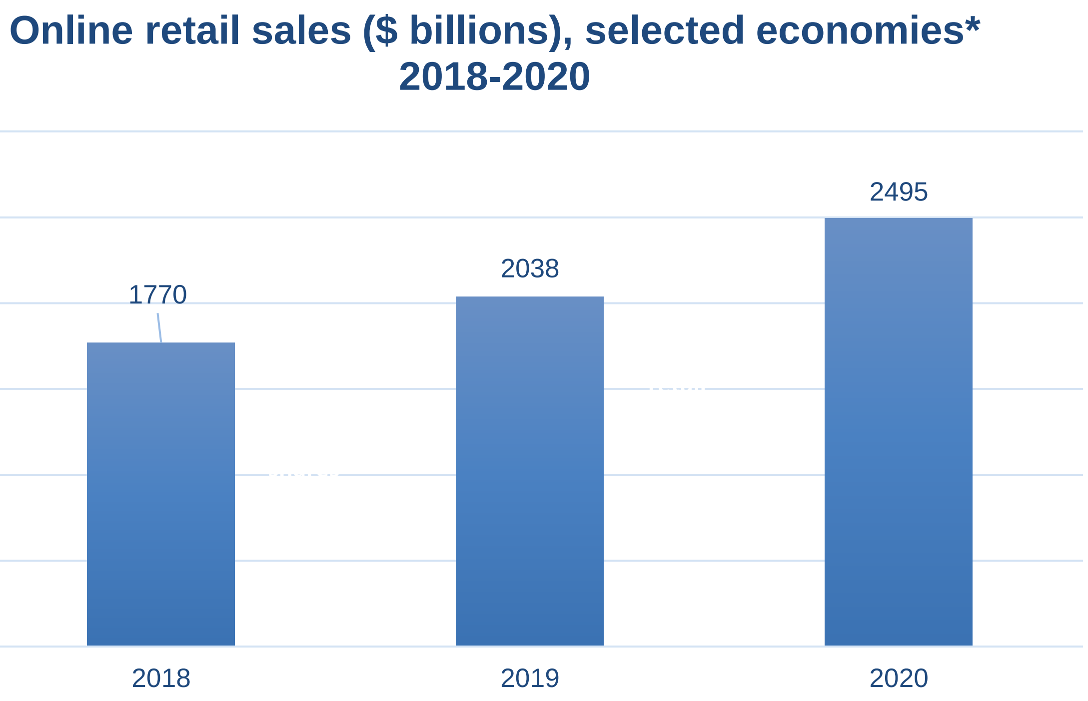
10 Reoptimize Regulations & Policies
- Build more **coherent policies/regulations** by **cross-ministry collaborations**

Source: A. T. Kearney, Ministry of Industry.

Tool #2

E-Commerce platforms

E-Commerce Platforms

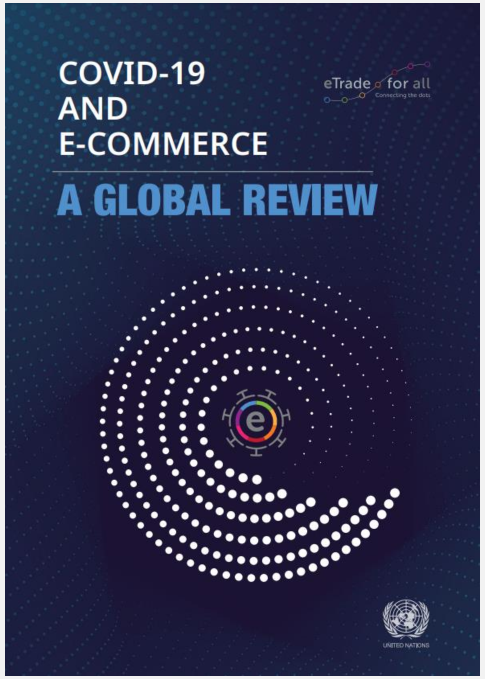


*Australia, Canada, China, Korea, Singapore, UK and USA

https://unctad.org/press-material/global-e-commerce-jumps-267-trillion-covid-19-boosts-online-retail-sales

Challenges Addressed and the Benefits

Benefits E-Commerce	Benefits Traditional Commerce
1. Cost effective 2. Faster Transaction and Better connectivity 3. Access to international value chains 4. Potential to tap into Larger consumer base 5. Instantaneous/very quick product feedback 6. Available 24x7	1. Suitable for perishables and *'touch and feel'* items 2. Easy access to human resources and skills development 3. Face-to-Face Interaction 4. Limited exposure to cyber security threats



E-Commerce Platform Risks

E-commerce challenges

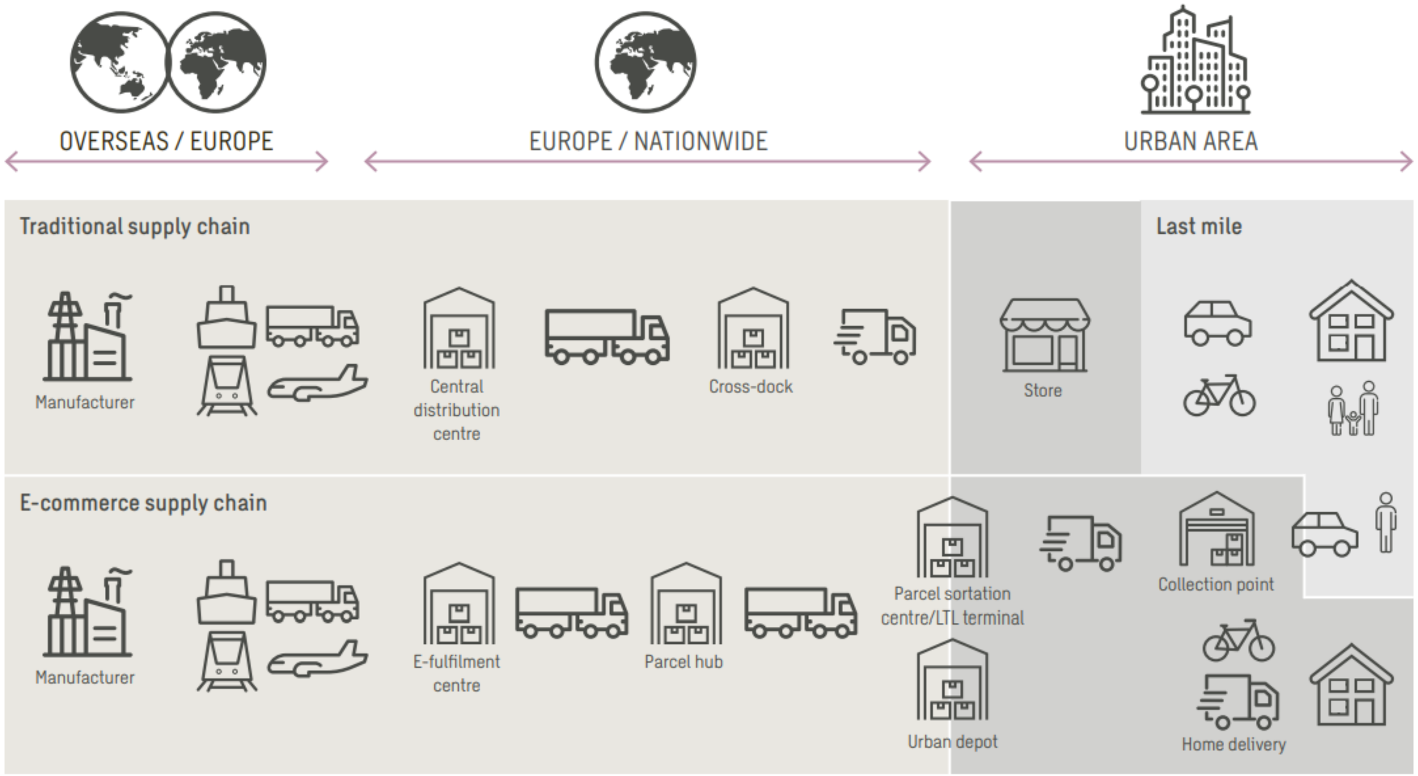
- E-commerce readiness assessments and strategy formulation
- ICT infrastructure and services
- Trade logistics and trade facilitation
- Payment solutions
- Legal and regulatory frameworks
- E-commerce skills development
- Access to financing for e-commerce

E-commerce risks

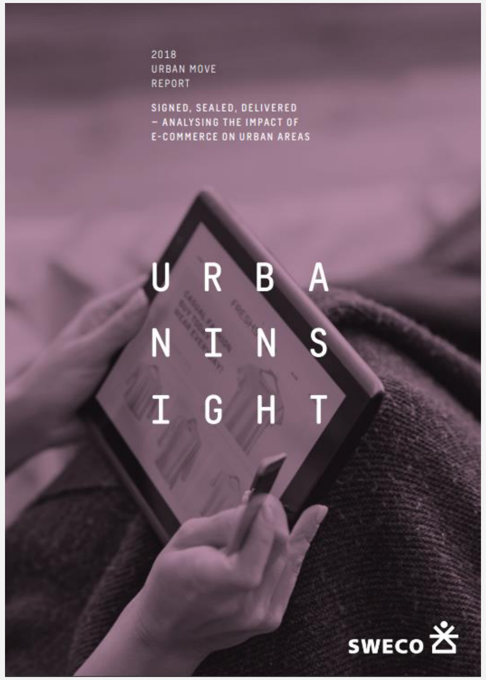
Deliberate acts	Human errors
• **Fraud**: This encompasses data frauds, system manipulation by rogue employees, etc. • **Security**: Hacker gain access to the interface between internal business networks and transactions done by the customer • **Computer viruses**: These are usually malign computer codes which can compromise customer security and the entire digital system/network	• **Poor management:** if e-business management doesn't prioritize security it can leave their customer/clients exposed to significant risks • **Untrained employees**: Due to lack of awareness, mistakes can be made by employees which leads to security risks

https://unctad.org/system/files/official-document/dtlstict2020d13_en.pdf

How Does it Contribute to a Smart Sustainable City?



https://www.swecourbaninsight.com/wp-content/uploads/2020/10/urban-insight-report_e-commerce_a4.pdf

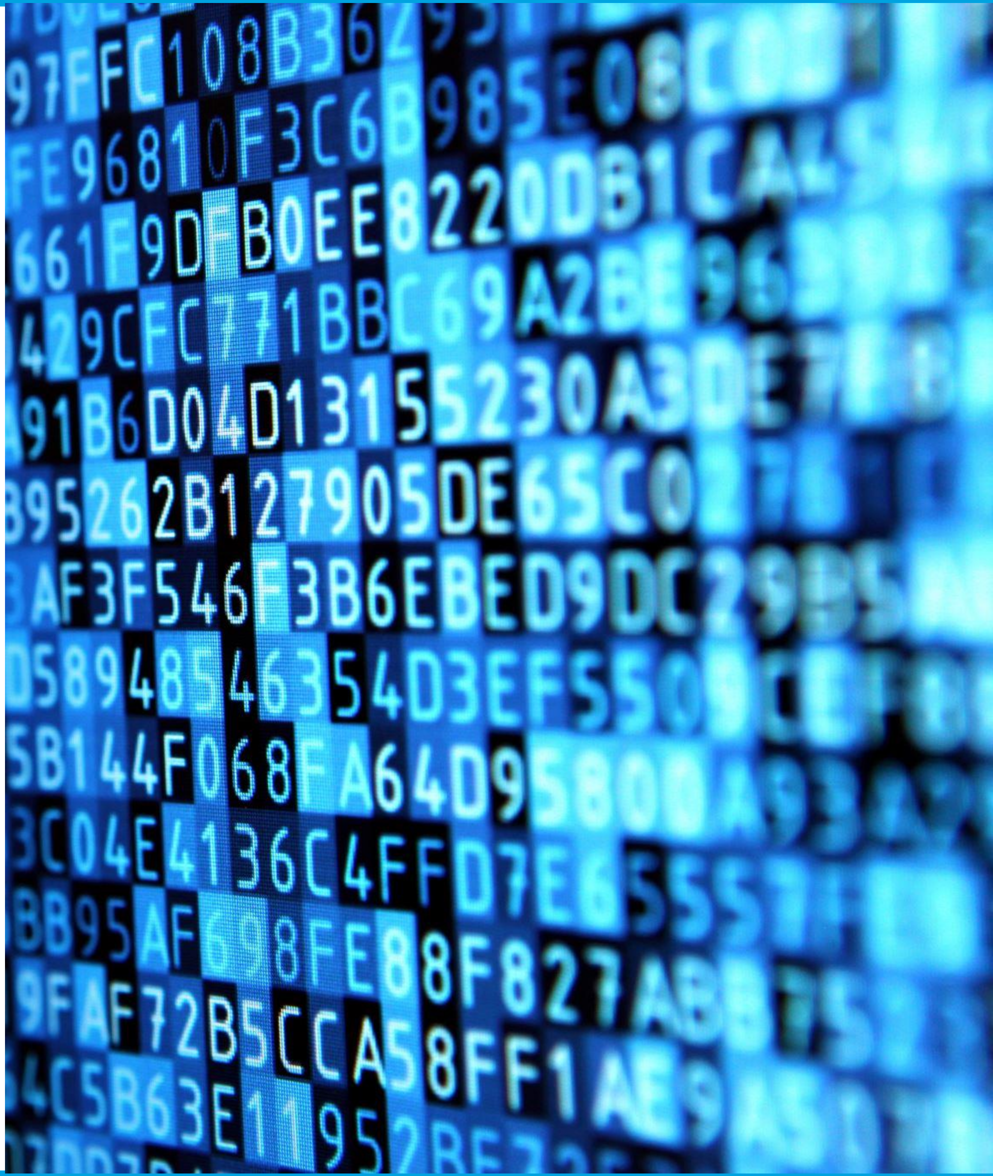


Example of Successful Implementation

https://unctad.org/system/files/official-document/dtlstict2020d13_en.pdf

Tool #3

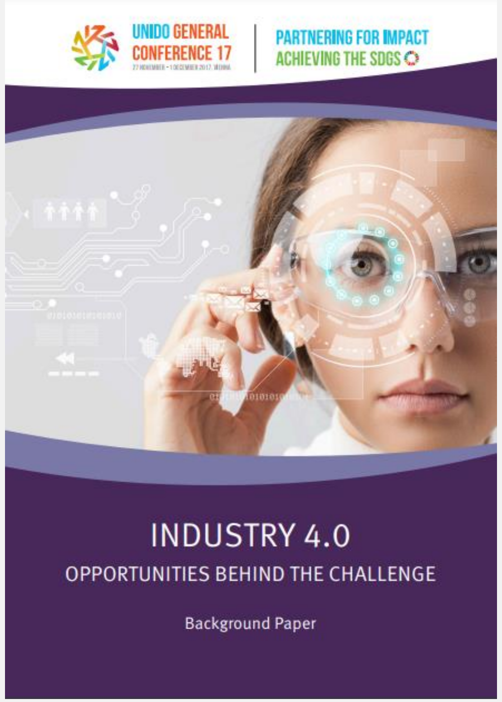
Big Data Analytics/Artificial Intelligence (AI)/Machine Learning (ML)



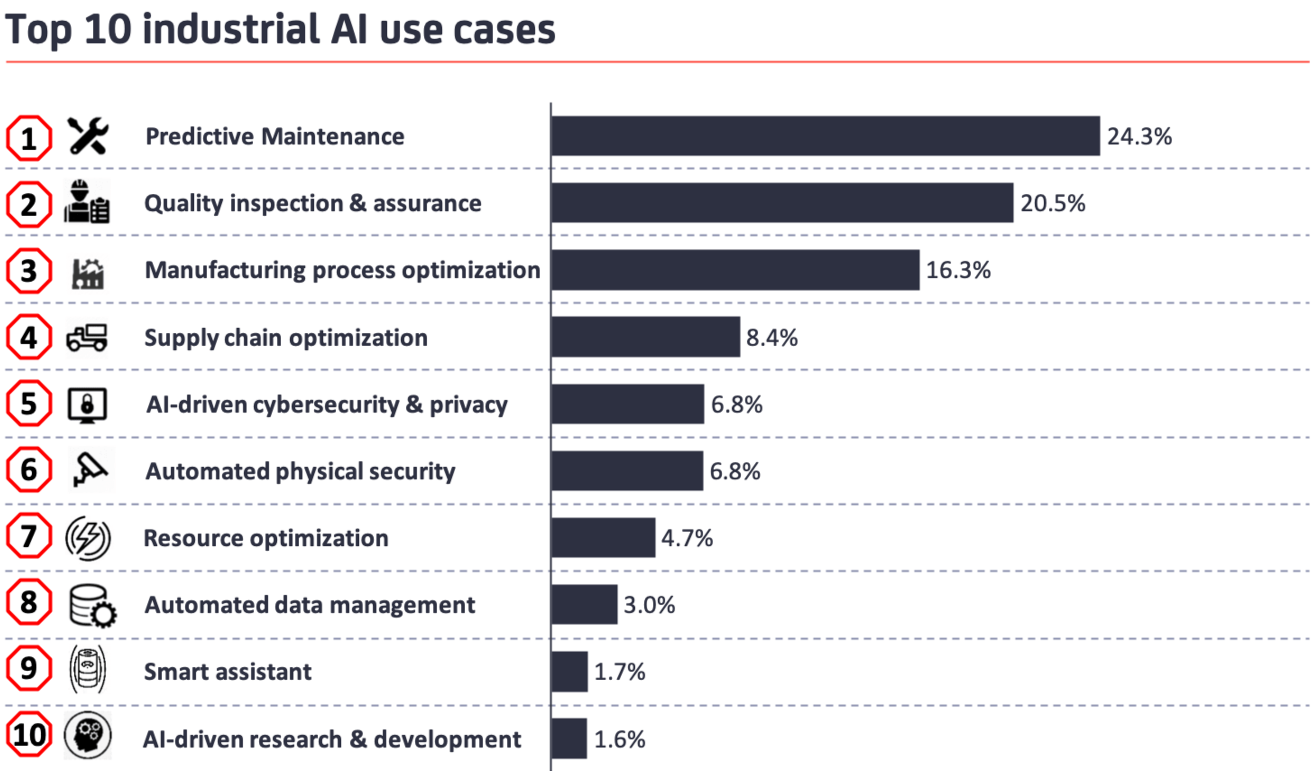
Big Data Analytics/Artificial Intelligence (AI)/Machine Learning (ML)

The Fourth Industrial Revolution (4IR) is rapidly evolving with the aid of big data analytics, artificial intelligence (AI) and machine learning (ML).

Thriving on insurmountable data, AI systems are built to **optimize processes**, **predict maintenance** and **enforce quality control in real-time** to meet changing demands and conditions in manufacturing processes, in the supply network and customer needs

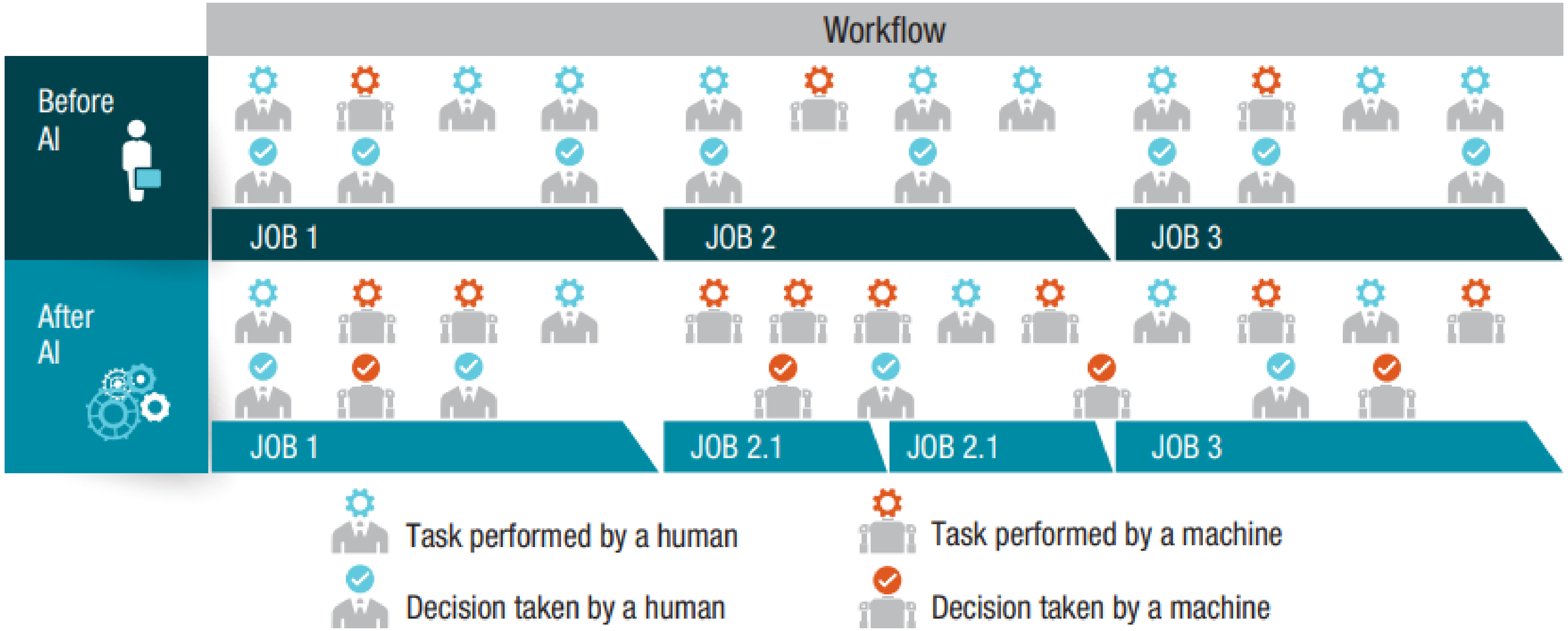


Challenges Addressed and Benefits



Big Data Analytics/AI/ML Risks

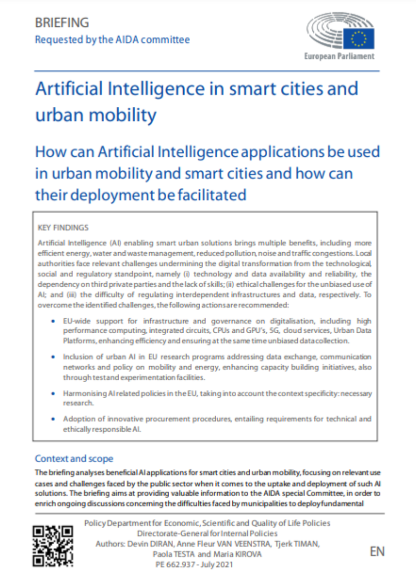
Jobs, tasks, decisions and automation by AI



Source: UNCTAD based on Agrawal et al. (2018) and Acemoglu and Restrepo (2019).

How Does it Contribute to a Smart Sustainable City?

- **AI for governance:** urban planning, tailored subsidy provision, disaster prevention and risk management.
- **AI for living standards**: safety, security, healthcare i.e.: smart policing, personalized healthcare, improved cyber security.
- **AI for education and citizen participation:** locally accurate, validated and actionable knowledge supporting decision-making.
- **AI for economy:** improve competitiveness via efficient supply chains and customer-tailored solutions
- **AI for mobility and logistics:** autonomous and sustainable mobility, smart routing and parking assistance, traffic management.
- **AI for infrastructure:** optimized infrastructure deployment, preventive maintenance of water and waste management, transportation, energy grids, urban lighting.
- **AI for environment:** biodiversity preservation, urban farming and air quality management.


BRIEFING
Requested by the AIDA committee

European Parliament

Artificial Intelligence in smart cities and urban mobility

How can Artificial Intelligence applications be used in urban mobility and smart cities and how can their deployment be facilitated

KEY FINDINGS

Artificial Intelligence (AI) enabling smart urban solutions brings multiple benefits, including more efficient energy, water and waste management, reduced pollution, noise and traffic congestions. Local authorities face relevant challenges undermining the digital transformation from the technological, social and regulatory standpoint, namely (i) technology and data availability and reliability, the dependency on third private parties and the lack of skills; (ii) ethical challenges for the unbiased use of AI; and (iii) the difficulty of regulating interdependent infrastructures and data, respectively. To overcome the identified challenges, the following actions are recommended:

- EU-wide support for infrastructure and governance on digitalisation, including high performance computing, integrated circuits, CPUs and GPU's, 5G, cloud services, Urban Data Platforms, enhancing efficiency and ensuring at the same time unbiased data collection.
- Inclusion of urban AI in EU research programs addressing data exchange, communication networks and policy on mobility and energy, enhancing capacity building initiatives, also through test and experimentation facilities.
- Harmonising AI related policies in the EU, taking into account the context specificity: necessary research.
- Adoption of innovative procurement procedures, entailing requirements for technical and ethically responsible AI.

Context and scope

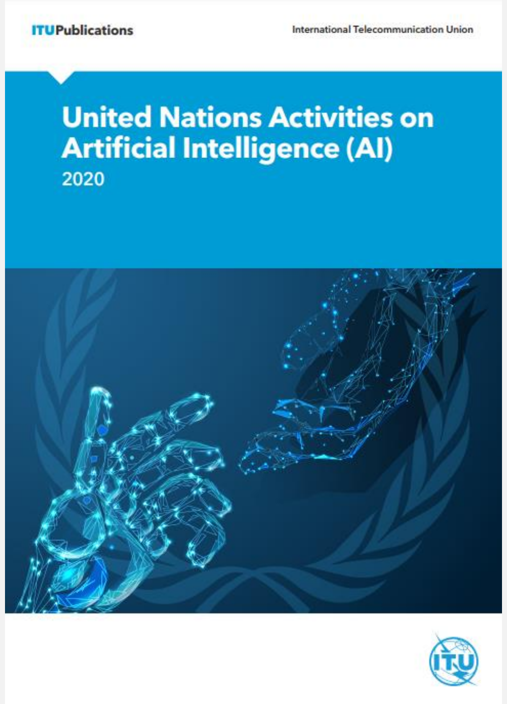
The briefing analyses beneficial AI applications for smart cities and urban mobility, focusing on relevant use cases and challenges faced by the public sector when it comes to the uptake and deployment of such AI solutions. The briefing aims at providing valuable information to the AIDA special Committee, in order to enrich ongoing discussions concerning the difficulties faced by municipalities to deploy fundamental

Policy Department for Economic, Scientific and Quality of Life Policies
Directorate-General for Internal Policies
Authors: Devin DIRAN, Anne Fleur VAN VEENSTRA, Tjerk TIMAN, Paola TESTA and Maria KIROVA
PE 662.937 - July 2021

EN

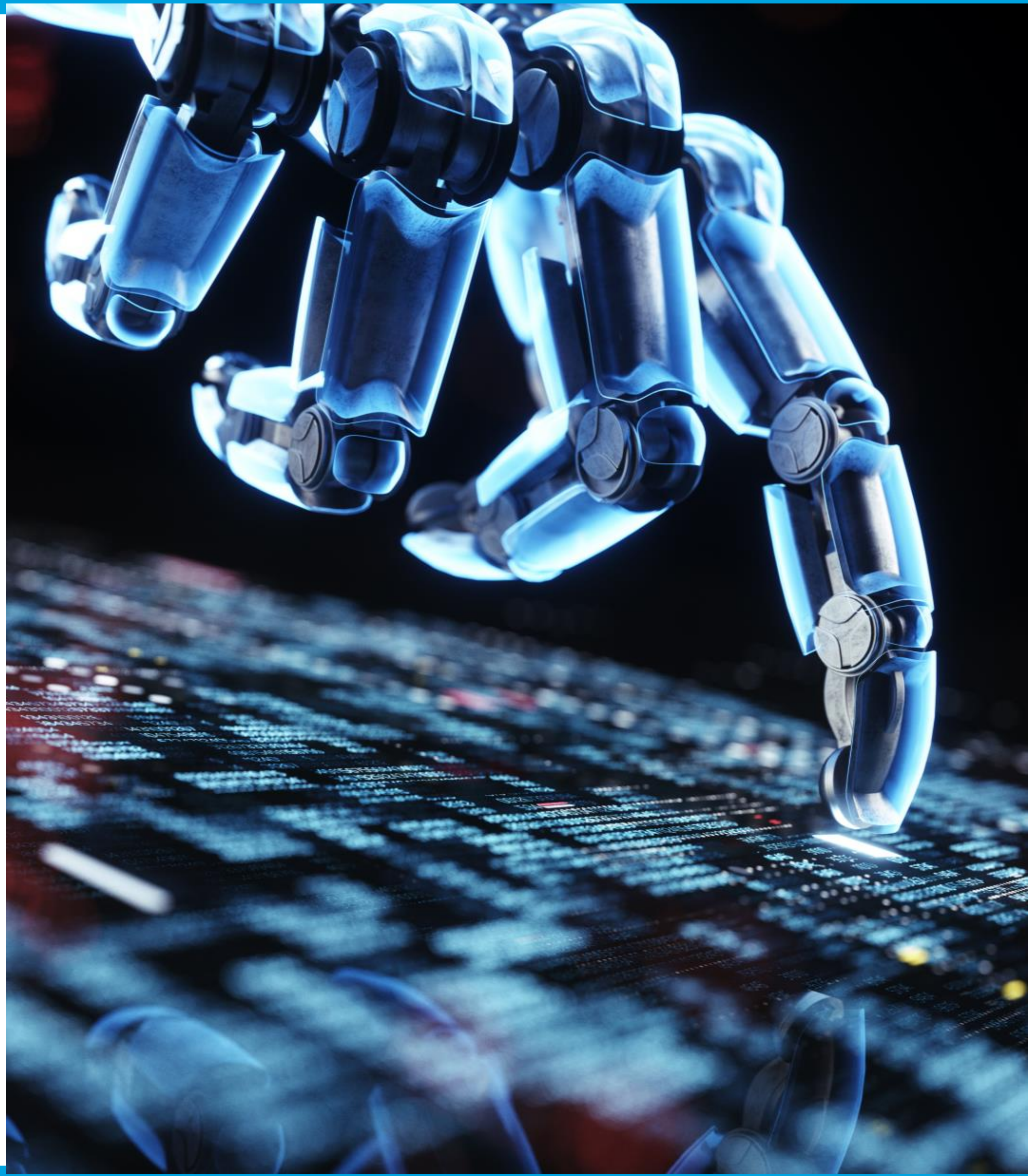
Example of Successful Implementation

- The project established a pilot Smart Manufacturing Innovation Centre (SMIC) to raise awareness on the opportunities and challenges of the 4IR technologies for Serbian SMEs.
- The SMIC provides demonstration facilities on advanced digital technologies and new materials:
  - Tools for the assessment on readiness for digitalization in manufacturing and skill-building
  - Technical services and shop floor assistance on Lean Management and Lean 4.0 Management for process optimization
  - Training packages on digitalization and automation in specific industrial sectors as well as on business environment for StartUps and ScaleUps in innovative digital technologies and smart materials.



Tool #4

Automation/Robots



Automation/Robots

- The word ‘robot’ was first coined by a Czech novelist Karel Capek in a 1920 play titled Rassum’s Universal Robots (RUR). The Czech translation for the word ‘robot’ means ***worker or servant***.

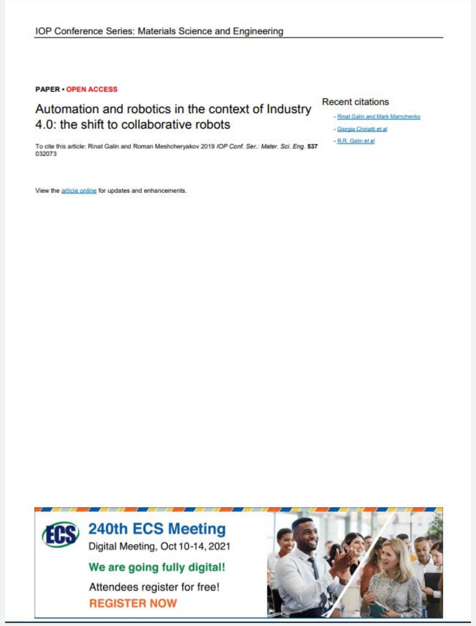
- According to the Robot Institute of America (1979) a ‘robot’ can be defined as *“A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks”.*

- The three main categories robots fall into are: 1) autonomous machines; 2) manipulators; and 3) fixed structures (legged/wheeled).

- Robots and automated processes are now found driving activity across several sectors including (but not limited to) automotive; aeronautics; semiconductors; and STEM research.

Challenges Addressed and the Benefits

- Increased Efficiency and Productivity
- Increased Safety
- Promotion of Skilled Workforce
- Faster Return on Investments
- Versatile Applications
- Cost Savings
- Smaller Environment Footprint
- Integration Capabilities


IOP Conference Series: Materials Science and Engineering

PAPER • OPEN ACCESS

Automation and robotics in the context of Industry 4.0: the shift to collaborative robots

To cite this article: Rinat Galin and Roman Meshcheryakov 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **537** 032073

Recent citations
- Rinat Galin and Mark Mamchenko
- Giorgia Chiriatti *et al*
- R.R. Galin *et al*

View the article online for updates and enhancements.

Automation/Robots Risks

While robots do offer many advantages to stakeholders and end-user there are several risks which this technology brings. Some of the key issues & threats are listed below:

Impact Dimensions

Security Issues

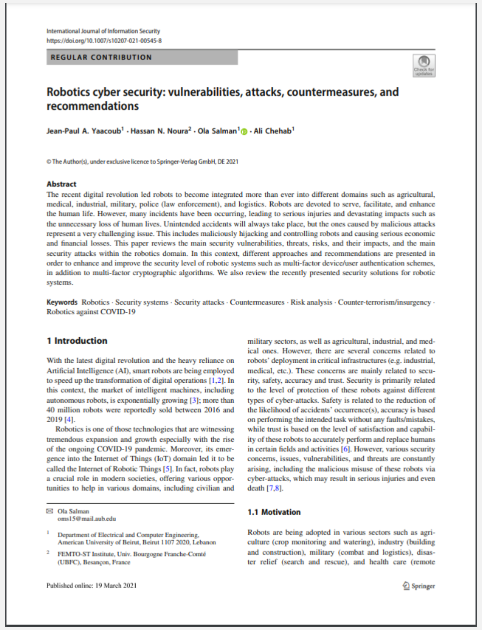
- Lack of secure networking
- Misconfiguration and bad programming
- Lack of tamper-resistant hardware
- Lack of safety designs
- Lack of employee screening

Security Threats

- Cyber Criminals
- Malicious Manufacturers
- Incompetent Developers
- Incompetent Operators
- Insiders & Outsiders

Impact Dimensions:

- Business and Industry
- Economy and Finance
- Operations and Functionality


International Journal of Information Security
https://doi.org/10.1007/s10207-021-00545-8

REGULAR CONTRIBUTION

Robotics cyber security: vulnerabilities, attacks, countermeasures, and recommendations

Jean-Paul A. Yaacoub[1] · Hassan N. Noura[2] · Ola Salman[1] · Ali Chehab[1]

Abstract
The recent digital revolution led robots to become integrated more than ever into different domains such as agricultural, medical, industrial, military, police (law enforcement), and logistics. Robots are devoted to serve, facilitate, and enhance the human life. However, many incidents have been occurring, leading to serious injuries and devastating impacts such as the unnecessary loss of human lives. Unintended accidents will always take place, but the ones caused by malicious attacks represent a very challenging issue. This includes maliciously hijacking and controlling robots and causing serious economic and financial losses. This paper reviews the main security vulnerabilities, threats, risks, and their impacts, and the main security attacks within the robotics domain. In this context, different approaches and recommendations are presented in order to enhance and improve the security level of robotic systems such as multi-factor device/user authentication schemes, in addition to multi-factor cryptographic algorithms. We also review the recently presented security solutions for robotic systems.

Keywords Robotics · Security systems · Security attacks · Countermeasures · Risk analysis · Counter-terrorism/insurgency · Robotics against COVID-19

1 Introduction

With the latest digital revolution and the heavy reliance on Artificial Intelligence (AI), smart robots are being employed to speed up the transformation of digital operations [1,2]. In this context, the market of intelligent machines, including autonomous robots, is exponentially growing [3]; more than 40 million robots were reportedly sold between 2016 and 2019 [4].

Robotics is one of those technologies that are witnessing tremendous expansion and growth especially with the rise of the ongoing COVID-19 pandemic. Moreover, its emergence into the Internet of Things (IoT) domain led it to be called the Internet of Robotic Things [5]. In fact, robots play a crucial role in modern societies, offering various opportunities to help in various domains, including civilian and military sectors, as well as agricultural, industrial, and medical ones. However, there are several concerns related to robots' deployment in critical infrastructures (e.g. industrial, medical, etc.). These concerns are mainly related to security, safety, accuracy and trust. Security is primarily related to the level of protection of these robots against different types of cyber-attacks. Safety is related to the reduction of the likelihood of accidents' occurrence(s), accuracy is based on performing the intended task without any faults/mistakes, while trust is based on the level of satisfaction and capability of these robots to accurately perform and replace humans in certain fields and activities [6]. However, various security concerns, issues, vulnerabilities, and threats are constantly arising, including the malicious misuse of these robots via cyber-attacks, which may result in serious injuries and even death [7,8].

1.1 Motivation

Robots are being adopted in various sectors such as agriculture (crop monitoring and watering), industry (building and construction), military (combat and logistics), disaster relief (search and rescue), and health care (remote

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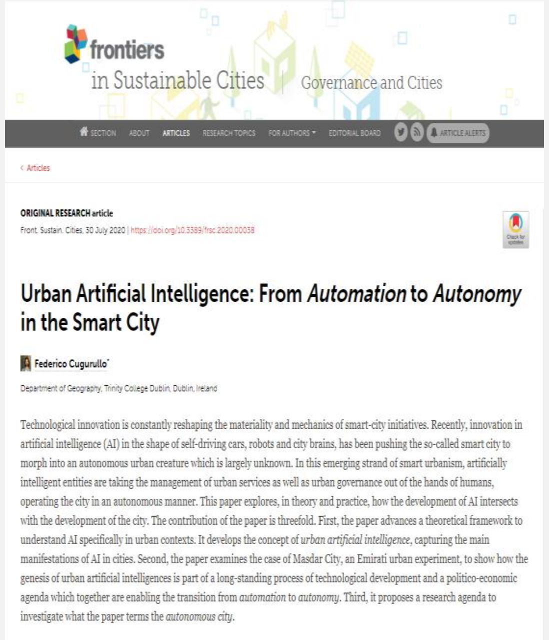
Published online: 19 March 2021

Springer

How Does it Contribute to a Smart Sustainable City?

Robots → **Robots + AI** → **Example: Service Robots**


frontiers in Sustainable Cities | Governance and Cities

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ORIGINAL RESEARCH article
Front. Sustain. Cities, 30 July 2020 | https://doi.org/10.3389/frsc.2020.00038

Urban Artificial Intelligence: From *Automation* to *Autonomy* in the Smart City

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Department of Geography, Trinity College Dublin, Dublin, Ireland

Technological innovation is constantly reshaping the materiality and mechanics of smart-city initiatives. Recently, innovation in artificial intelligence (AI) in the shape of self-driving cars, robots and city brains, has been pushing the so-called smart city to morph into an autonomous urban creature which is largely unknown. In this emerging strand of smart urbanism, artificially intelligent entities are taking the management of urban services as well as urban governance out of the hands of humans, operating the city in an autonomous manner. This paper explores, in theory and practice, how the development of AI intersects with the development of the city. The contribution of the paper is threefold. First, the paper advances a theoretical framework to understand AI specifically in urban contexts. It develops the concept of *urban artificial intelligence*, capturing the main manifestations of AI in cities. Second, the paper examines the case of Masdar City, an Emirati urban experiment, to show how the genesis of urban artificial intelligences is part of a long-standing process of technological development and a politico-economic agenda which together are enabling the transition from *automation* to *autonomy*. Third, it proposes a research agenda to investigate what the paper terms the *autonomous city*.

Example of Successful Implementation

- UNIDO is currently implementing a project to establish a 4IR demonstration and innovation center in the Brest Region of Belarus.

- The pilot center exemplifies the type of production approach that can become the engine of economic growth in the region and the country by demonstrating :

    - How forward-thinking engagement on how leveraging technologies (such as automation and robotics) can lead to smart & clean manufacturing.

    - How new technological developments can lead to improve skills development with minimal job displacement.

- The key challenges addressed through this project are the ***lack of information on state of the art technologies; shortage of skilled personnel; lack of 4IR infrastructure; and inefficient industrial processes.*** (These challenges are not unique to Belarus alone)

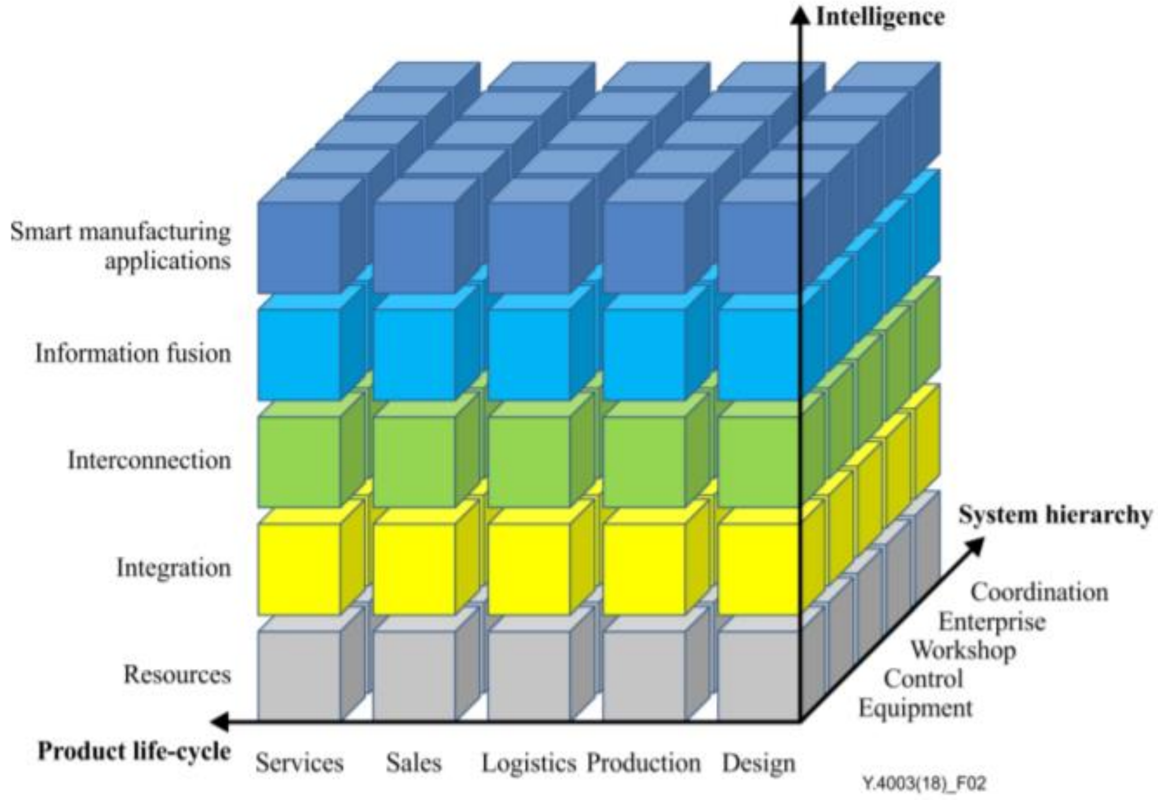
- Prior achievements have included supporting the upgrading of component manufacturers in the automotive sector to move from lean management to *digital kaizen*. The project has trained more than 500 experts and helped 44 pilot companies to achieve economic returns exceeding US$9mn.

Tool #5

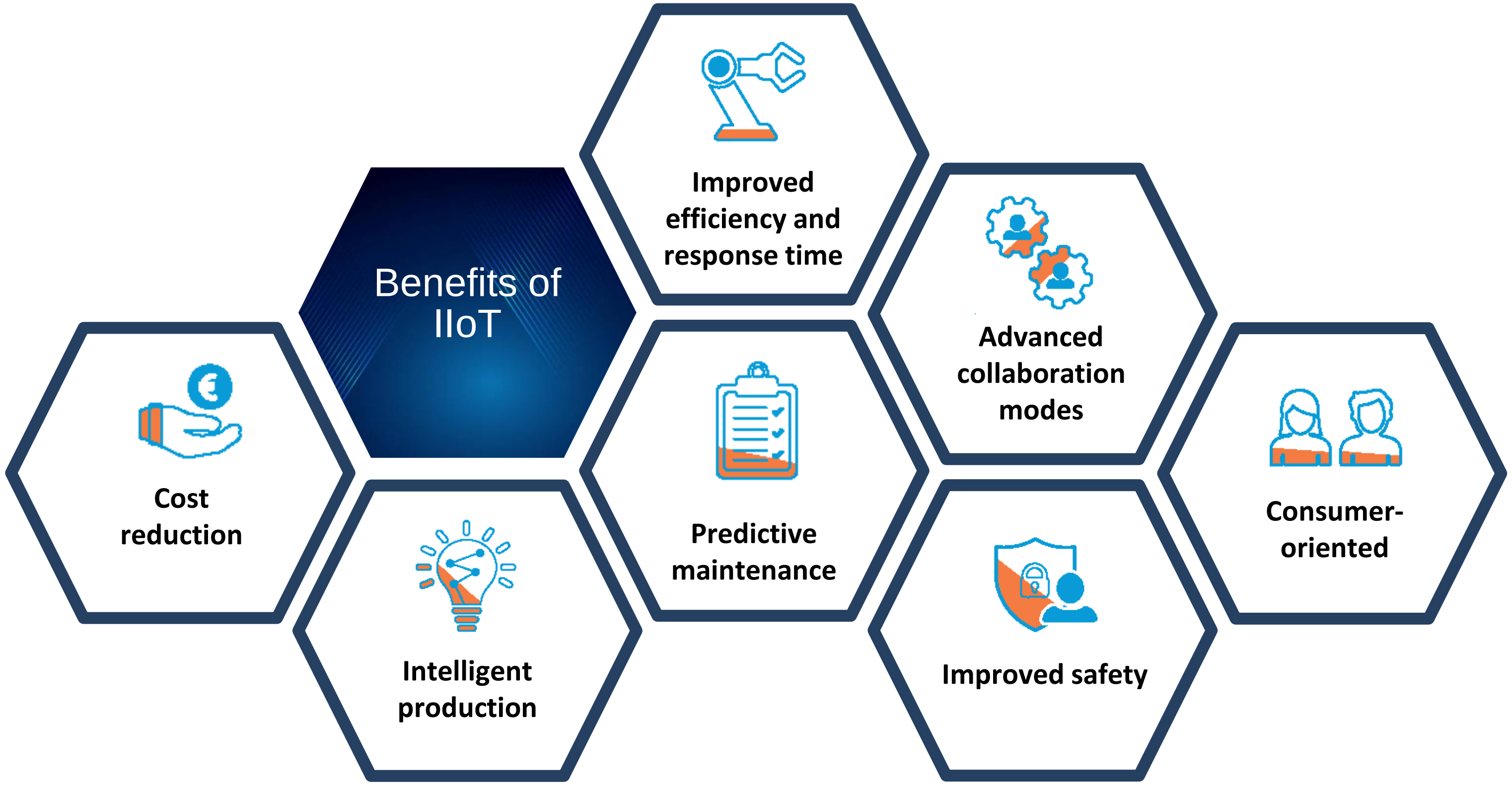
Industrial Internet of Things (IIoT)

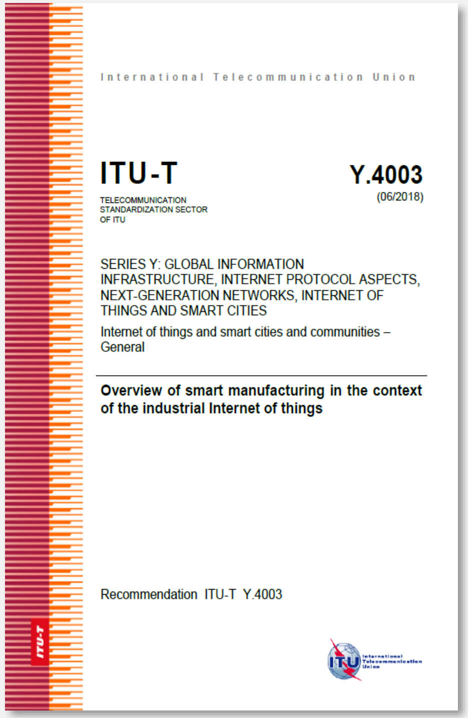
Internet of Things (IoT)

Reference model of smart manufacturing in the context of the industrial IoT in the product life-cycle view



Challenges Addressed and the Benefits




International Telecommunication Union

ITU-T

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

Y.4003

(06/2018)

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Internet of things and smart cities and communities – General

Overview of smart manufacturing in the context of the industrial Internet of things

Recommendation ITU-T Y.4003

Internet of Things (IoT) Risks

Industrial Internet of Things: Challenges, Opportunities, and Directions

Emiliano Sisinni, *Member, IEEE*, Abusayeed Saifullah, *Member, IEEE*, Song Han, *Member, IEEE*, Ulf Jennehag, *Member, IEEE*, and Mikael Gidlund, *Senior Member, IEEE*

***Abstract*—Internet of Things (IoT) is an emerging domain that promises ubiquitous connection to the Internet, turning common objects into connected devices. The IoT paradigm is changing the way people interact with things around them. It paves the way for creating pervasively connected infrastructures to support innovative services and promises better flexibility and efficiency. Such advantages are attractive not only for consumer applications, but also for the industrial domain. Over the last few years, we have been witnessing the IoT paradigm making its way into the industry marketplace with purposely designed solutions. In this paper, we clarify the concepts of IoT, Industrial IoT, and Industry 4.0. We highlight the opportunities brought in by this paradigm shift as well as the challenges for its realization. In particular, we focus on the challenges associated with the need of energy efficiency, real-time performance, coexistence, interoperability, and security and privacy. We also provide a systematic overview of the state-of-the-art research efforts and potential research directions to solve Industrial IoT challenges.**

***Index Terms*—Industrial internet of things (IIoT), real-time communication, reliability, security, wireless sensor network (WSN).**

I. Introduction

INTERNET of Things (IoT) is a computing concept describing ubiquitous connection to the Internet, turning common objects into connected devices. The key idea behind the IoT concept is to deploy billions or even trillions of smart objects capable of sensing the surrounding environment, transmit and process acquired data, and then feedback to the environment. It is expected that by the year 2021, there will be around 28 billion connected devices [1]. Connecting unconventional objects to the

IoT IIoT Industry 4.0 CPS

Fig. 1. IoT, CPS, IIoT, and Industry 4.0 in Venn diagram.

Internet will improve the sustainability and safety of industries and society, and enable efficient interaction between the physical world and its digital counterpart, i.e., what is usually addressed as a cyber-physical system (CPS). IoT is usually depicted as the disruptive technology for solving most of present-day society issues such as smart cities, intelligent transportation, pollution monitoring, and connected healthcare, to name a few. As a subset of IoT (see Fig. 1), *Industrial IoT (IIoT)* covers the domains of machine-to-machine (M2M) and industrial communication technologies with automation applications. IIoT paves the way for better understanding of the manufacturing process, thereby enabling efficient and sustainable production.

Flexibility and scalability required by IoT communications are typically addressed using wireless links. In the past, wireless technologies in industrial applications were mostly based on ad hoc solutions, e.g., individually developed for connecting moving parts or hard-to-reach devices. Only recently, standards purposely designed for the industry (e.g., WirelessHART [2] and ISA100.11a [3]) were released. However, they face limitations in terms of scalability and coverage when very large areas need to be covered. While cellular technologies, such as 3/4/5G technologies, promise to connect massive devices over long distances, they require infrastructure support and licensed band [4]. IIoT applications typically require relatively small throughput per node and the capacity is not a main concern. Instead, the need for connecting a very large number of devices to the Internet at low cost, with limited hardware capabilities and energy resources (e.g., small batteries) makes latency, energy efficiency, cost, reliability, and security/privacy more desired features [5].

Meeting the above mentioned requirements poses a number of key challenges on the evolution of IIoT. Addressing these

Manuscript received January 8, 2018; revised May 13, 2018; accepted June 28, 2018. Date of publication July 2, 2018; date of current version November 1, 2018. Paper no. TII-18-0060. *(Corresponding author: Mikael Gidlund.)*

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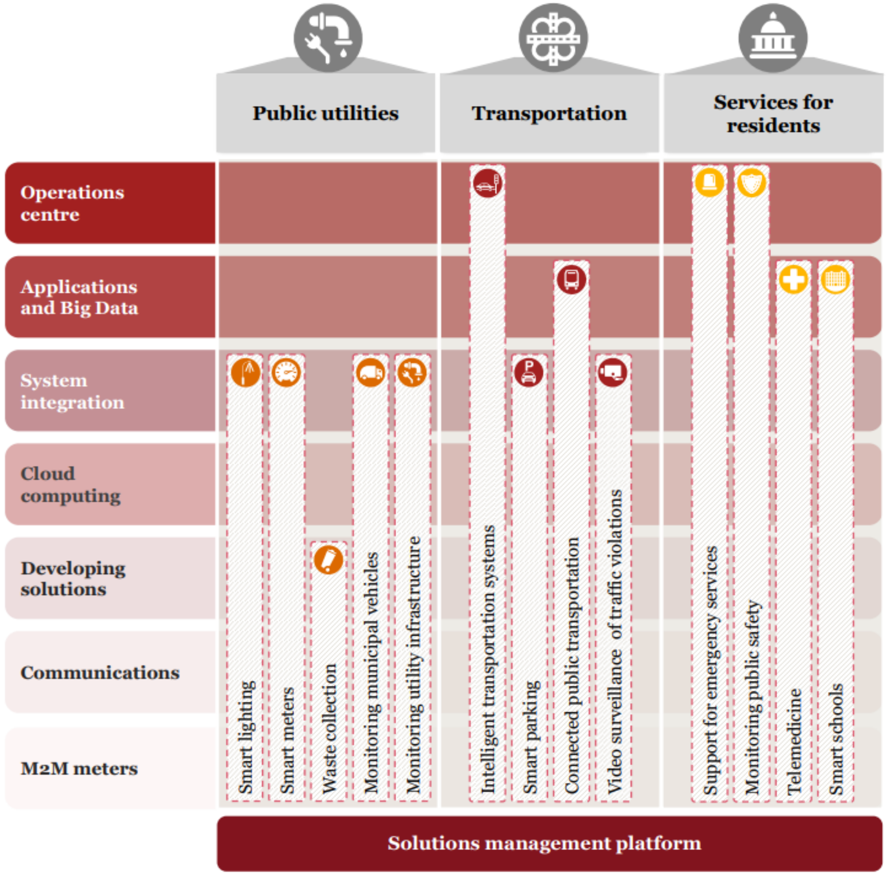
Color versions of one or more of the figures in this paper are available online at http://ieeexplore.ieee.org.
Digital Object Identifier 10.1109/TII.2018.2852491

How Does it Contribute to a Smart Sustainable City?

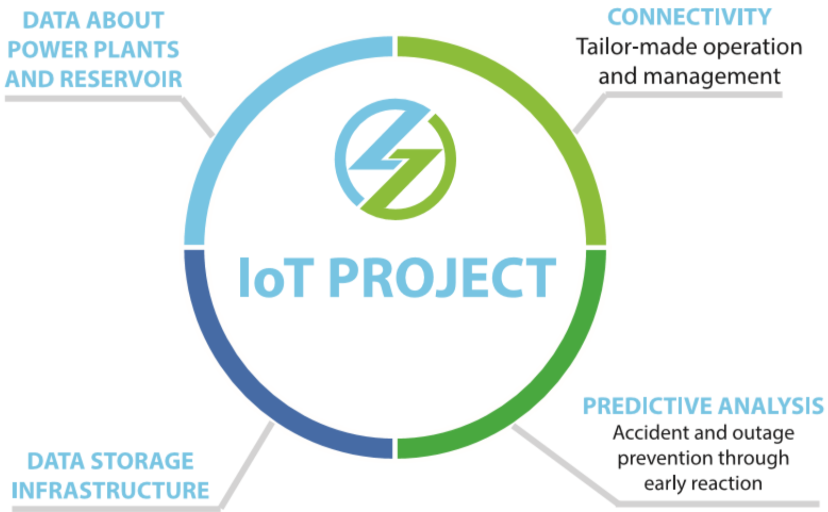


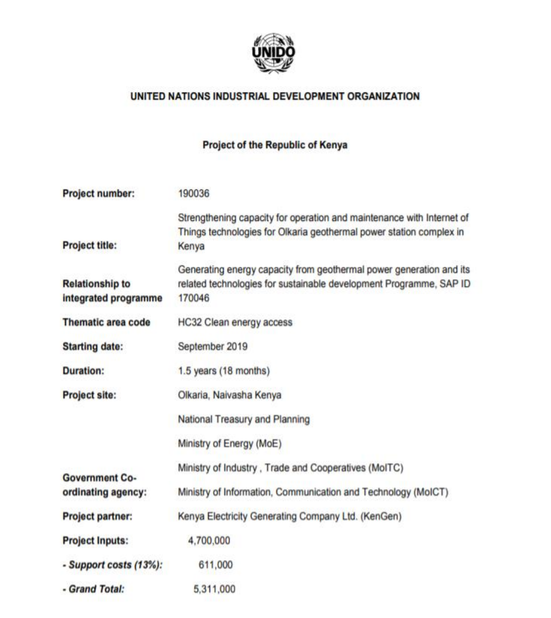
Example of Successful Implementation

Using the Internet of things for Energy
Improve geothermal energy production in Kenya

Pilot adoption of IoT technologies in **Kenya** to strengthen operation and maintenance of the plants and move towards remote monitoring and preventive maintenance in the future.

Innovative technological solutions can add value to the already existing geothermal installation and enhance operations.





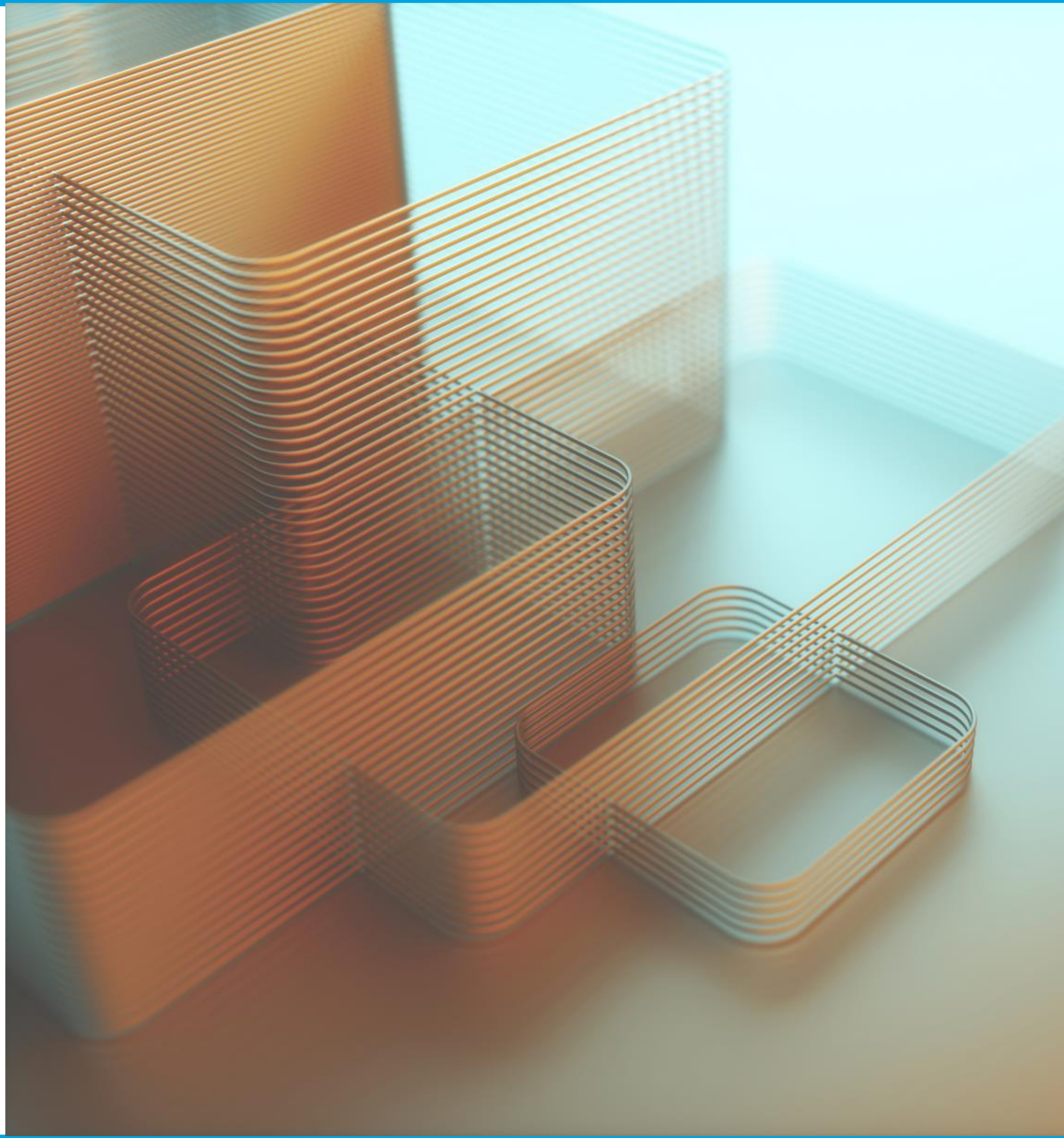
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Project of the Republic of Kenya

Project number:	190036
Project title:	Strengthening capacity for operation and maintenance with Internet of Things technologies for Olkaria geothermal power station complex in Kenya
Relationship to integrated programme	Generating energy capacity from geothermal power generation and its related technologies for sustainable development Programme, SAP ID 170046
Thematic area code	HC32 Clean energy access
Starting date:	September 2019
Duration:	1.5 years (18 months)
Project site:	Olkaria, Naivasha Kenya
Government Co-ordinating agency:	National Treasury and Planning Ministry of Energy (MoE) Ministry of Industry , Trade and Cooperatives (MoITC) Ministry of Information, Communication and Technology (MoICT)
Project partner:	Kenya Electricity Generating Company Ltd. (KenGen)
Project Inputs:	4,700,000
- Support costs (13%):	611,000
- Grand Total:	5,311,000

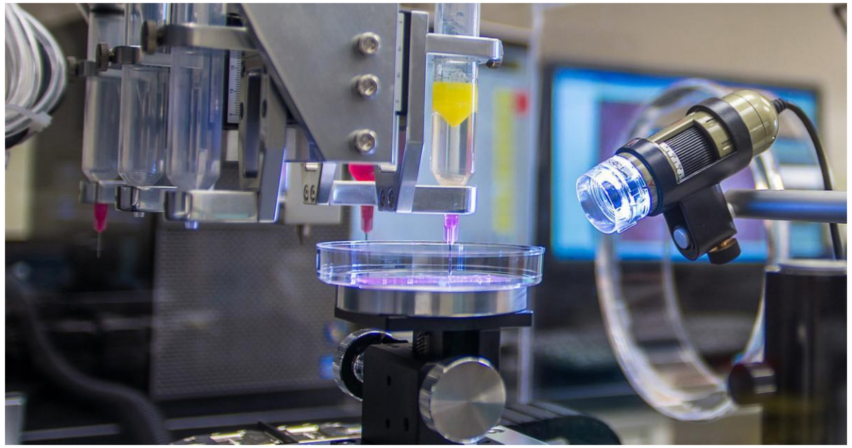
Tool #6

3D Printing



3D Printing

- 3D printing is a technology that is able to create physical objects from a geometrical representation through successive addition/layering of materials.
- Conventional thermoplastics, ceramics, graphene-based materials, and metals are the materials that can be printed by using 3D printing technology.
- The seven groups of 3D printing are: binding jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination and vat photopolymerization
- 3D printing technology is increasingly used for the mass customization, production for many products of open source designs in the field of agriculture, in healthcare, automotive industry, and aerospace industries

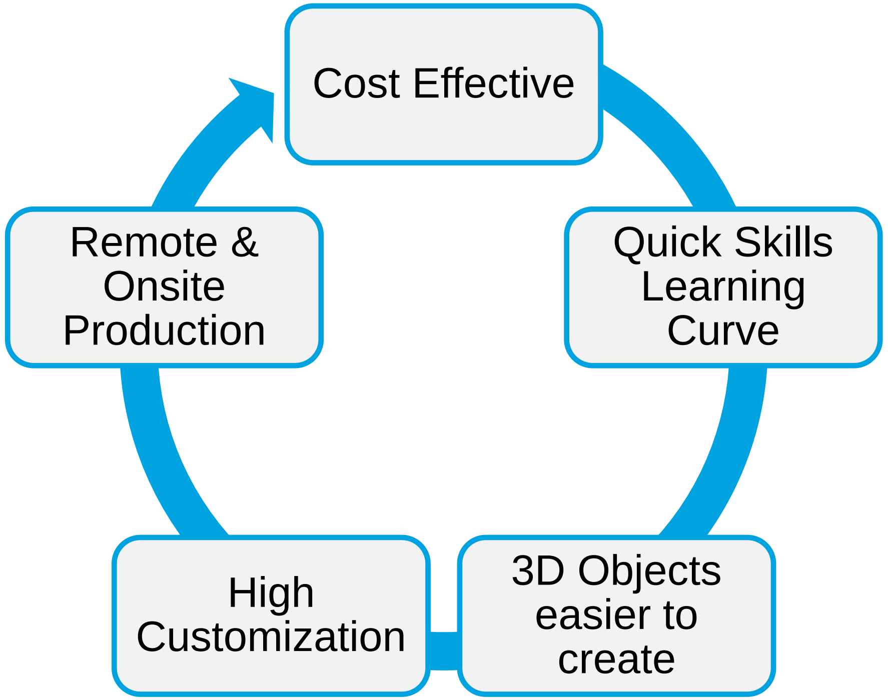


Directed Energy Deposition

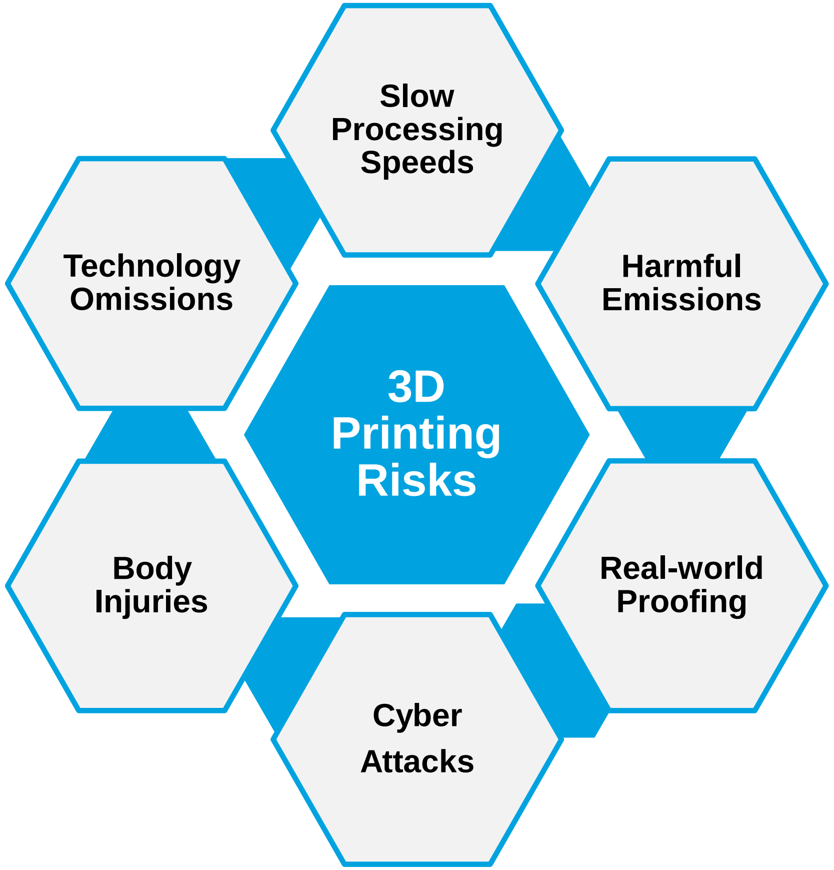
11 minute - 3D Printing Introduction Video

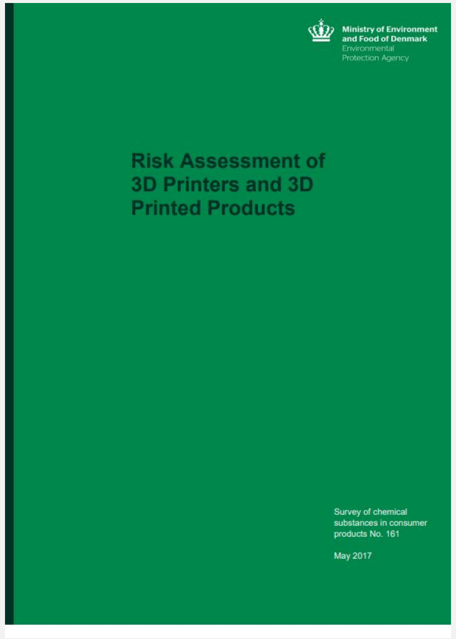
Challenges Addressed and the Benefits

The popularity of 3D printing can be attributed to its many advantages over conventional fabrication techniques:



3D Printing Risks





How does this contribute to a Smart Sustainable City?

Potential

- 3D printing offers sustainability, provides the freedom for smart planning, and has almost no restrictions when it comes to designs.

Sustainability

- 3D printing fosters sustainability: it reduces waste by using the exact amount of material it needs, while also contributing waste management and recycling in general.

Affordable

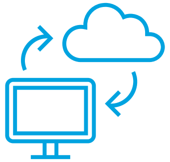
- 3D printing can also help to create more affordable housing options by printing houses and even entire residential areas.

3D printed “earth walls”

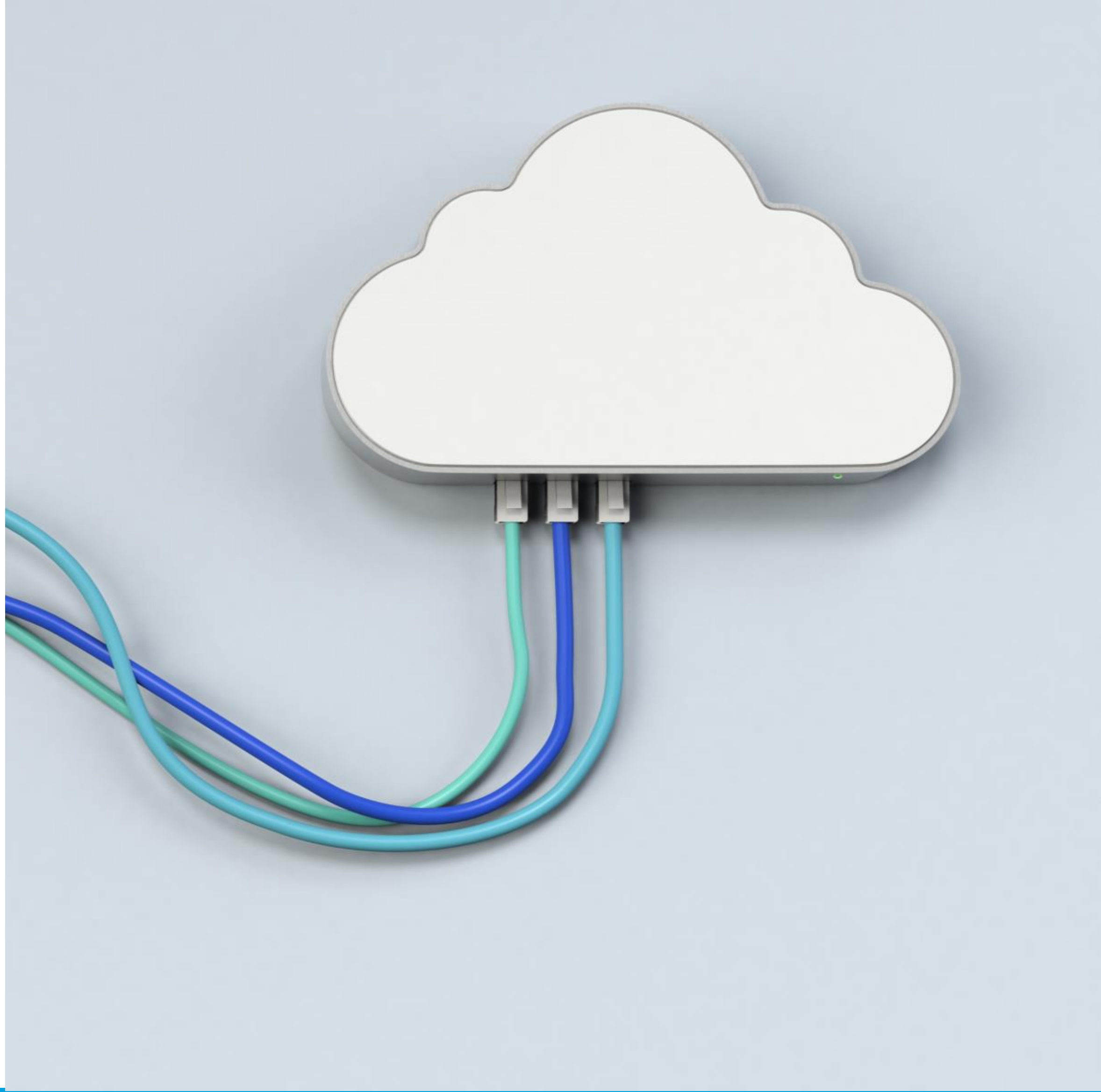
3D printed house in Tabasco

Example of Successful Implementation

Tool #7



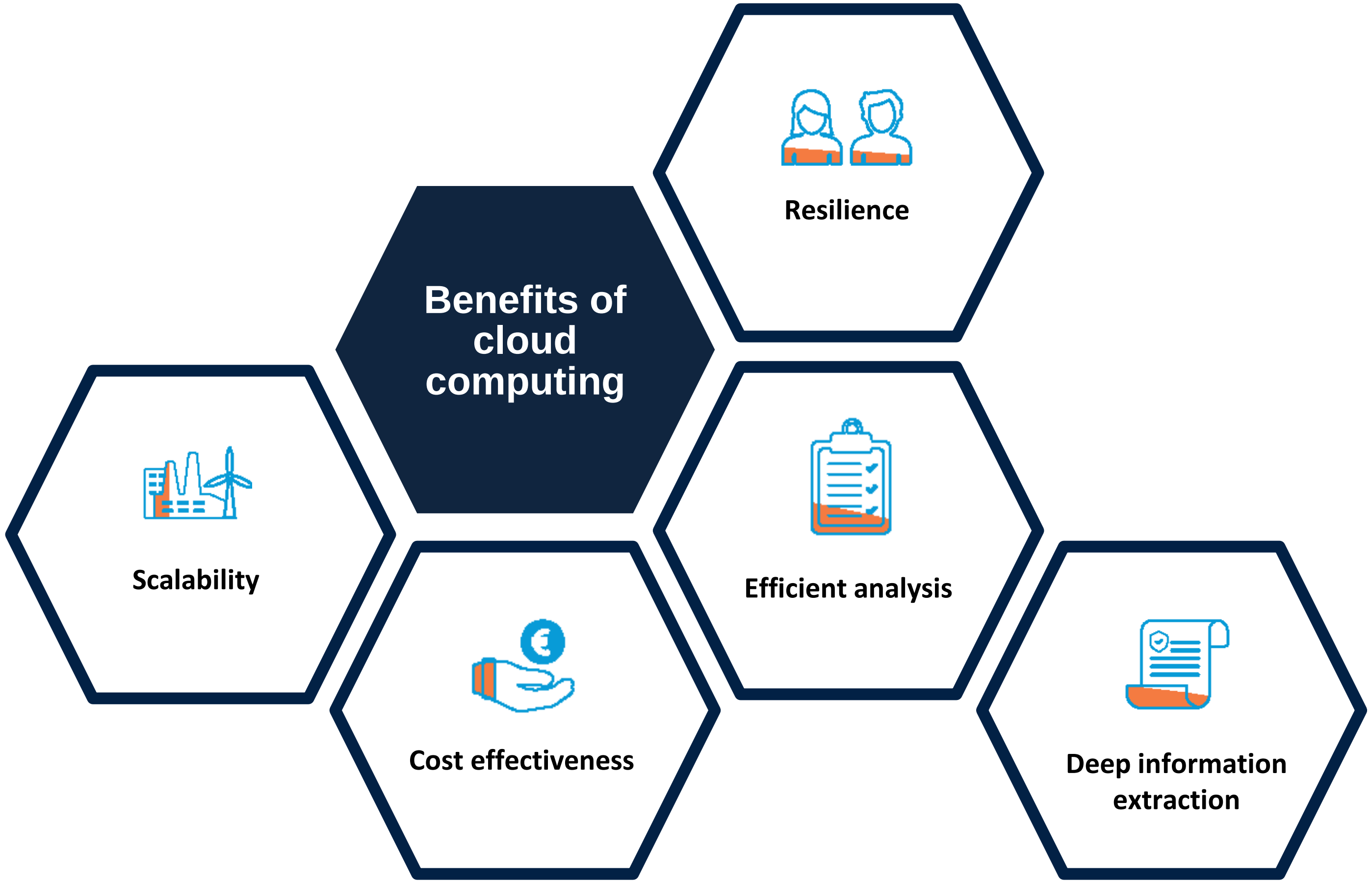
Cloud Computing



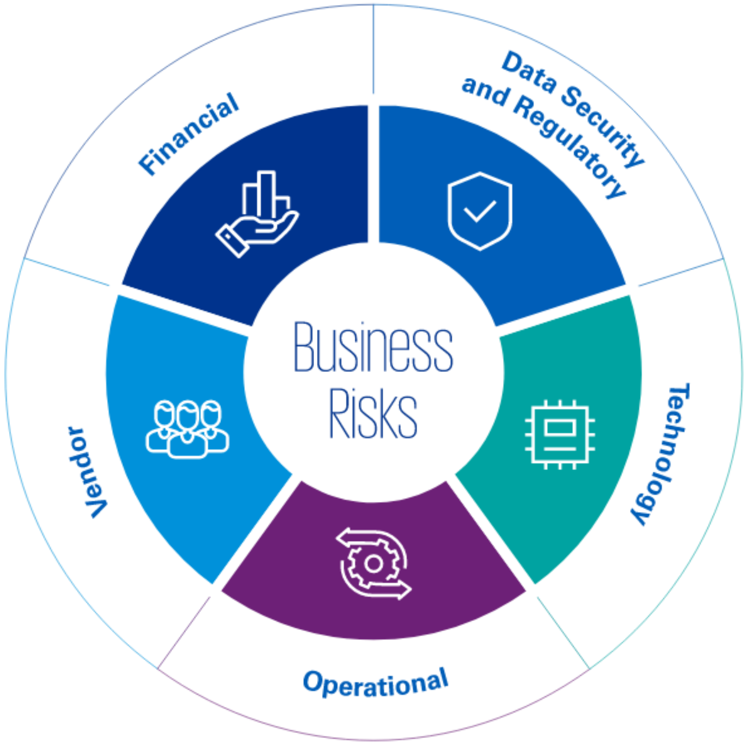
Cloud Computing

Cloud computing is a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand.

Challenges Addressed and the Benefits

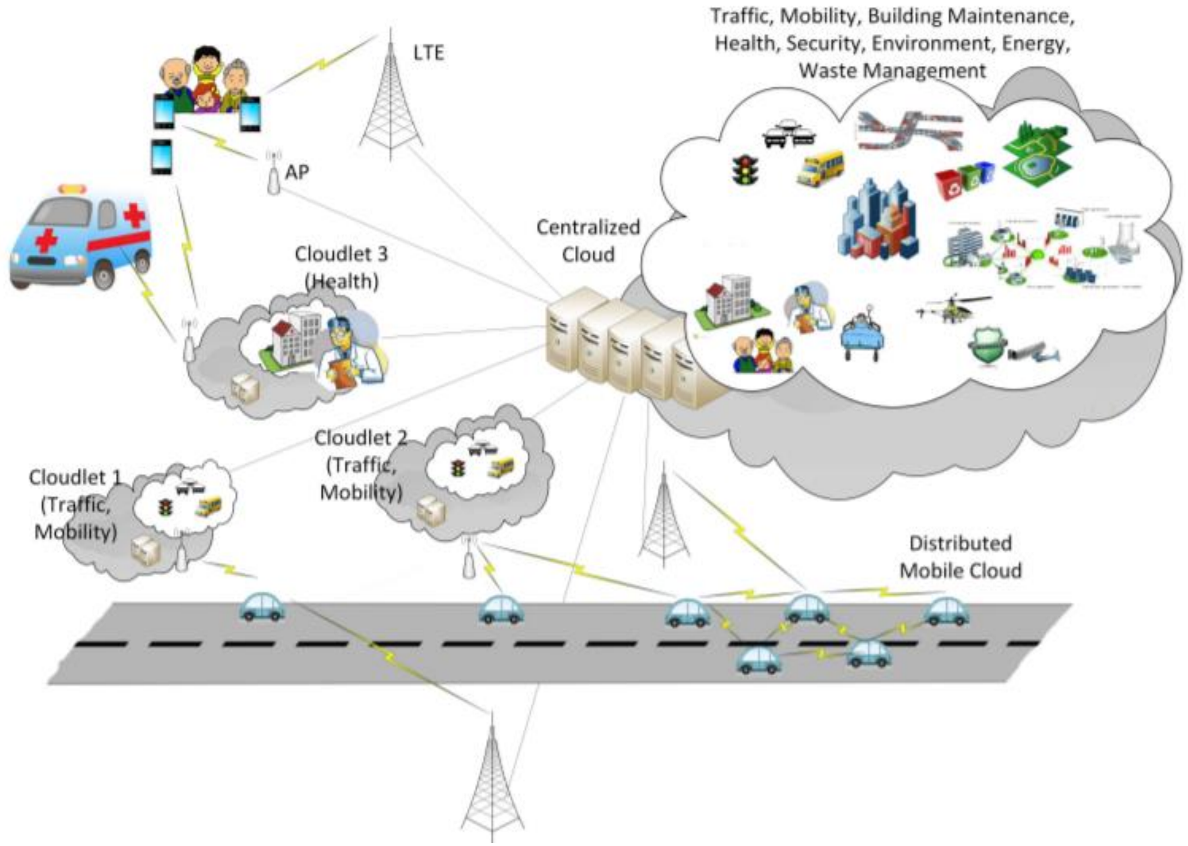


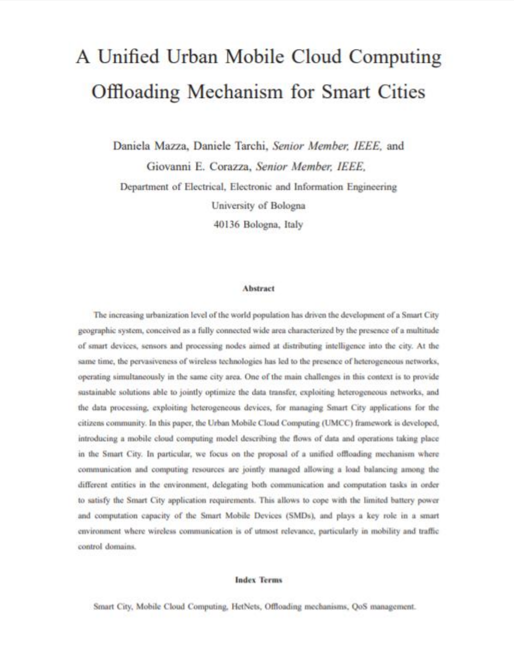
Cloud Computing Risks



KPMG

How Does it Contribute to a Smart Sustainable City?





A Unified Urban Mobile Cloud Computing Offloading Mechanism for Smart Cities

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University of Bologna
40136 Bologna, Italy

Abstract

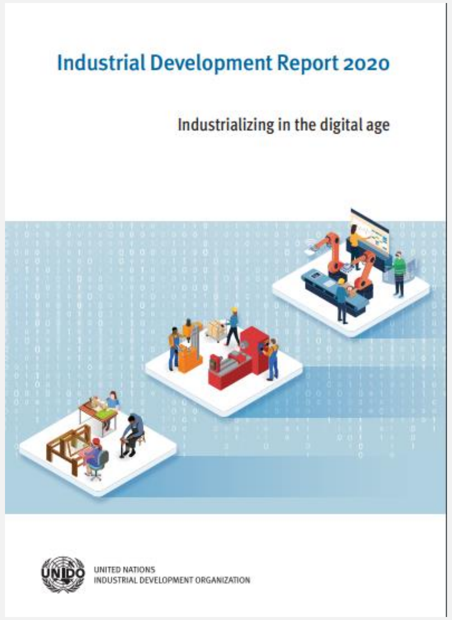
The increasing urbanization level of the world population has driven the development of a Smart City geographic system, conceived as a fully connected wide area characterized by the presence of a multitude of smart devices, sensors and processing nodes aimed at distributing intelligence into the city. At the same time, the pervasiveness of wireless technologies has led to the presence of heterogeneous networks, operating simultaneously in the same city area. One of the main challenges in this context is to provide sustainable solutions able to jointly optimize the data transfer, exploiting heterogeneous networks, and the data processing, exploiting heterogeneous devices, for managing Smart City applications for the citizens community. In this paper, the Urban Mobile Cloud Computing (UMCC) framework is developed, introducing a mobile cloud computing model describing the flows of data and operations taking place in the Smart City. In particular, we focus on the proposal of a unified offloading mechanism where communication and computing resources are jointly managed allowing a load balancing among the different entities in the environment, delegating both communication and computation tasks in order to satisfy the Smart City application requirements. This allows to cope with the limited battery power and computation capacity of the Smart Mobile Devices (SMDs), and plays a key role in a smart environment where wireless communication is of utmost relevance, particularly in mobility and traffic control domains.

Index Terms

Smart City, Mobile Cloud Computing, HetNets, Offloading mechanisms, QoS management.

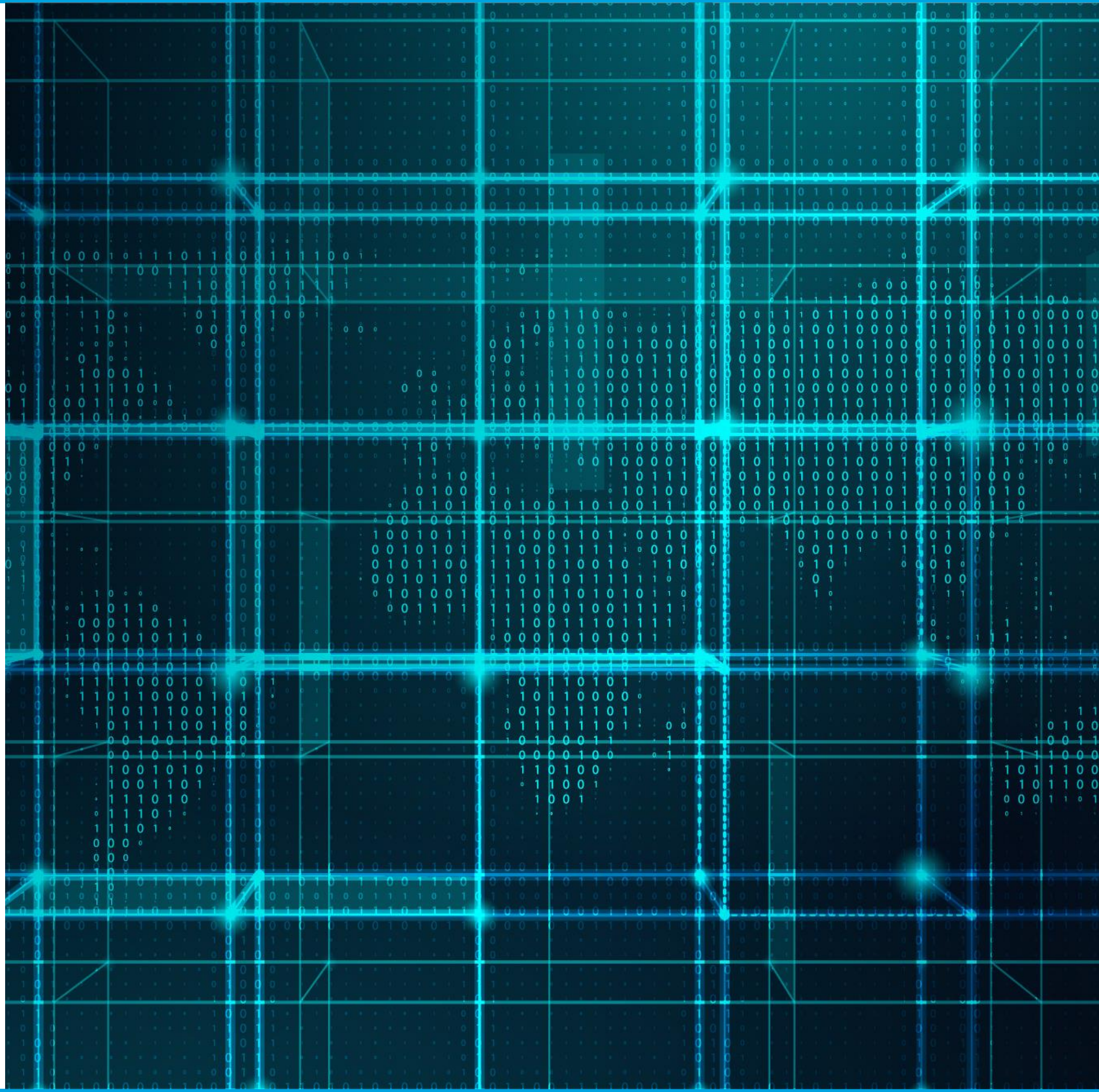
Example of Successful Implementation

Case study:
Fostering the development and adoption of cloud computing in Zhejiang province



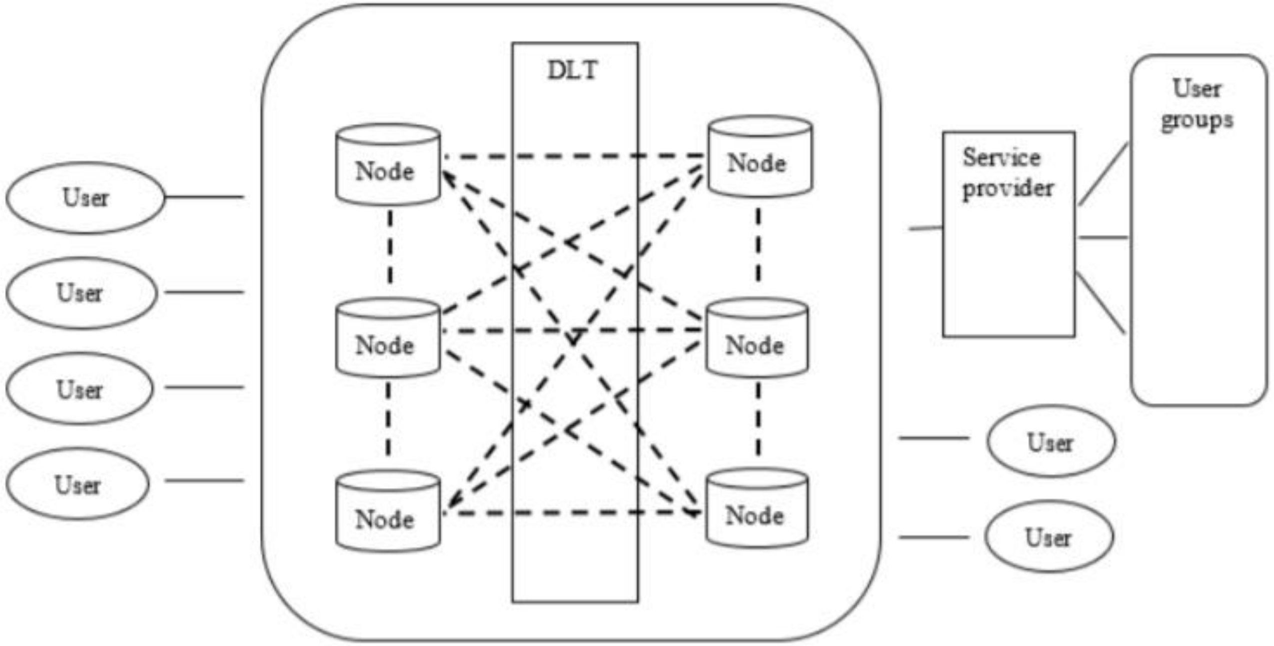
Tool #8

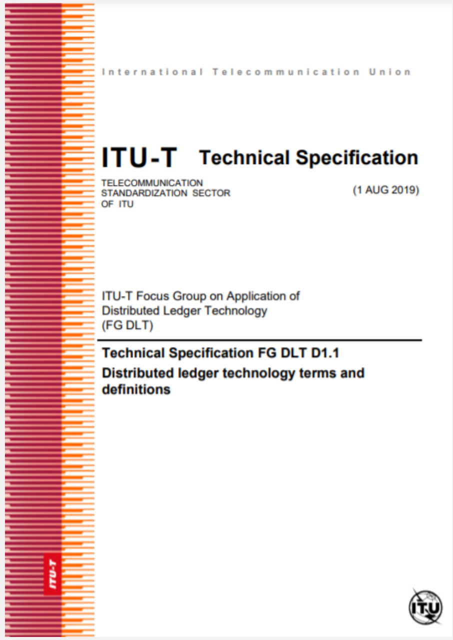
Blockchain



Blockchain

A typical example of Distributed Ledger Technology (DLT) actors and components




International Telecommunication Union

ITU-T **Technical Specification**

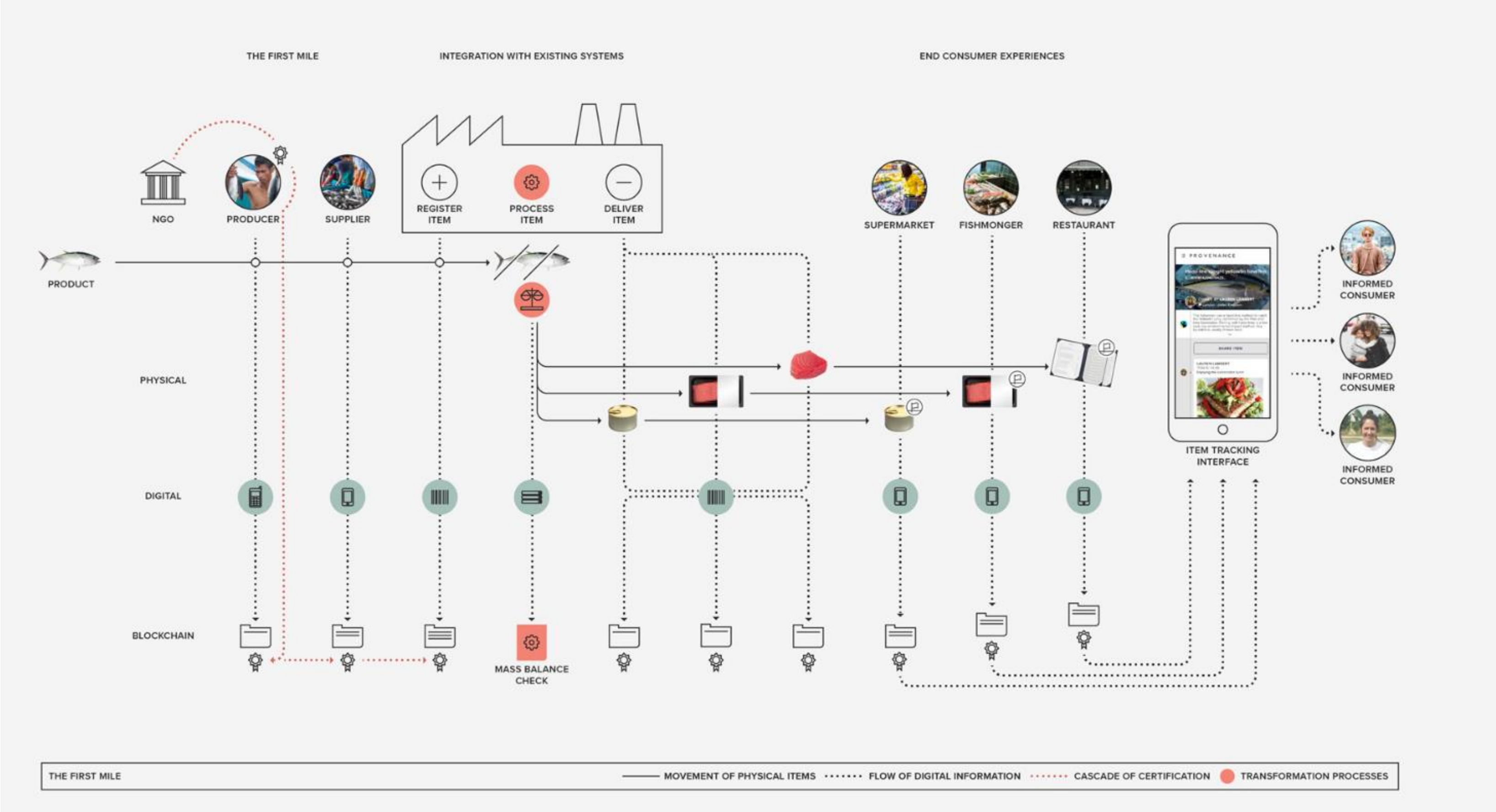
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

(1 AUG 2019)

ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT)

Technical Specification FG DLT D1.1
Distributed ledger technology terms and definitions

Challenges Addressed and the Benefits



Blockchain providing the base layer of truth across the supply chain.

United Nations Commission on Science and Technology for Development
Inter-sessional Panel 2020-2021
18-22 January 2021
Geneva, Switzerland

Issues Paper

on

Harnessing blockchain for sustainable development: prospects and challenges

Advance Unedited Draft

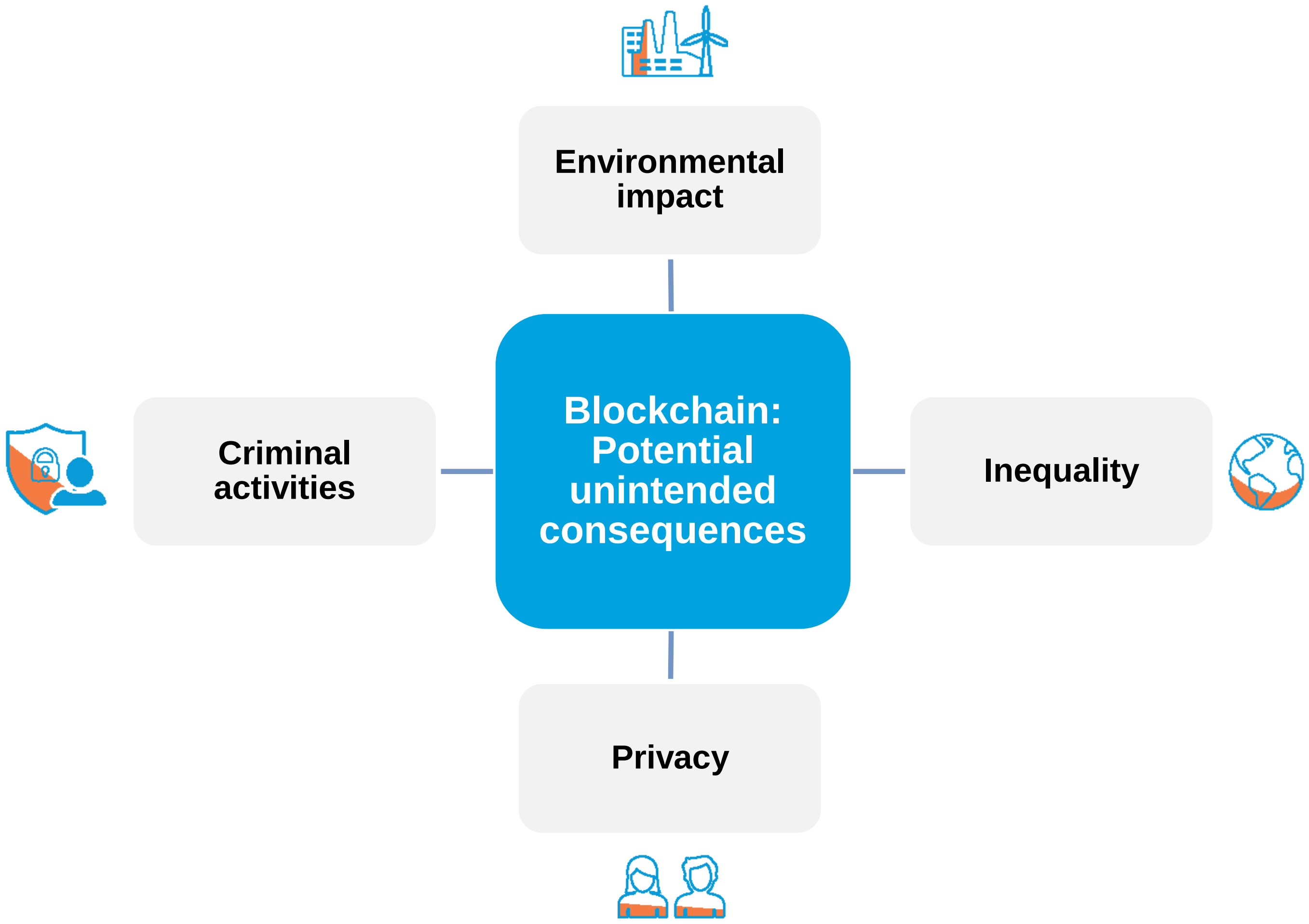
NOT TO BE CITED

Prepared by the UNCTAD Secretariat[1]

28 November 2020

[1] This draft was prepared by the Science, Technology and Innovation Policy Section of the Division on Technology and Logistics of UNCTAD, in collaboration with Solomon Anzagra, Thomas Van Giffen, Olivier Combe, and Rasim Alam (Harvard Kennedy School). Contributions from the Governments of Austria, Belgium, Cuba, Finland, the Islamic Republic of Iran, Kenya, Latvia, Portugal, Romania, Russian Federation, Saudi Arabia, Switzerland, Thailand, Turkey, and the United Kingdom as well as from ECE, ESCAP, ESCWA, FAO, ITC, ITU, UNIDO, WFP, and WIPO are gratefully acknowledged.

Blockchain Risks



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How Does it Contribute to a Smart Sustainable City?

Layer	Aspect
Business model	Governance model
	Data standardization
	Commercial model
	Legal framework
Platform	Consensus mechanism
	Smart contract
	Authentication and authorization
Infrastructure	Hybrid cloud
	Managed blockchain
	Proprietary components


WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

White Paper

Inclusive Deployment of Blockchain for Supply Chains:
Part 6 – A Framework for Blockchain Interoperability

In Collaboration with Deloitte

April 2020

Example of Successful Implementation #1

Pilot project in Ghana

Blockchain for traceability

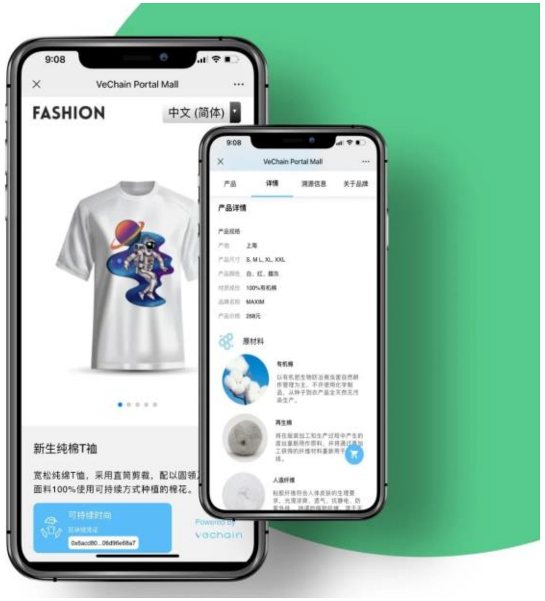
Methodology to evaluate the readiness of the value chain for the adoption of blockchain technologies for traceability. Blockchain technology allows the consumer to trace the ingredients of a product back to its origin.

GQSP
GLOBAL QUALITY AND STANDARDS PROGRAMME

Example of Successful Implementation #2

Real use case – China

Blockchain-enabled sustainability solution for fashion businesses



Module 10 –
4IR and Smart Manufacturing

Thank you for completing this Module of the ITU Toolkit on Digital Transformation for People-Oriented Cities and Communities.

We hope that you found the information in this Module useful toward planning and initiating your city or community’s digital transformation process.

Please review the resources highlighted within for further details, including valuable real-world use cases, on how to get started on – and optimize from the onset – your city or community’s digital transformation journey.

Toolkit on Digital Transformation for People-Oriented Cities and Communities

u4ssc@itu.int

4IR and value chain development: Reference materials

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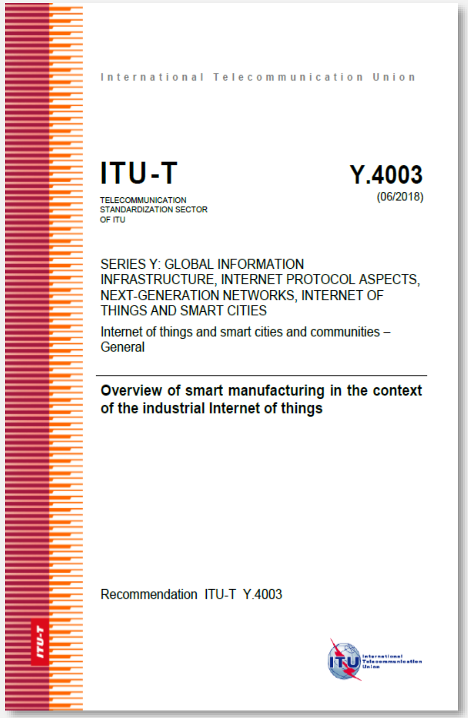
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Internet of things and smart cities and communities – General

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Recommendation ITU-T Y.4003

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