FACULTAD
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TRENDS AND CHALLENGES OF CYBER-SOCIAL-TECHNOLOGICAL-COGNITIVE APPROACH IN ECOSYSTEMS

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TOPICS

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- 21st CENTURY NATURAL AND ANTICIPATORY COMPUTING
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INTRODUCTION

- This lecture aims to provide a forum to discuss the main ideas about **cyber-social-technological-cognitive approach** present in different ecosystems.

- Nowadays, investments that promote disruptive technologies and **digital transformation** accompanied by advances in **Industry 4.0** enable the development of intelligent and smart systems in different domains and ecosystems.

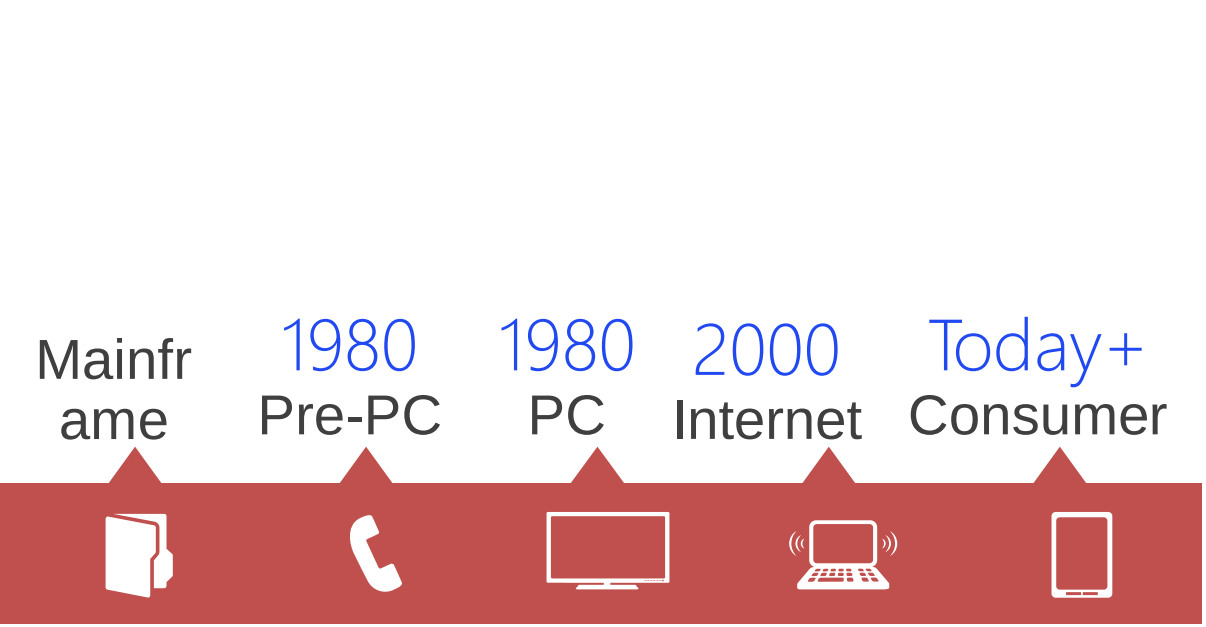
- The **hyperspace** allows the interconnection of multiple spaces of computers and networks which are interlinked with each other mainly in the cyber, social, technological and cognitive domains.

Let's look at the breakthrough of technological change

Penetration rate - Years to reach 50 million users

- The radio: 30 years
- The phone: 20 years
- Television: 12 years
- Cell phones: 12 years
- Www. :three years
- iPods: three years
- Blogs: three years
- MySpace: 2.5 years
- Facebook: 2 years
- YouTube: 1 year

21st century natural and anticipatory computing



- Increasingly natural interfaces.
- Embedded intelligence in everyday objects.
- Massive data store and machine learning.
- Broad access to networks.

EXTERNAL SIGNALS OF THE INFORMATION SOCIETY

(Gartner, 2017)

World-Wide Web
Electronic Portals and
Poster (WWW)

Employee Portals

E-commerce

E-Procurement

Sales Force Automation

INTERNET – email, social networks

Customer Sites

VIDEOCONFERENCE
(zoom, Meet)

Mobile phones

Order Fulfillment

GLOBAL
VOICE/DATA/
VIDEO NETWORK

Digital Asset Management

Supply Chain Collaboration

Flexible Manufacturing

TELEPHONE AND
NETWORK
BANKING

E-Marketing

TV DIGITAL
TV CABLE
Telecommunications
Via Satellite

GEOGRAPHIC
INFORMATION
SYSTEMS

R&D

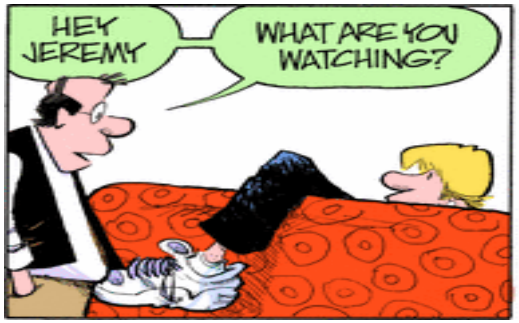
Quadcopter

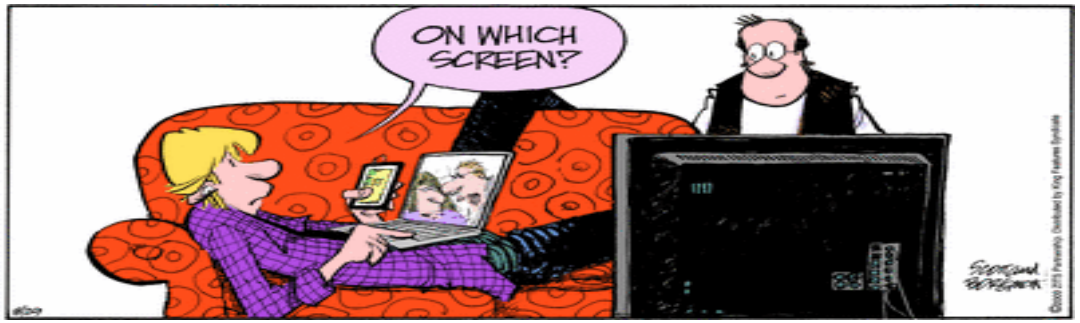
None of this existed before 2000:

Blackberry
iPod, iPad
iPhone
Cell phone with camera
XBox
Satelital radio
Wii
MySpace
Hybrid cars

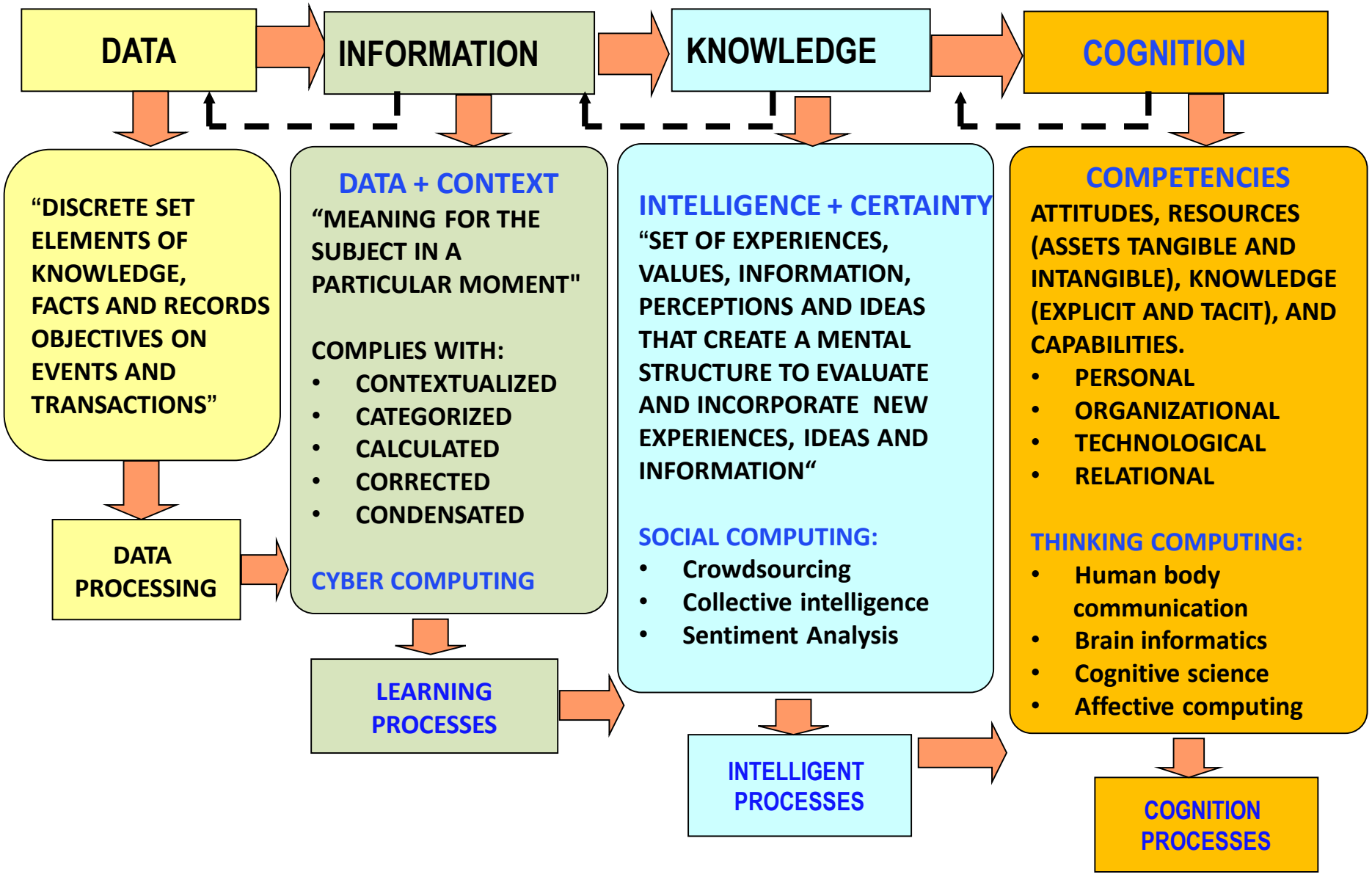
YouTube
Facebook
Google+
LinkedIn
Pandora
Twitter
Flickr
Skype
iTunes
WhatsApp

Kindle
Firefox
3D TV
TiVo
Broadband
Farmville
Groupon
Zoom, Meet
EGG





THE CREATION OF VALUE IN THE ECONOMY OF THE KNOWLEDGE



The changing data lifecycle –technology is moving faster than society can manage

Collection

Increasing amount of granular and real-time data is collected by sensors and mobile devices.

Pasive data collection by byllion of sensors renders the concept of individual consent extremely difficult to uphold.

Management

Data sets are increasingly interconnected and shared to create new value.

“Anonymous Data” is increasingly difficult to mantain as linked datasets can reveal unique attributes of individuals.

Data lifecicle

Distribution

Platform economics drive winer-take-all market dynamics in how data is collected, managed, processes and shared.

The ability to orchestrate how predictive and granular insights are applied at scale is concentrated among a few comercial actors.

Processing

Increasingly sophisticated machine-learning algorithms can process complex datasets more effectively.

The inscrutability of advances data processing techniques (AI/ML) créate uncertainty on data forencics and how decisions are made.

Ref: World Economic Forum Center for the Fourth Industrial Revolution

Where do we see the opportunities?

- The ecosystem helps in the design, analytics, and mapping of the physical world in the cyberspace using digital entities, processes, and transactions.

- In this context, we have the opportunity to analyse and discuss trends in some of the main conceptual models and architectures that integrate relevant attributes in hyperspace in different ecosystems:

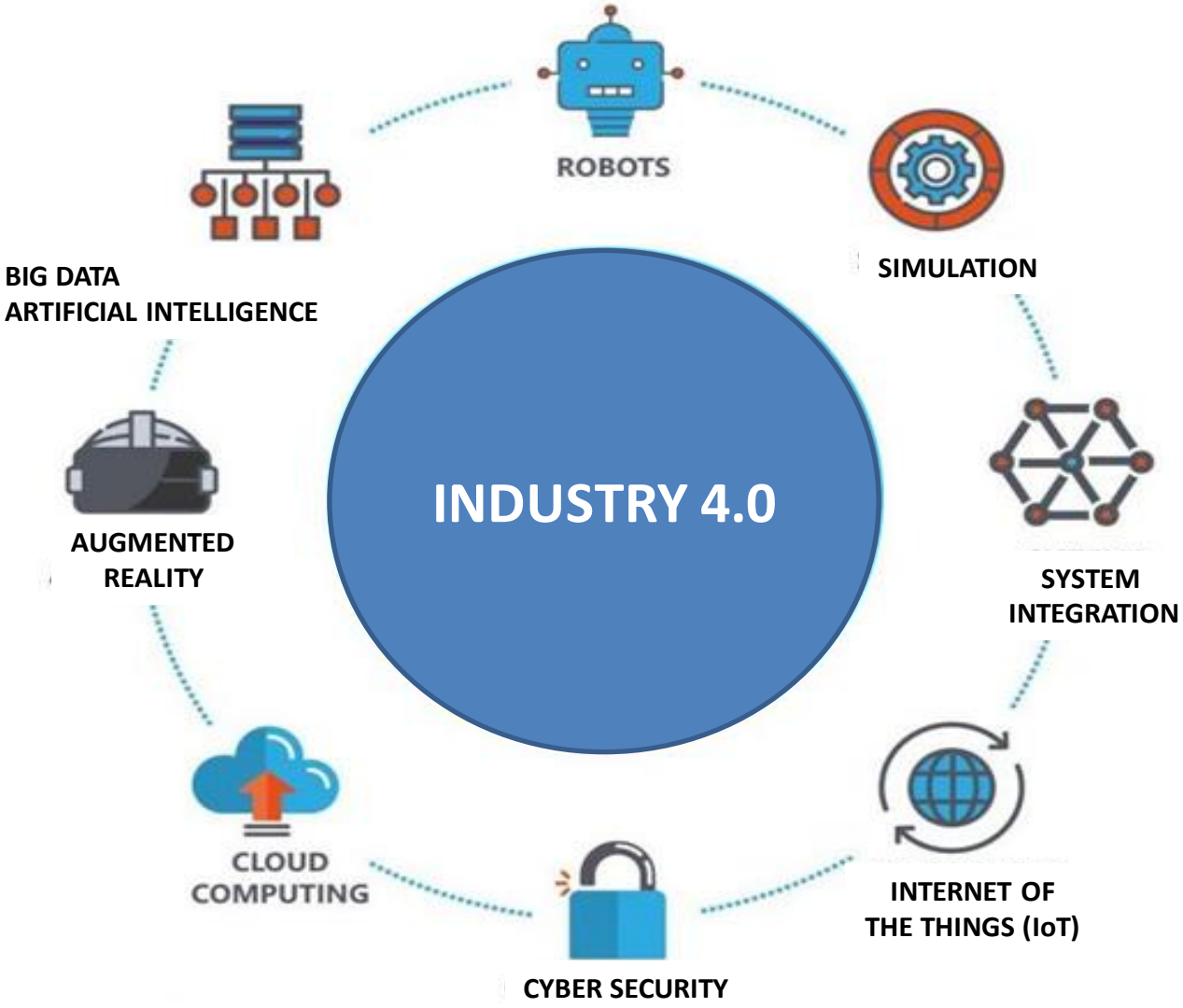
    - **Smart medium-size ports.**
    - **Green Cyber-social energy ecosystems.**
    - **Health and wellness systems.**

- In particular, it is important to highlight the role of internet services (IoS) that is taking over complex collaborative applications using interoperable cross-platform resources and cloud storage.

- The advances in AI, Neuroscience, and Cognitive sciences enable the development of:

    - **Human Body Communication (HBC)**
    - **Human Information Processing (HIP)**
    - **Internet of the People (IoP).**

Industry 4.0: Nine technologies that are transforming the industry



MAIN TECHNOLOGIES OF INDUSTRY 4.0

ROBOTS

- Robotics was used in the industry more than five decades ago and completely transformed manufacturing environments.
- There are currently more than 1.2 million industrial robots in operation worldwide.
- The developers of this technology are expanding their capabilities to improve their cognitive aspects.
- Robotics would eliminate, by 2030, the need for labor in some productive sectors.

INTERNET OF THINGS

- **IoT has the potential to improve people's lives by using sensors and transmitters arranged in machines and other objects for mass use and connected to the Internet, allowing communication between them.**
- **AI allows the development of autonomous things as physical devices with automate functions previously performed by humans.**
- **Increasingly, autonomous things are operating in closed environments, such as mines or warehouses, but they will eventually evolve to more open spaces.**
- **Autonomous things operate along a spectrum from semiautonomous devices to fully autonomous cars.**
- **As the number of autonomous things increases, there will be a shift from things that operate alone to a swarm of collaborative intelligent things.**
- **Drones and autonomous vehicles are operating across different environments.**
  - A group of robots could operate a coordinated assembly processes.
  - A group of drones can transport parts in a production process.

Main Technologies of Industry 4.0

CYBER SECURITY

- Adobe was going through hell: 2.9 billion personal details.
- Panic at Sony: Up to 77 million personal details stolen from Playstation.
- Target targeted: 110 million customers banking data leaked.
- Adult Friend Finder exposed: 400 million personal preferences lost.
- Marriott hotels: the personal privacy of 500 million customers compromised.

All individuals, institutions and infrastructure are resilient to vulnerabilities created by increasing digital connectivity.

The increase in the number of AI solutions and potential points of attack, via IoT devices and highly connected services, creates a true security challenge.

AI security includes three key perspectives:

- **Protecting AI-powered systems:** securing AI training data, training pipelines and ML models.
- **Leveraging AI to enhance security defense:** using ML to understand patterns, uncover attacks and automate parts of cybersecurity processes.
- **Anticipating nefarious use of AI by attackers:** Identifying attacks and defending against them.

Main Technologies of Industry 4.0

- Distributed cloud refers to the **distribution of public cloud services** to locations outside the cloud provider's physical data centers.
- It is perceived the evolution from centralized public cloud to **distributed public cloud**.
- In distributed cloud, the **cloud provider is responsible for all aspects of cloud service:** architecture, delivery, operations, governance and updates (Google Cloud, Amazone Sage Maker, Microsoft Asure).
- It also allows providers to deliver on the promises made by **hybrid cloud**, a system that blends external services from a provider and internal services running on-premises.
- The problem is that hybrid cloud is very difficult to implement in a cost-efficient or reasonable manner.
- **Distributed cloud is now in the early stages of development**, so most providers currently offer only a small subset of services in this way.

Main Technologies of Industry 4.0

AUGMENTED REALITY

Human augmentation is the use of technology and science to heighten a person's cognitive and physical experiences.

Physical Augmentation

Changes an inherent physical capability via implanting or hosting a technology element on the body.

- Sensory augmentation (hearing, vision, perception).
- Appendage and biological function augmentation (exoskeletons, prosthetics).
- Brain augmentation (implants to treat seizures).
- Genetic augmentation (somatic gene and cell therapy).

Cognitive Augmentation

Enhances a human's ability to think and make better decisions.

- Exploiting information and applications to enhance learning or new experiences.
- Augmented intelligence scenarios (AI working with humans).
- Physical implants that deal with cognitive reasoning.

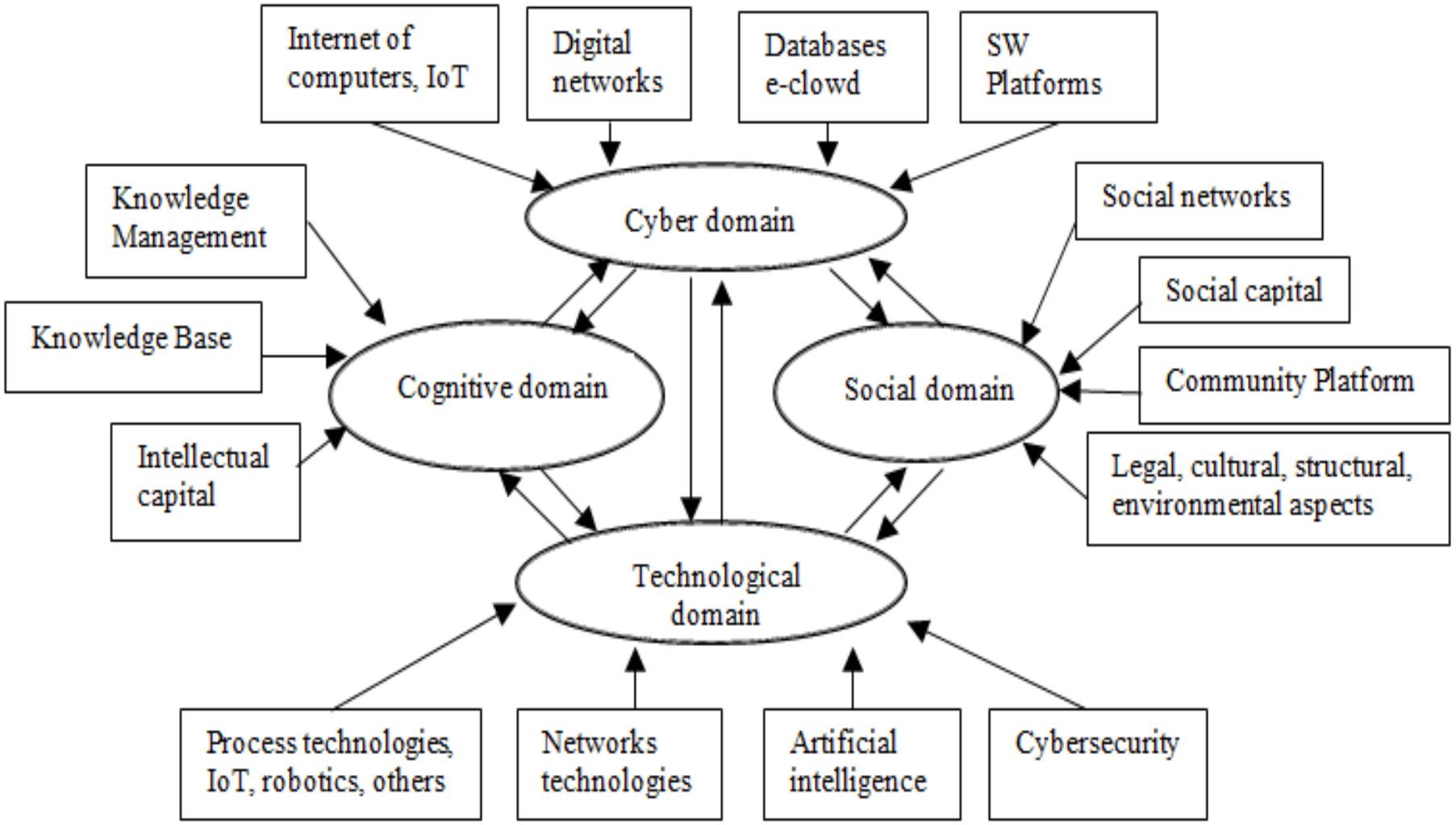
BIG DATA - ARTIFICIAL INTELLIGENCE.

- Artificial Intelligence (AI) is used today in mobile phone apps, large-volume analysis of information on home devices, digital representation of real-world systems, and the use of digital platforms to sustain conversations in different languages.
- Machine learning, in particular deep learning based on multi-layered neural networks, facilitates the realization of tasks such as image recognition, autonomous vehicles and call centers, among others.

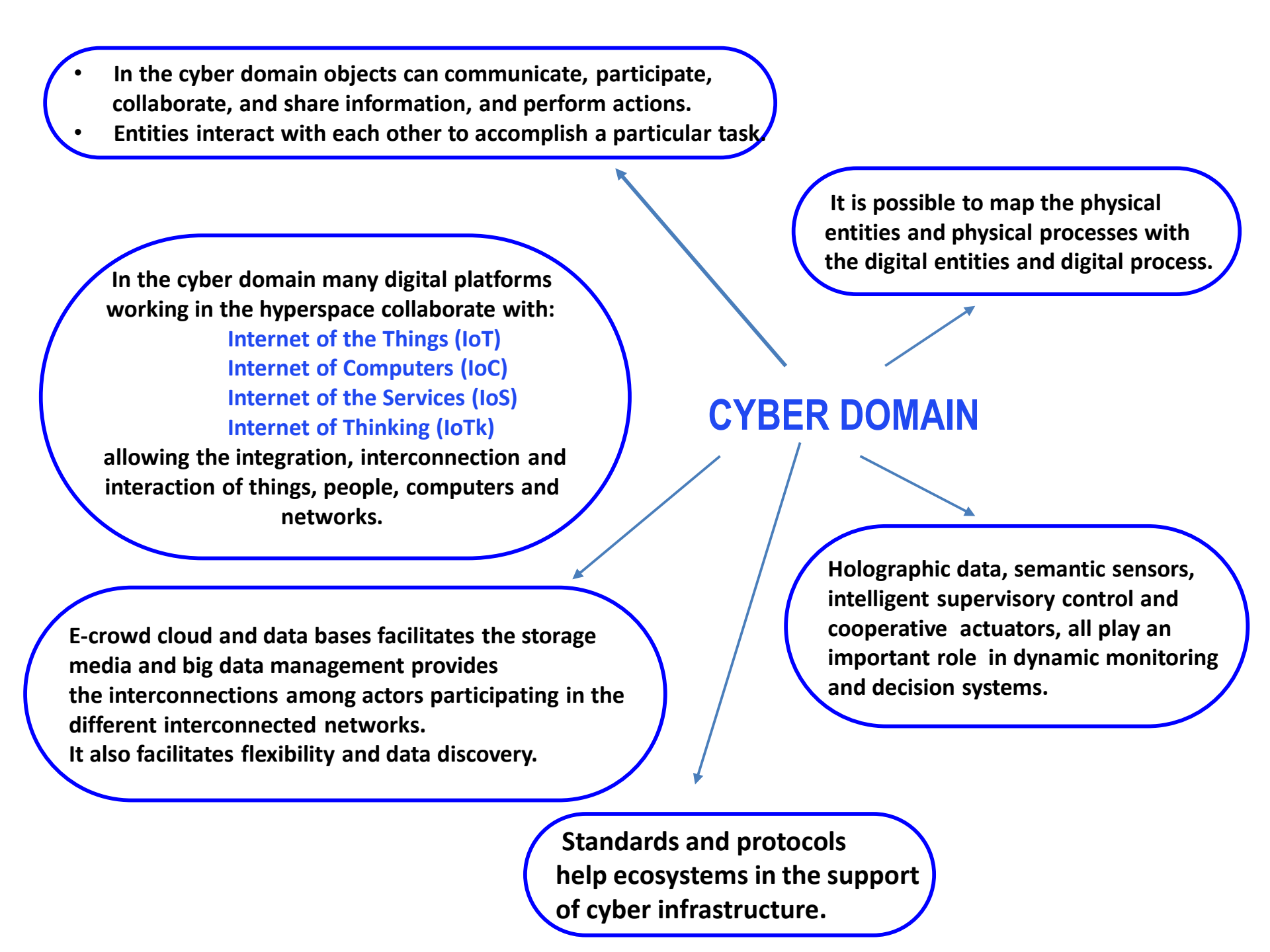
ANALYTIC

- Great analytic leaders first identify important sources of new value to customers and the business, and then build the data and analytics capability required to capture it.
- Without this focus, there is a significant risk that companies will waste valuable time and money.
- Ultimately a great analytic capability will include the algorithms to improve customer experience and operations, data-driven decision-making embedded in the day to day, and the assets, processes and skills to support analytic enablement.

CYBER-SOCIAL-TECHNOLOGICAL-COGNITIVE FRAME



The cyber-social-technological-cognitive approach is present today in very different ecosystems.


• In the cyber domain objects can communicate, participate, collaborate, and share information, and perform actions.
• Entities interact with each other to accomplish a particular task.
It is possible to map the physical entities and physical processes with the digital entities and digital process.
In the cyber domain many digital platforms working in the hyperspace collaborate with:
Internet of the Things (IoT)
Internet of Computers (IoC)
Internet of the Services (IoS)
Internet of Thinking (IoTk)
allowing the integration, interconnection and interaction of things, people, computers and networks.
CYBER DOMAIN
Holographic data, semantic sensors, intelligent supervisory control and cooperative actuators, all play an important role in dynamic monitoring and decision systems.
E-crowd cloud and data bases facilitates the storage media and big data management provides the interconnections among actors participating in the different interconnected networks.
It also facilitates flexibility and data discovery.
Standards and protocols help ecosystems in the support of cyber infrastructure.

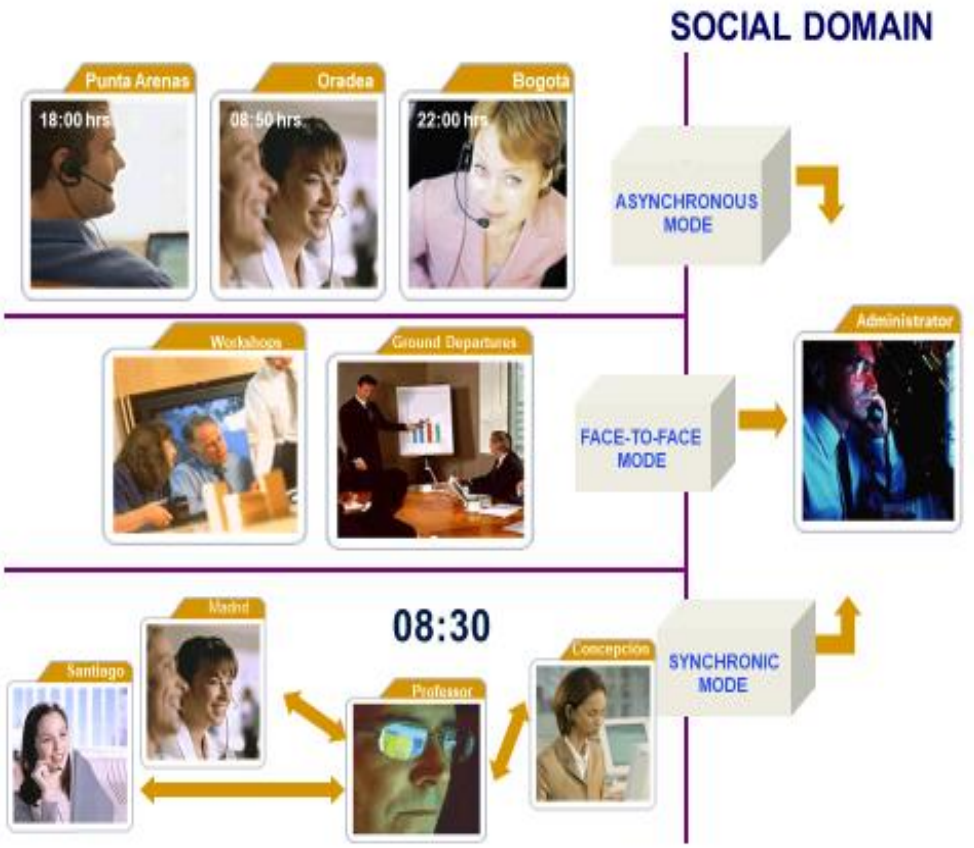
SOCIAL DOMAIN

- It is perceived that many of the social management networks are used by citizens who wish to express their opinion or interact with other people participating in the network.

- Also, companies or public and private institutions are providing public service and supporting main activities, developing forums and crowd applications to share:

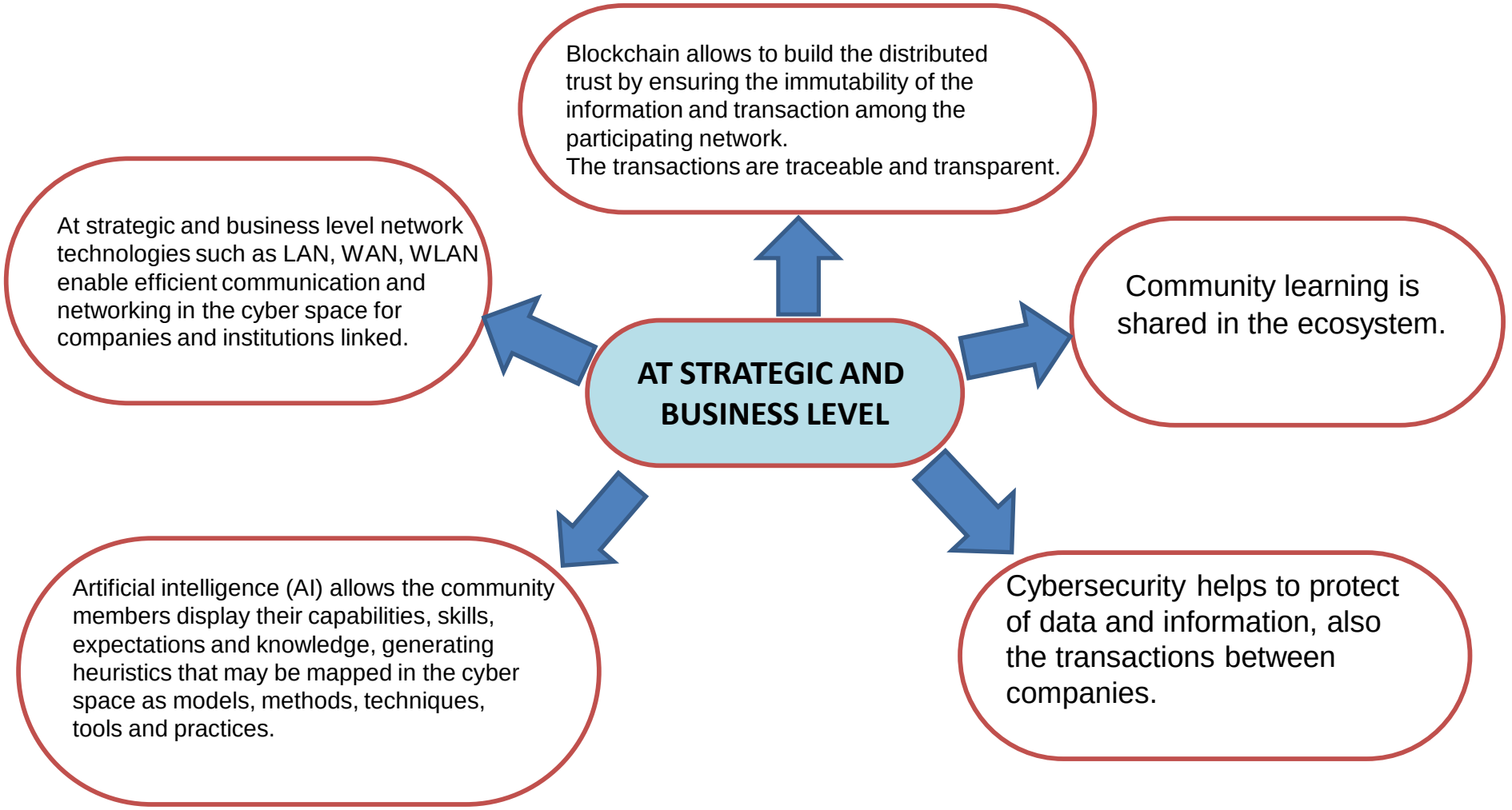
  - Protocols - Knowledge - Regulations -
  - Ideas - Procedures -

- In this context legal, cultural, structural, and environmental factors are managed involving:
  - companies' goals and objectives
  - structure
  - standards
  - values for the community
  - culture and socialization of services



The 2020 trends are structured around the idea of "people-centric smart spaces".

In Technological Domain Industry 4.0 and digital transformation provides a set of technologies participating in the strategic, business and operational levels.



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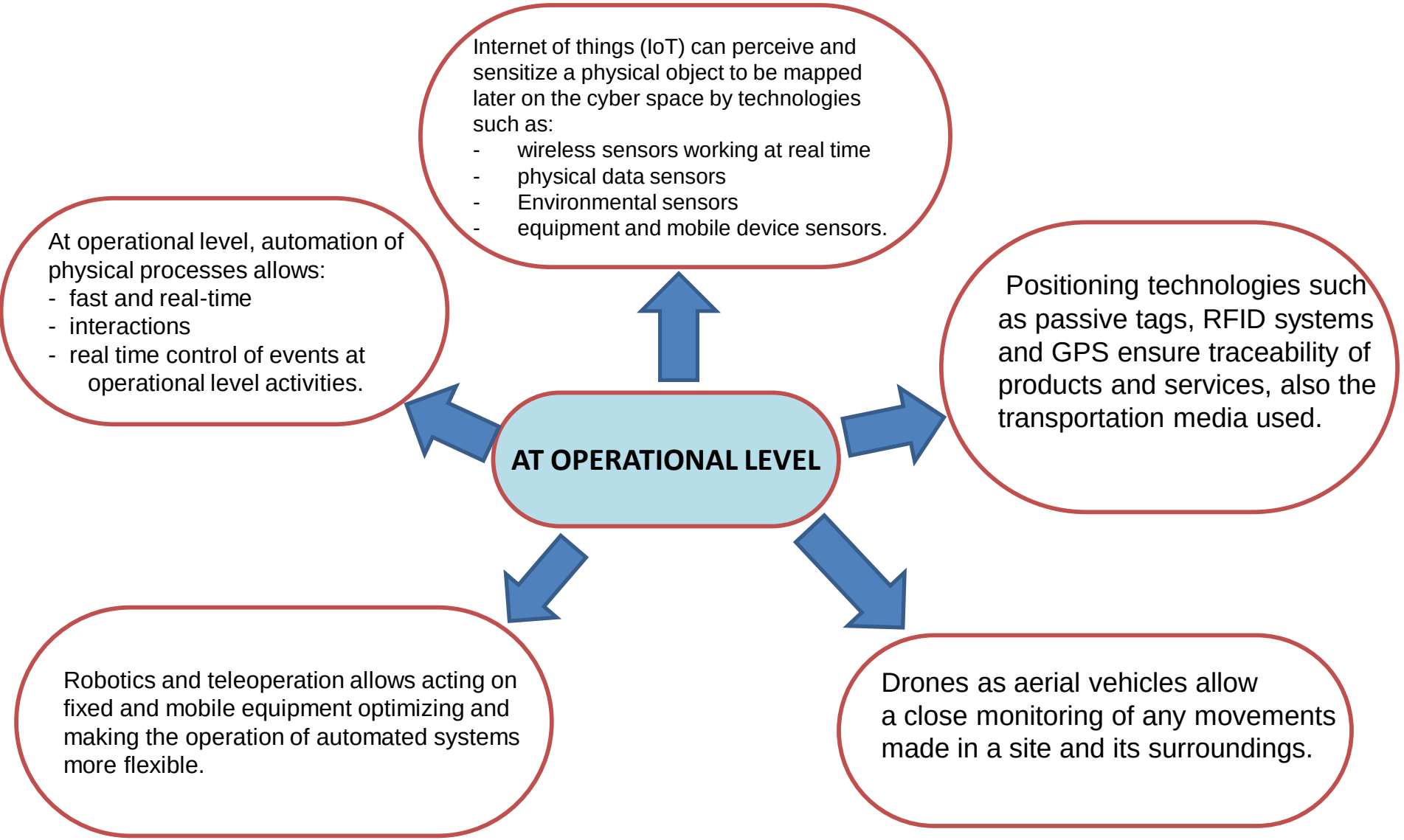
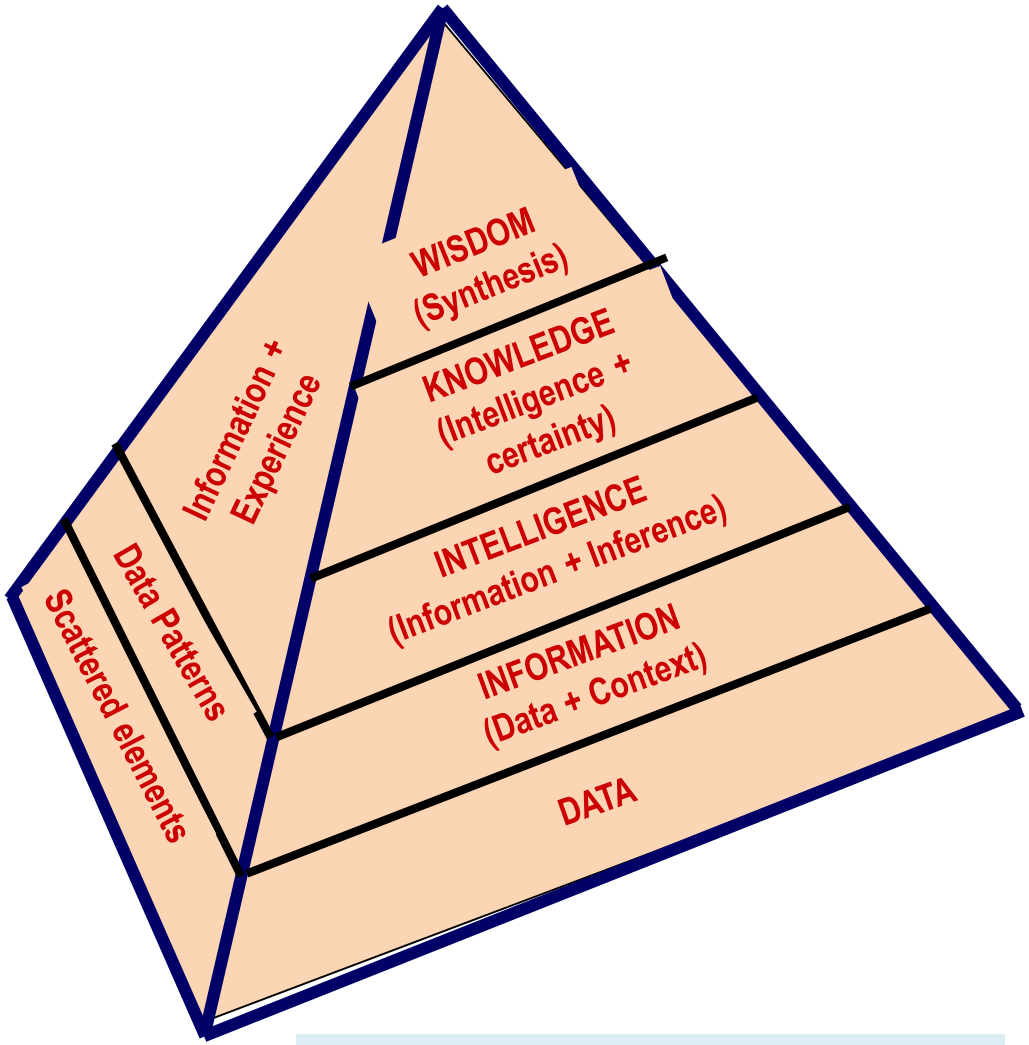


COGNITIVE DOMAIN

- In Cognitive Domain the available knowledge provided by a person, a group, or a community of actors can be stored in the cyber space.
- It facilitates the classification and management of social, structural and intellectual capital of each organization participating in the ecosystem.

- Intellectual capital considers the knowledge of the progress of both intellectual and social capital of the community allowing planning the training needs for different actors.



PIRAMIDE OF KNOWLEDGE

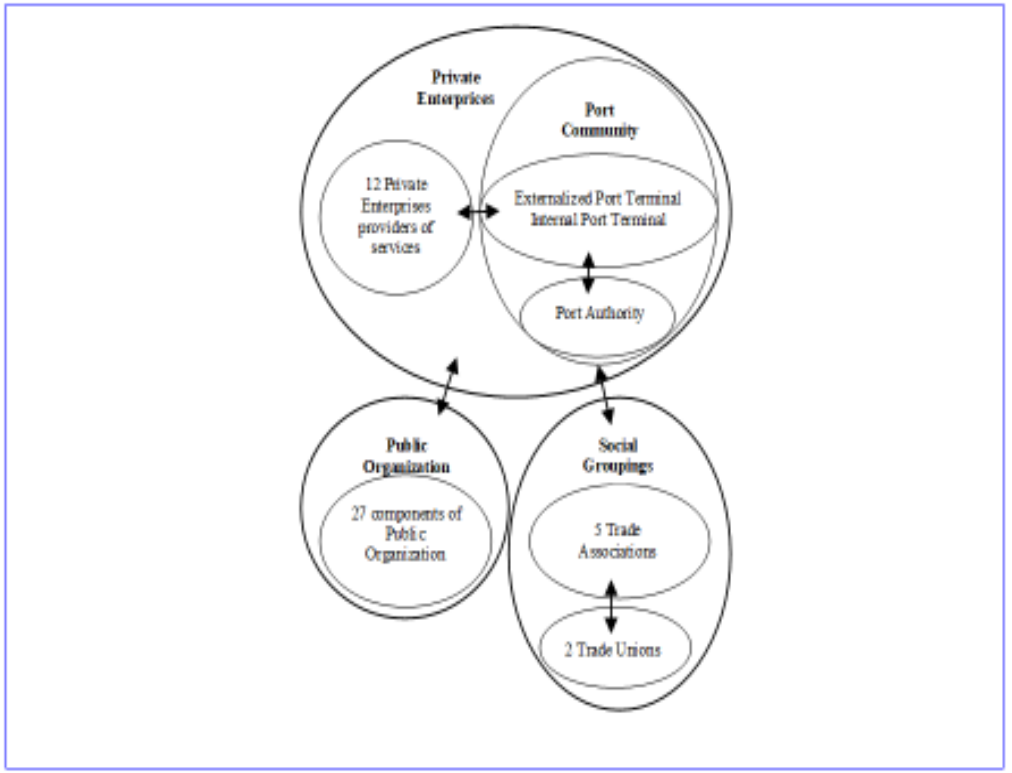
CSTC IN SMART MEDIUM-SIZE PORTS

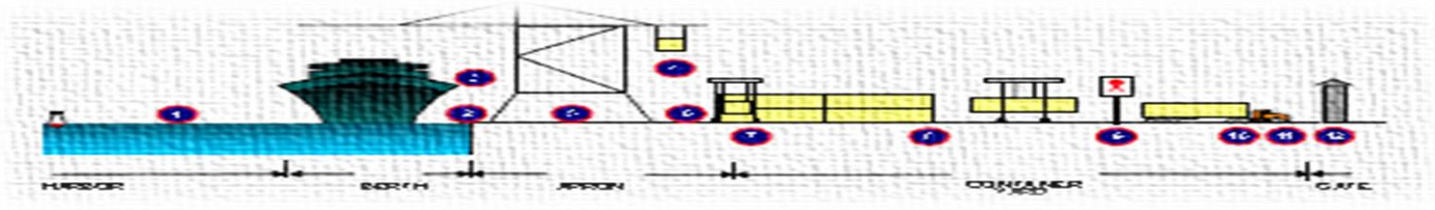
Characteristics of Fifth generation ports: automated and sensorized, intensive in the use of artificial intelligence tools, sensors, RFID radio frequency, differential GPS system, Internet of Things (IoT), data management for Big Data, among others.

- ✓Focused on the customer and the community
- ✓Research and development of technologies on the clusters
- ✓Sustainable development
- ✓Governance models
- ✓Business processes
- ✓Human capital

"making intelligent decisions with a large amount of data in real time to identify existing opportunities and risks"

ACTORS PARTICIPATING IN THE PORT COMMUNITY





CYBER DOMAIN IN SMART MEDIUM-SIZE PORTS

- ✓ Medium size ports are belonging to Industry 3.0 (automation, information technologies and communications).
- ✓ Some of the features of Industry 4.0 such as IoT, clouds, social networks, big data, simulation, AI, and development of plans aimed at future disruptive technologies.
- ✓ Ports are promoting the use of IoT, IoC, IoP, and IoTk through public policies, including the taxing aspect.
- ✓ Cloud computing is the most used in the ports.
- ✓ Digital government is being implemented and also the massive use of Internet.
- ✓ Digital transformation is being incorporated by the main ports and their associated companies.
- ✓ Data and information are handled but not yet transformed into explicit knowledge.

SOCIAL DOMAIN IN SMART MEDIUM-SIZE PORTS

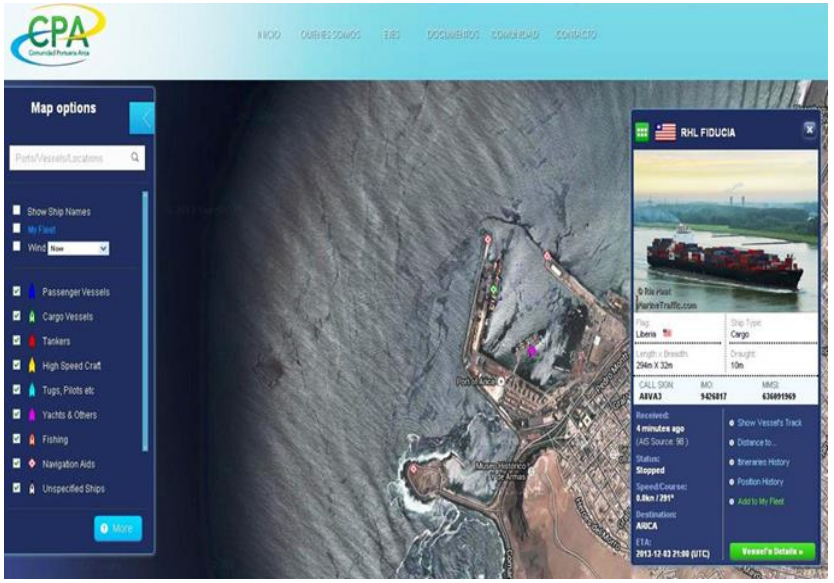
- ✓ Companies implement their processes and business models.
- ✓ Economic benefits, regulation, certification and standards in short-term are implemented.
- ✓ Legislation is updated, also regulations.
- ✓ Knowledge and culture about Smart Ports is introduced.
- ✓ Platforms that allow networking in the cyber space, such as logistic forums are being designed and there are port communities that use digital and social management.
- ✓ It takes a great deal of effort from companies, universities and government to form the human capital needed to drive technological innovation projects.

TECHNOLOGICAL DOMAIN IN SMART MEDIUM-SIZE PORTS

- ✓ Medium-sized ports and operating companies are gradually introducing disruptive technologies at a stage of contagion in its adoption.
- ✓ Investment in automation, particularly in digital infrastructure is observed.
- ✓ Technologies for improving processes, safety and human capital are implemented.
- ✓ Drones and simulators are used by the transport logistics industry.
- ✓ GPS Systems helps monitoring the charge.
- ✓ RFID technology allows load traceability.
- ✓ Risks are assumed to innovate.

COGNITIVE DOMAIN IN SMART MEDIUM-SIZE PORTS

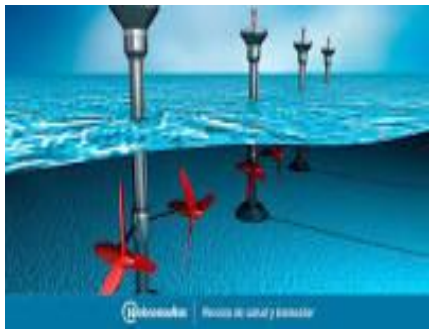
- ✓ Enabling technologies are being developed for improving the structural capital of the ports, incorporating technology in physical and information processes, such as the external terminal port and cargo traceability.
- ✓ Human capital with strategic knowledge and skills managing and executing projects with disruptive technologies are implemented.
- ✓ Good practices are incorporated in management.
- ✓ It is believed that technological transformation will decrease the employment rate in the short term.
- ✓ More skilled workers are needed, who are able to use, in a long-term basis, work tools like sensors, mobile equipment, video analysis, RFID, drones and 3D printing, cyber-security and technologies related to Energy Management and Efficiency.



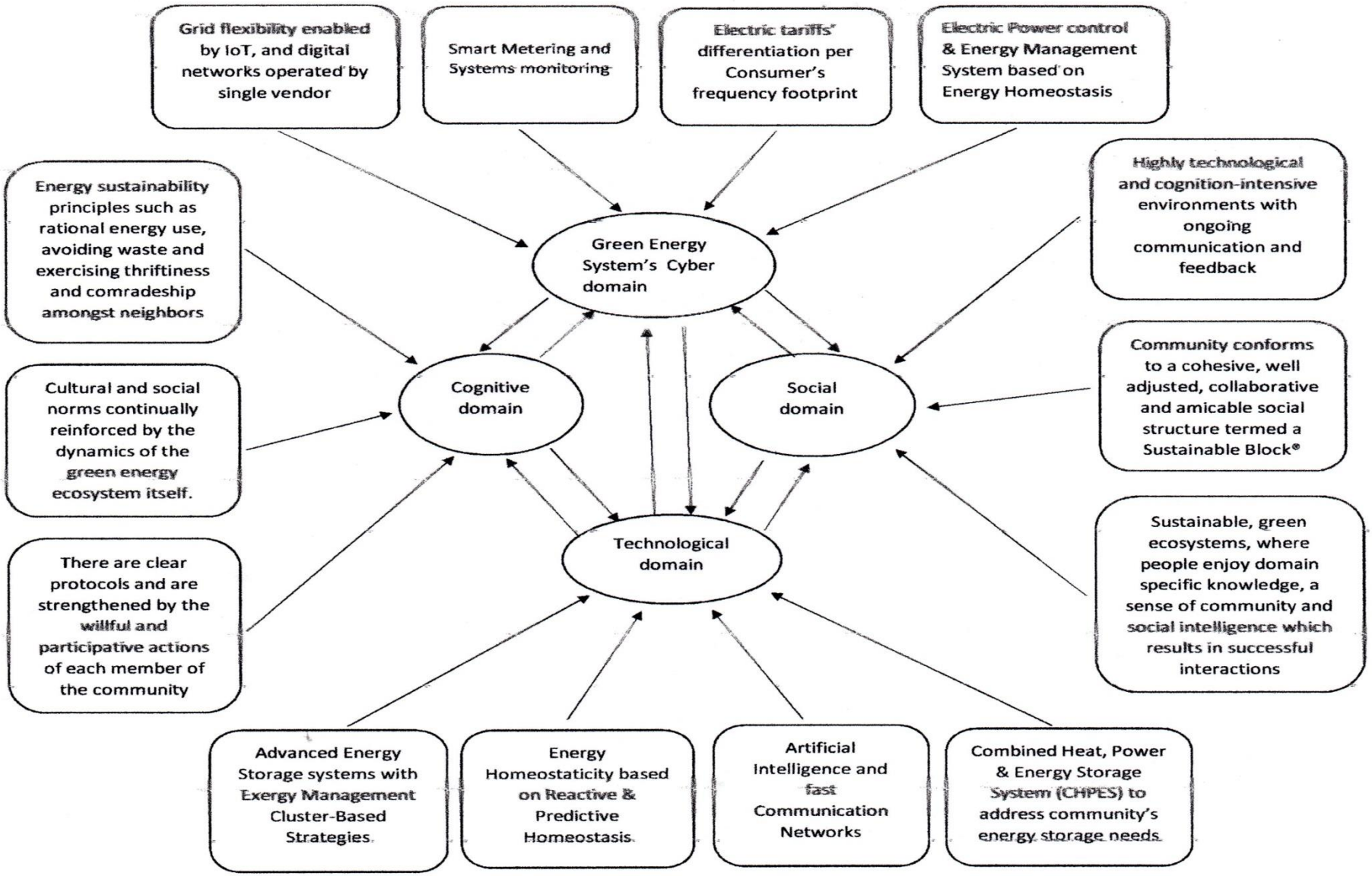
Green Cyber-Social-Technologic-Cognitive Ecosystems

- Global energy consumption is expected to increase by 56%, during the period 2010-2040.
- Much of this increase will occur in China, India and Russia, which would increase their energy demand by up to 90%, to satisfy their industries and populations.
- Despite the decline in investment costs of unconventional renewable energy, a significant portion of global energy is expected to continue to come from non-renewable energy sources such as coal, natural gas and oil.
- In this context, Green Ecosystems are those which, above all, seek to sustain themselves and thrive.
- They do so by building energy environments that, although highly technological and intensively cognitive and dynamic in nature, supportive of the community's members, and also highly productive.
- Types of renewable or non-exhaustible energy sources include: solar, wind energy, hydropower, biomass and biofuels, geothermal energy and the one generated by waves, tides and sea currents.



Green Cyber-Social-Technologic-Cognitive Energy Ecosystems



CYBER DOMAIN

Green energy system's cyber domain enables technologies and processes to operate seamlessly such as:

- Grid flexibility enabled by IoT, and digital networks.
- Smart metering.
- Electric tariffs' differentiation per Consumer's.
- Frequency footprint Electric Power control & Energy Management System based on Energy Homeostasis.
- New concept of energy consumer producer "prosumer".

TECHNOLOGICAL DOMAIN

- In the case of green energy systems, there are advanced technologies and processes which are all link to and driven by technology.
- Photovoltaic solar energy has significantly reduced its costs and become an economically viable alternative to generate electricity.
- Another technology in development is to convert sunlight into heat, and then convert heat back into light.
- Generating nuclear fusion energy poses the challenge of finding a way to scale this process to a commercial size, in an efficient, economical and environmentally friendly way.
- Managing the nitrogen cycle present in amino acids can help not degrade the environment
- Quite common to green energy systems are advanced energy storage systems with exergy management which are employed in cluster-based strategies.

SOCIAL DOMAIN

The Social domain is a catalyst of social change, and allows to build community's cohesion and understanding, generating public awareness and cohesiveness within the community's everyday life.

- Social domain is both enabled and enhanced by highly technological and cognition - intensive environments, where the community conforms to a cohesive, well adjusted, collaborative and amicable social structure.
- Well organized, cohesive and empowered social domains enable sustainable, green ecosystems, where people enjoy domain-specific knowledge, a sense of community and social intelligence which results in successful, far reaching interactions.

COGNITIVE DOMAIN

- Cognitive domain enables and enhances energy sustainability principles such as rational energy use, avoiding waste and exercising thriftiness and comradeship amongst neighbors.
- Energy homeostaticity, which is based on reactive and predictive homeostasis, as well as AI and fast communication networks to address community's energy needs.
- Cognitive domain also enables and enhances cultural and social norms continually reinforced by the dynamics of the green energy ecosystem itself.
- Likewise, there are clear system protocols which are strengthened by the willful and participative actions of each member of the community.

How cyber-social ecosystems can mirror Green Energy Systems and Energy Sustainability in Residential Communities?

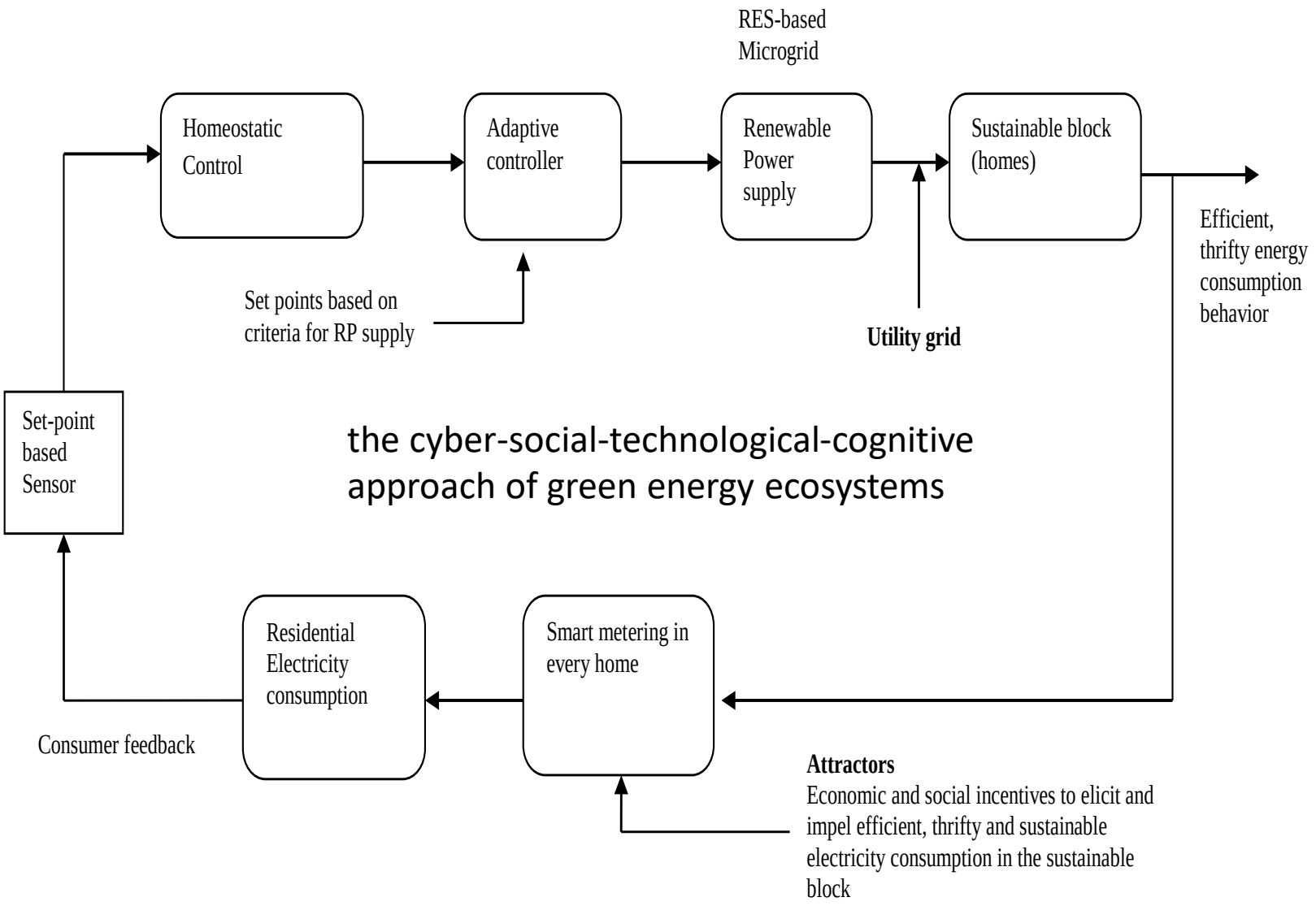
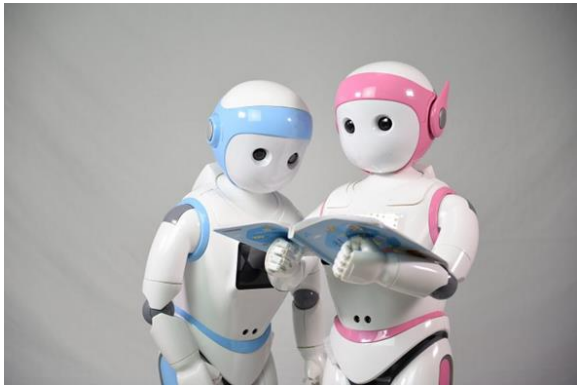


Diagram of a Sustainable Green Energy System that Emulates how Green Sustainable Ecosystems Operate.

CSTC IN HEALTH AND WELLNESS SYSTEMS IN A TIME OF PANDEMIC

CYBER DOMAIN

- Today different open source data platforms and AI are used to track the spread of the disease.
- **ArcGIS Dashboard:** It corresponds to a dashboard of John Hopkins University in the USA, which has been used over the past time to directly visualize virus expansion around the planet, this updates in real time the relative data on confirmed, deceased and recovered cases, using multiple data sources.
- A South Korean company has developed an Artificial Intelligence SW to track the health of the patient who has already been discharged. It also helps to better track people who have close contacts with confirmed cases of coronavirus.
- Our robots in Chile are using Artificial Intelligence AI software and Natural Language for visiting patients in hospitals.
- Big Data technology has extraordinary potential in the field of medicine as it allows to analyze large volumes of data in order to predict, prevent or customize treatments in different pathologies.
- Fever detection systems using artificial intelligence and drones are designed.
- There are also smart helmets that can measure temperature and patient data.
- It is proposed to use machine learning algorithms to improve the identification of possible cases of COVID-19 more quickly, using a web survey based on a mobile phone. This reduces the spread in susceptible populations.



CSTC IN HEALTH AND WELLNESS SYSTEMS IN A TIME OF PANDEMIC

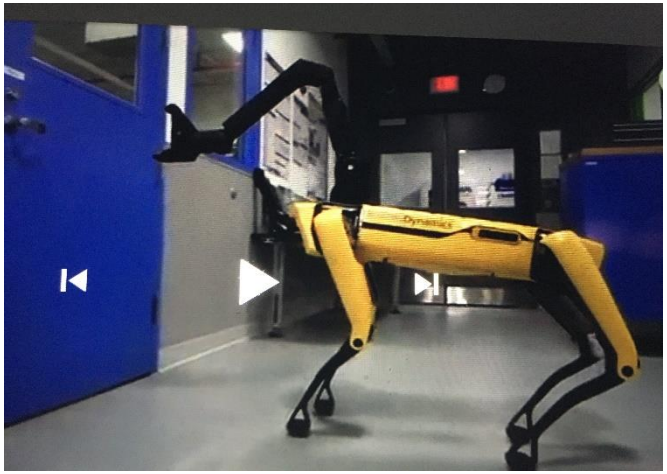
TECHNOLOGICAL DOMAIN

- Aid robots that transport medicine and food to people in isolation areas are recently being used in China.
- Robots equipped with several high-resolution cameras and infrared thermometers are able to simultaneously scan the temperature of 10 people within a radius of 5 meters.
- A new dog-like robot from Boston Dynamics can open doors, visit and clean contaminated areas.
- In many countries, disinfectant robots are being used.

- Technological tools have been developed to help detect whether people have a new coronavirus by detecting visual signs of COVID-19 in ct scans of lung; to control, in real time, changes in body temperature by using portable sensors.

- In Colombia robots help transport food and goods to quarantined users.
- Police patrol robots with 5G technology, deliver new capabilities to help officers. They have been deployed to airports and shopping malls.

- In Schools in Shanghai, New York, and Tel Aviv, among others, the students themselves built robotic devices that deliver small doses of gel alcohol who reaches hands with one of their sensors.
- In Japan students develop a scanner that measures the temperature of everyone who transits school and immediately alerts them if someone has a fever.



CSTC IN HEALTH AND WELLNESS SYSTEMS IN A TIME OF PANDEMIC

SOCIAL DOMAIN

"Frontline healthcare professionals are still exposed to the pathogen with direct contact with the patient, albeit with safety equipment".

Broad areas identified by National Science Foundation and White House, USA where robotics can make a difference:

- Clinical care (e.g. telemedicine and decontamination).
- Logistics (e.g. delivery and management of contaminated waste).
- Recognition (e.g. monitoring of voluntary quarantine compliance).
- Communications (e.g. between patients-doctors-family).
- Crowd platforms (e.g. telemedicine).

"Creation of Cyber-Resilient Organizations"

COGNITIVE DOMAIN

- Advanced computer intelligence enable today automated diagnosis and prescriptions for treatment, helped by computerized catalogs of patient health information.
- The use of artificial intelligence is massive in diagnosis, allowing specialists to see the most complex cases.
- The UK's Knowledge Transfer Network (KTN) is a government-funded body that promotes links between universities and businesses provides intensive care and rapid training and education for health care personnel to support people who self-isolate or work from home.
- the White House in conjunction with a group of researchers have prepared the challenge of searching for research data called CORV-19. This is a resource of more than 52000 academic articles, including more than 42000 full texts all related to: Covid-19, Sars-Cov-2 and related coronavirus.

Conclusions

Use case factory.

- Algorithms are continuously built and improved that customize and automate digital experiences.

Data-driven insights.

- It collects and analyzes customer, end-user, and operations data that informs great digital design choices.

Test and optimize.

- Provide statistical rigor for efficient and valid multivariate tests to optimize digital offers, designs, and marketing campaigns.

Measurement and monitoring.

- Today, interactive dashboards are designed and implemented, tracking site performance, seeking user satisfaction, and generating business KPIs to prioritize continuous improvement

CHALLENGES TO FACE

- Excessive reliance on conventional wisdom by competing with the disruptive core creates a tremendous challenge to engineering.
- Changing resistance, risk aversion and lack of urgency is mandatory.
- The gaps in next-generation talent face the incentives of the old world.
- A complex matrix, organizational silos, and an aging asset base can hinder new ideas.
- It is necessary to change the perspective of Investors with quarterly expectations that do not 'bet big'.
- Overcome the fact that communities have not been built to support the digital age.

Multumesc mult
Muchas gracias
Thanks a lot
Большое спасибо

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