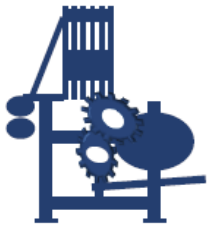
ReInHerit
WEBINAR
ReInHerit
"The contribution of modern technologies to the protection of archaeological sites and monuments in an environment of intense climatic phenomena."
21 July 2023 | 3:00-4:00 pm (CET)
European Commission

Industrial 4.0

Industry 1.0
Mechanisation



Late 18th Century
1784 –
First mechanized loom

Industry 2.0
Manufacturing

Late 19th Century
1870 -
First conveyor belt,
Cincinnati slaughterhouse

Industry 3.0
Automation

Early 1970s
1969 -
First Programmable Logic Controller (PLC), Modicon 084

Industry 4.0
Integration

Today

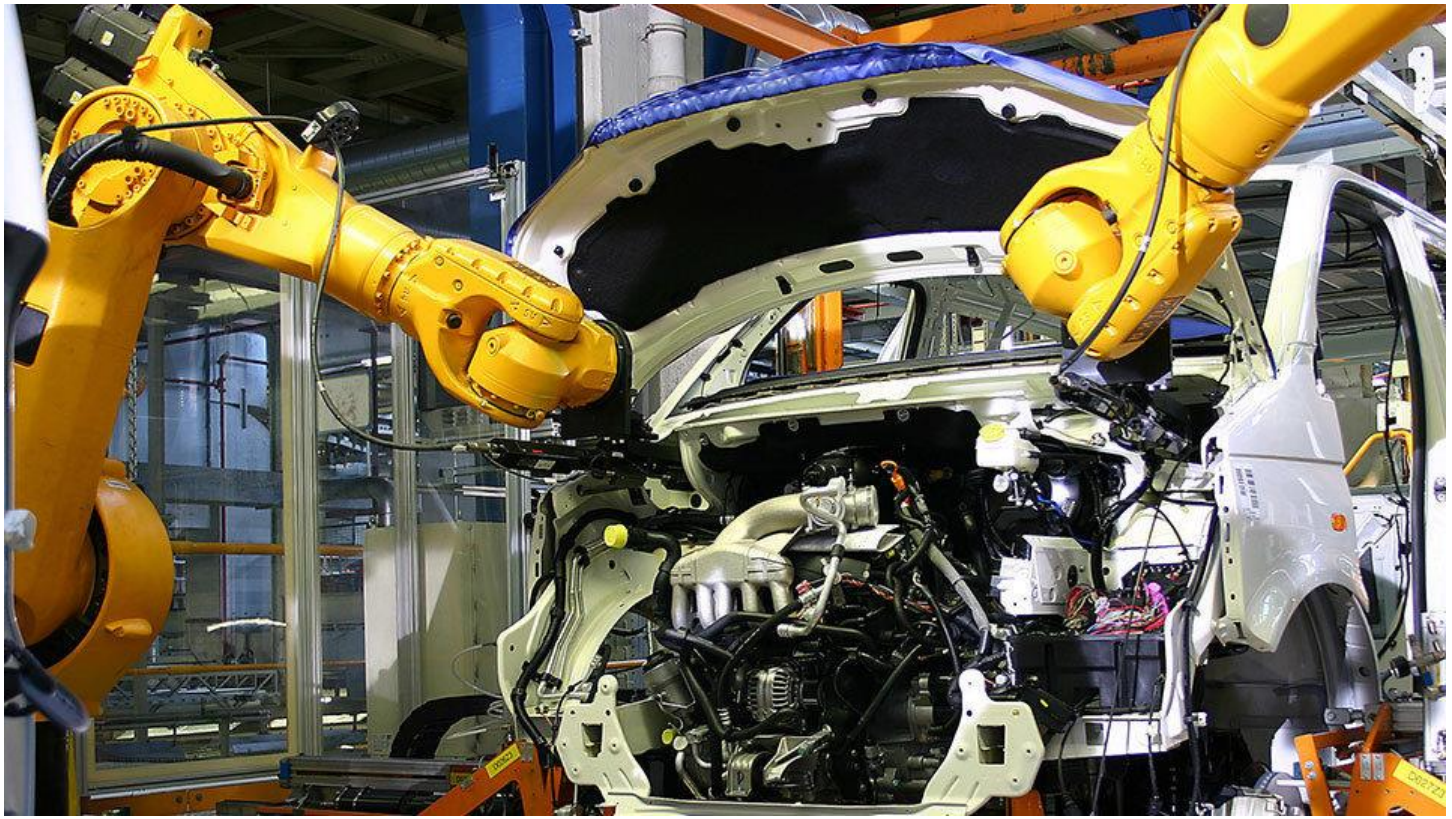
Cyber Physical Systems (CPS) by **digital transformation**

Automation by **electronics and IT**

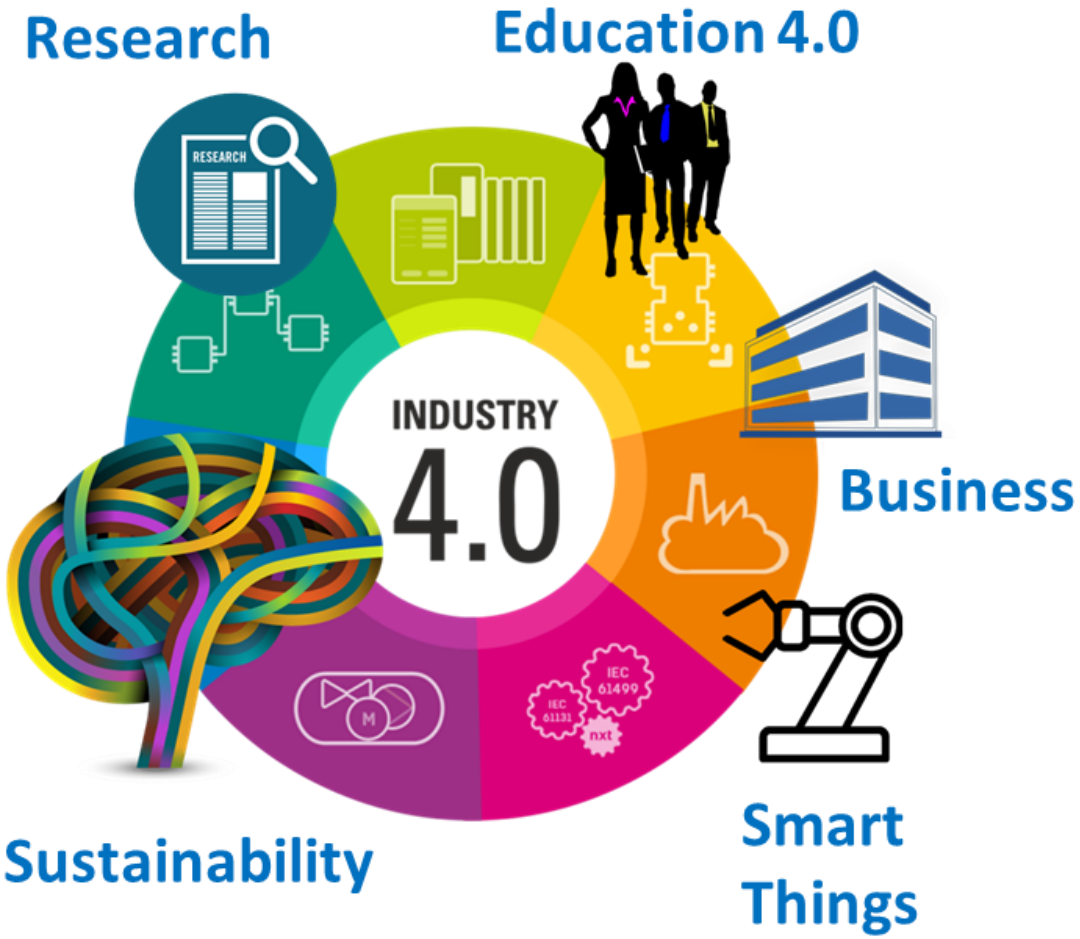
Mass production and division of labor powered by **electrical energy**

Mechanical production facilities powered by water and **steam power**

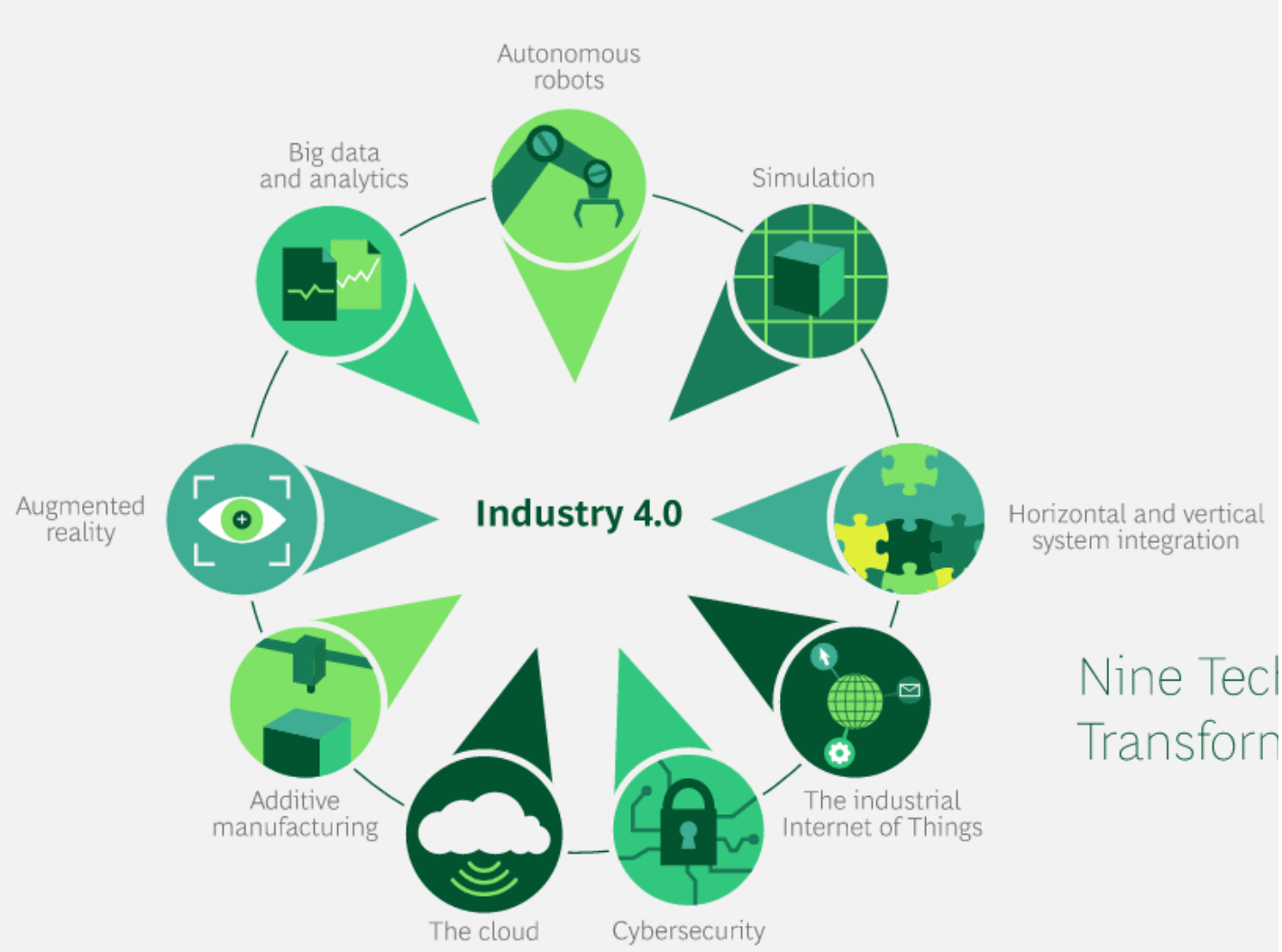
Industrial 4.0



Industrial 4.0



Industrial 4.0



What is the real meaning of Industry 4.0

Data, computing, connectivity

- Big data (real-time)
- Internet of Things
- Cloud technology

Artificial intelligence & AA

- Predictive algorithms
- Machine learning models
- Advanced analytics (with big data)

Human-machine interaction

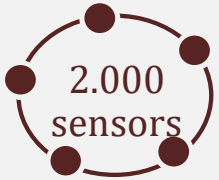
- Touch and voice based interfaces
- Virtual and augmented reality

Digital-to-physical conversion

- 3D printing
- Advanced robotics, autonomous vehicles
- Blockchain (e-ledgers)

Digitization:
Opportunity for a new competitive model

Sensors, big data, cloud



Thousands of sensors per plant sending *real-time* data to cloud

Artificial intelligence

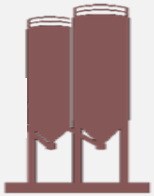
Real-time optimizers increase plant output by >10% vs. BAT

Advanced analytics

Predictive scheduling & dispatching of deliveries

Internet of Things (IoT)

Automated replenishment (vendor-managed inventory)

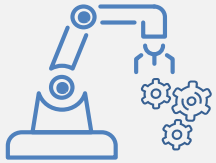


Virtual/Augmented Reality

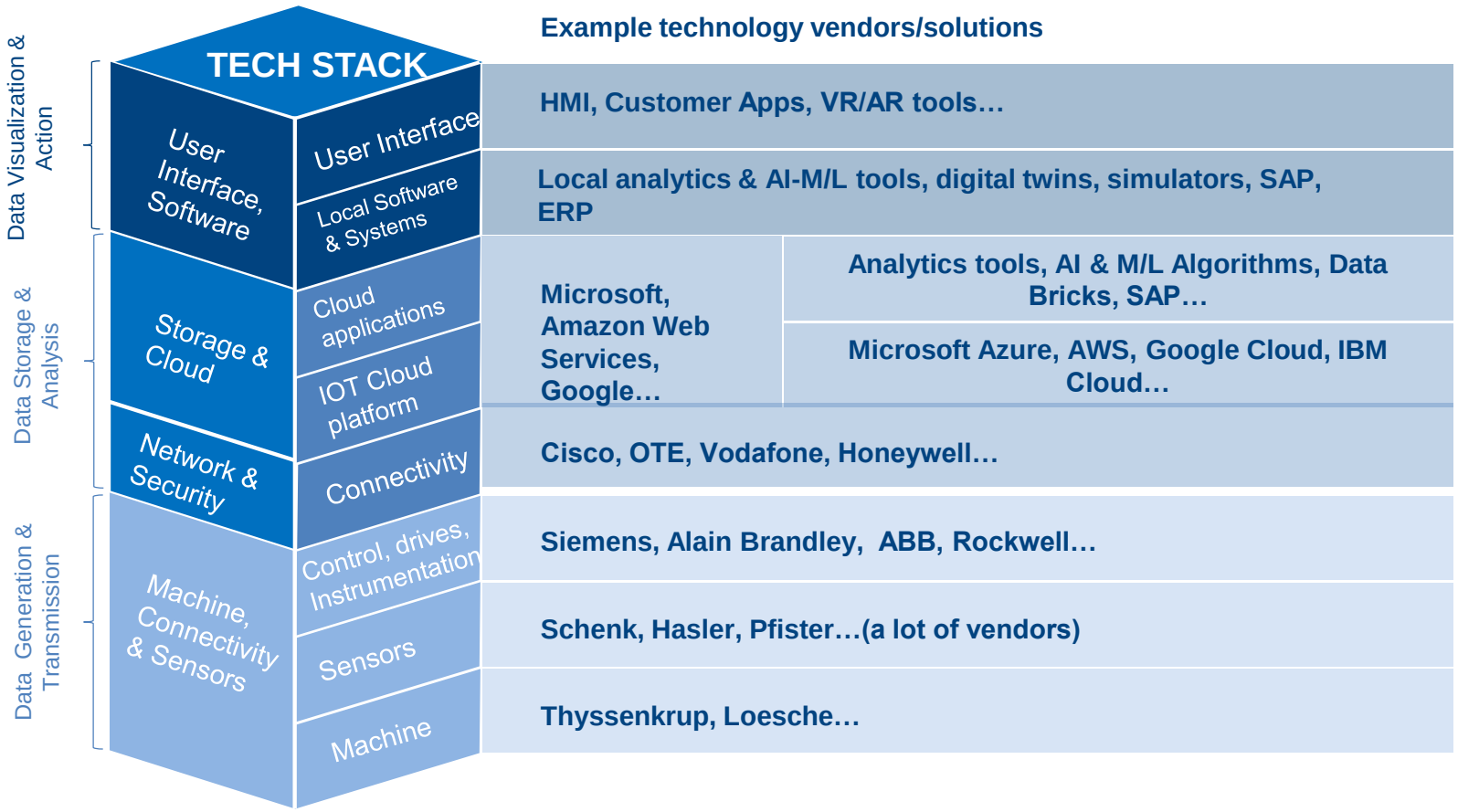
Remotely-guided plant maintenance

Digital-to-physical

3D printing of strategic spare parts



Embedded data platforms



Source: McKinsey, Reuters, thyssenkrup Insights, Mordor Intelligence

From raw data to smarter business decisions

Collect and store data from any source

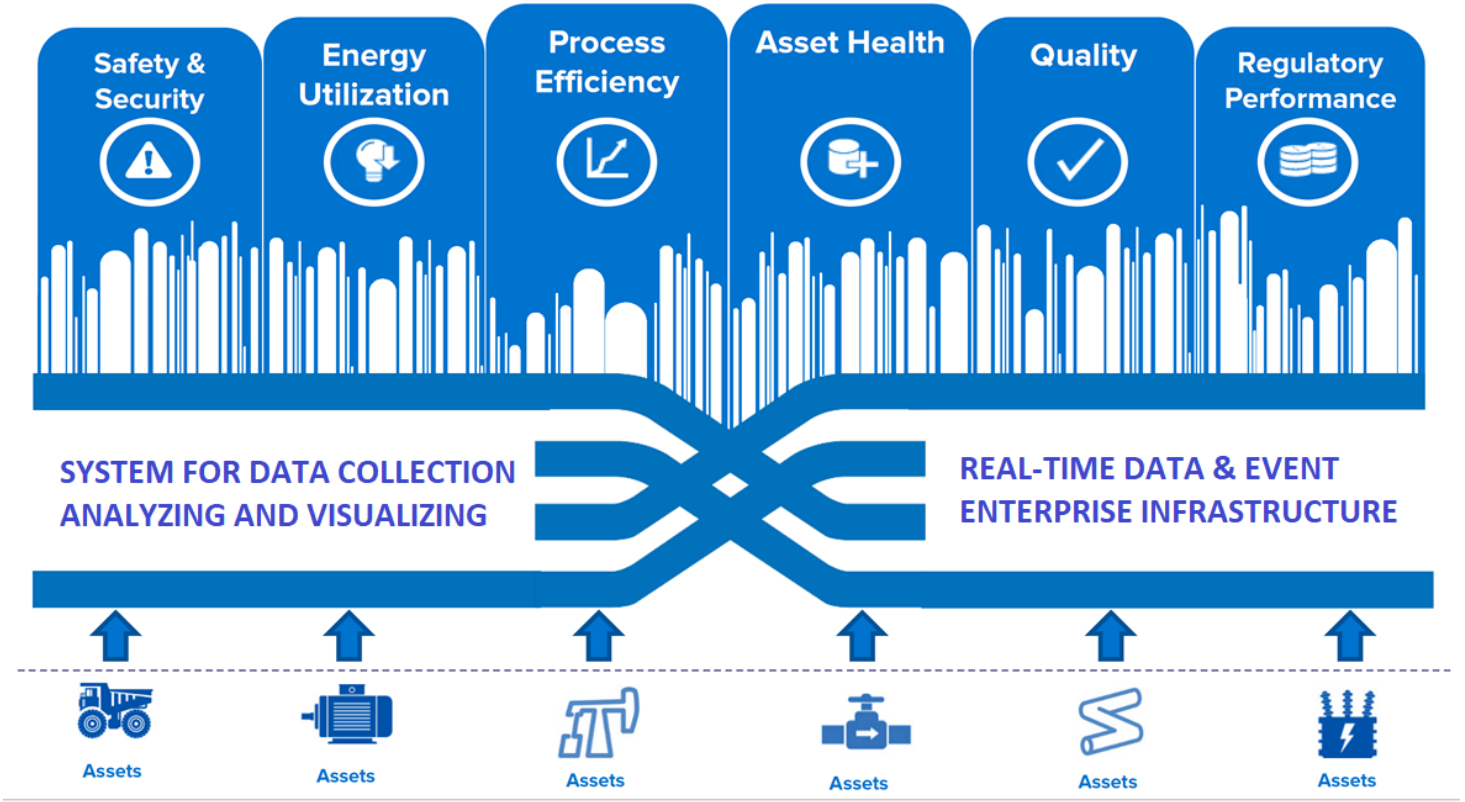
Add context and organize raw data to make it useful

Visualize data on-demand and get custom notifications

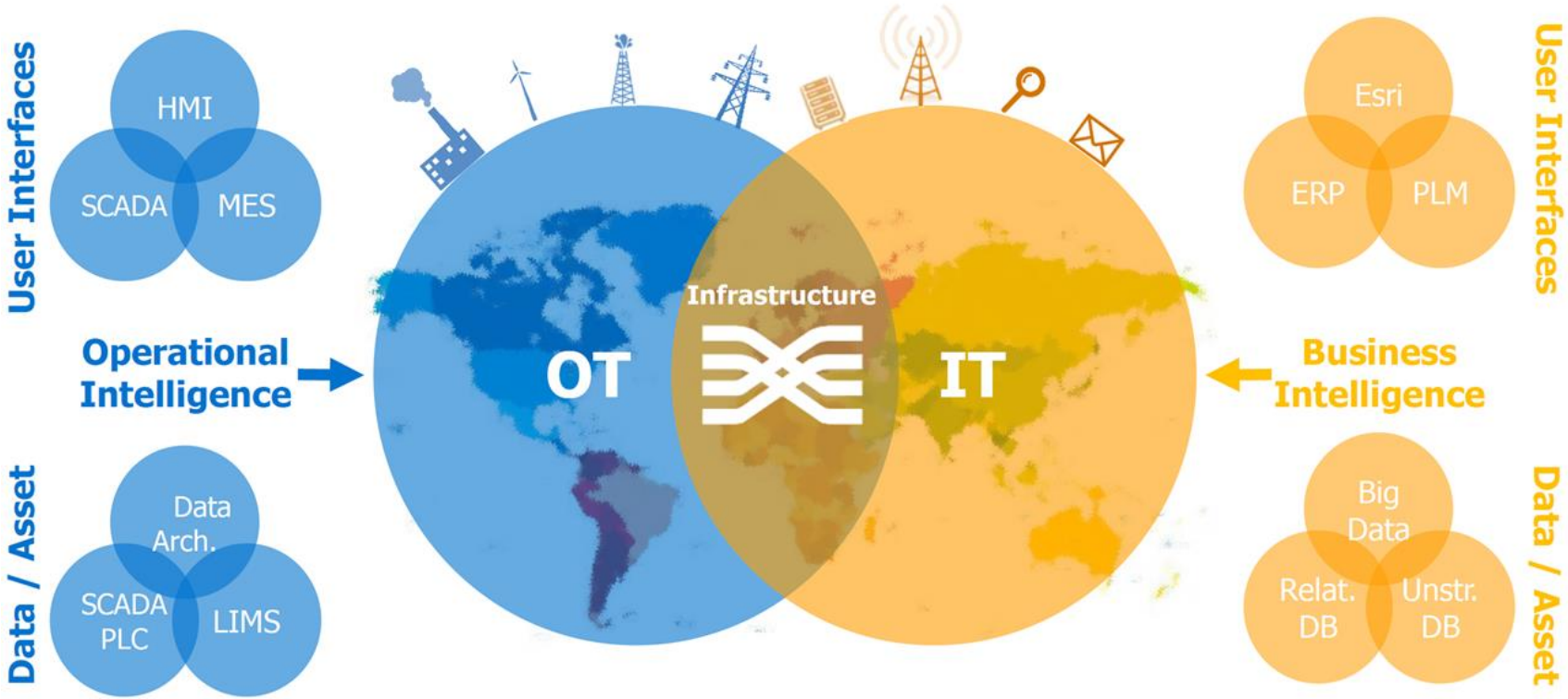
Share data between operations and business

✓ **Power data-driven decisions**

Data Management – Data Infrastructure – Real Time Data



IT – OT Convocation



Sensors - Raw data collaction

Critical points for sensor's analysis:

- **Criteria** per Sensor type
- **Normal Operation Conditions**
- **Evaluation** of analysis findings by domain experts

Automated analysis on Cloud

Core Team remote meetings

- **Revision of the analysis criteria** and modification of algorithms
- **Definition** of **Normal Operation Conditions** by **Process Engineers**
- **Prioritize Sensor Analysis** based on digital projects like **RTO, Predictive maintenance**
- **Analyze PID performance**
- **Monitoring of Sensors Analysis on Tableau (specific dashboards)**

Increased reliability on Historical Data Analysis

Industry 4.0 fields and Culture

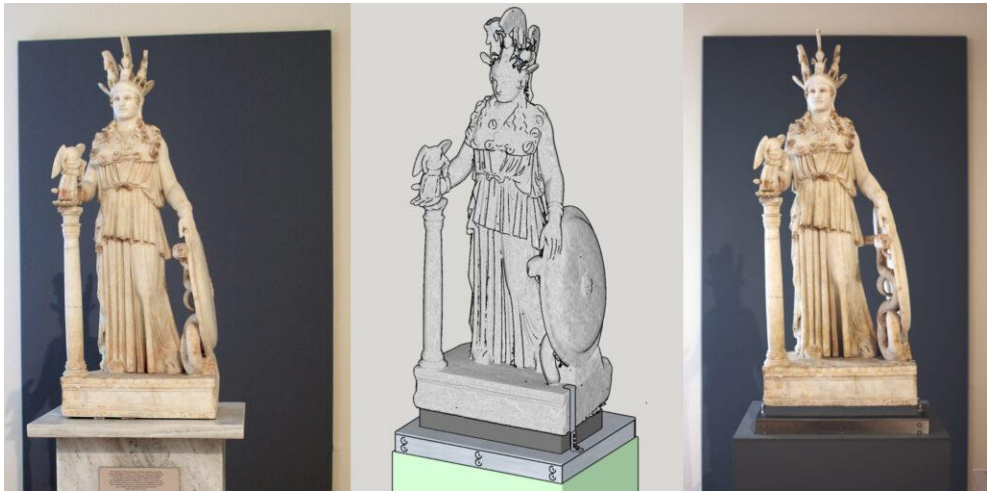
- Robotics
- CAD/CAM/CAE
- 3D Scanning – Reverse Engineering
- 3D Printing
- Cloud and Big Data Technologies
- Artificial Intelligent
- Internet of Things (IoT)
- Virtual and Augmented Reality

Robotics

https://riknews.com.cy/article/2020/4/12/diadiktuake-episkepse-se-mouseio-me-xenago-ena-rompot-3421205/

https://www.nytimes.com/2021/07/11/world/europe/carrara-italy-robot-sculptures.html

CAD/CAM/CAE



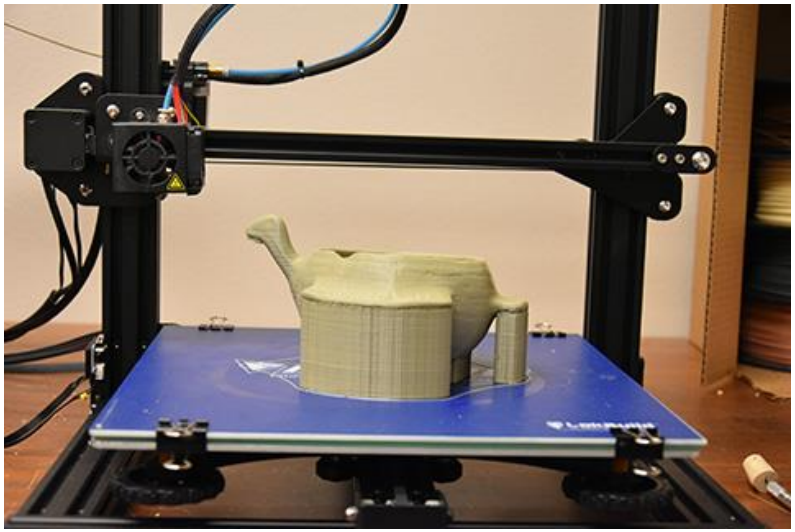
https://www.namuseum.gr/en/to-moyseio/sculpture-conservation-laboratory/design-and-manufacture-of-mounts-and-supports/16527-2/

3D Scanning – Reverse Engineering

https://archeology.uark.edu/3d/

https://www.creaform3d.com/blog/the-scanner-goscan-3d-used-to-digitize-a-national-archaeological-discovery/

3D Printing

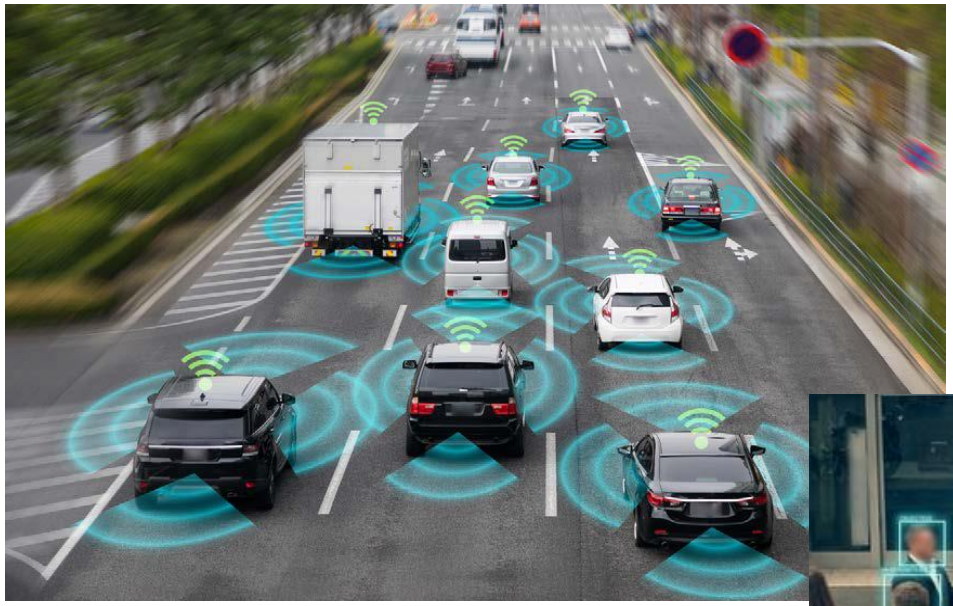


https://archeology.uark.edu/3d/

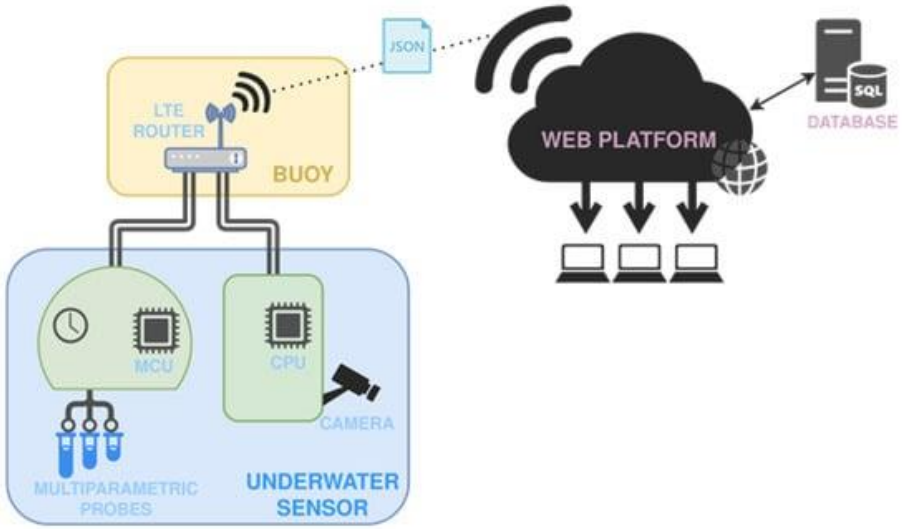
https://3dprint.com/135048/103dp-landmarks-monuments/

Cloud and Big Data Technologies

Artificial Intelligent



Internet of Things (IoT)



Lupia, M.; Gagliardi, G.; Cario, G.; Cicchello Gaccio, F.; D'Angelo, V.; Folino, P. A Smart System for Environmental Parameter Monitoring in Underwater Archaeological Sites. *Electronics* 2023, *12*, 2918. https://doi.org/10.3390/electronics12132918

Virtual and Augmented Reality

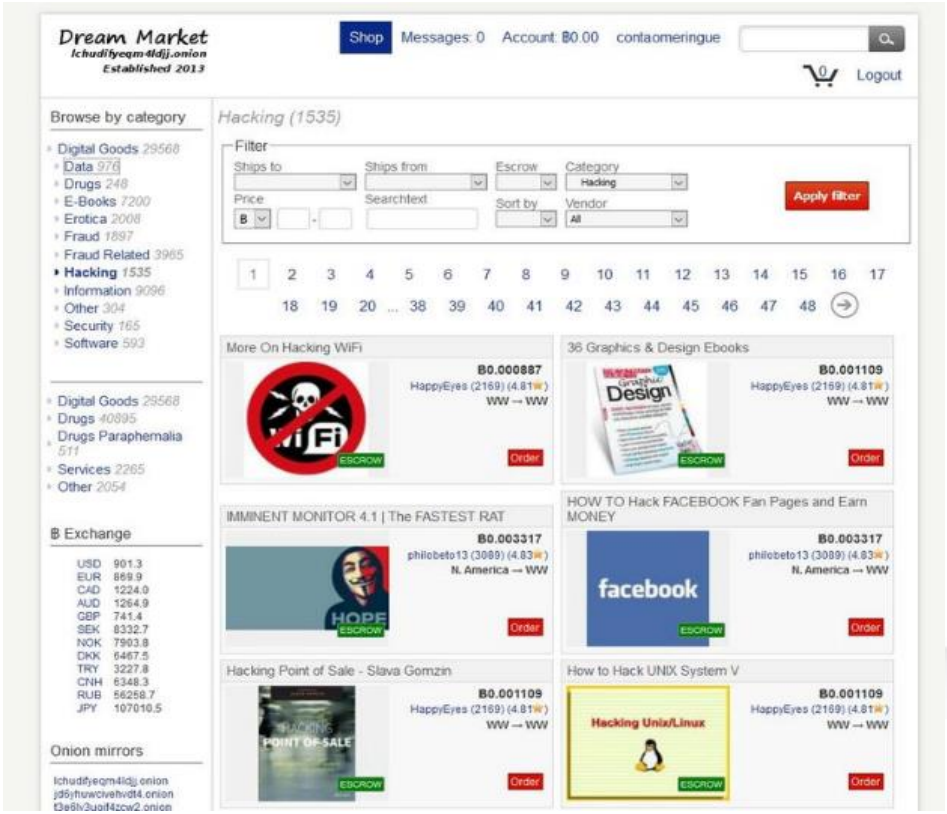
https://scooterise.com/modern-way-exploring-ancient-monuments/

https://www.olympiabackintime.com/

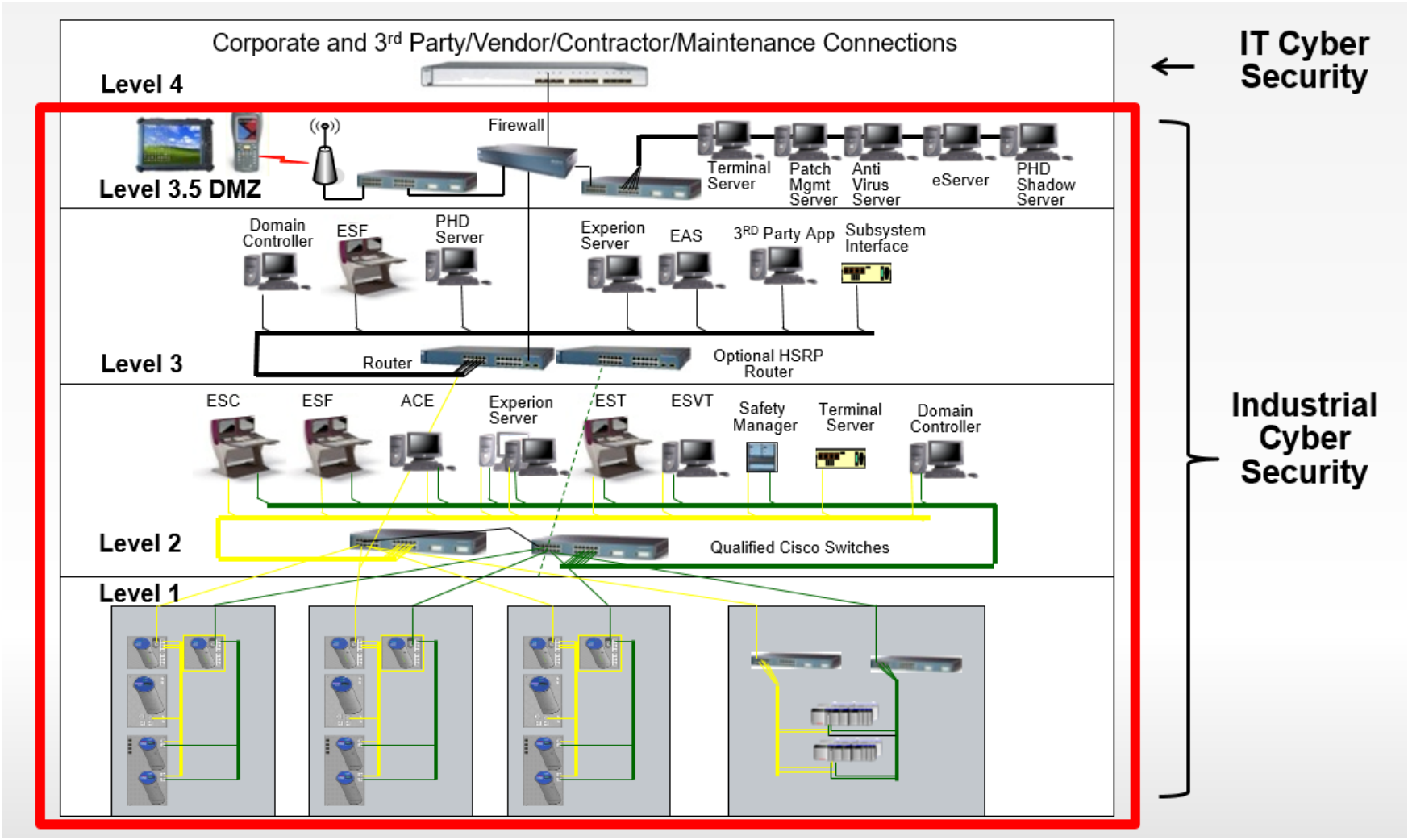
https://www.biblicalarchaeology.org/daily/news/virtual-reality-archaeology/

Cyberattacks

Attack planning now easier than ever



Cybersecurity Model in Infrastructures



Cyber attacks –Nuclear power plant data

Date Reported: Nov 2018
Company: Ingerop
Based: France
Vector: Hack
Type: Exfiltration
Industry: Construction
Result:

- 11,000 files from a dozen projects were accessed.
- 65 GB data relating to nuclear power plants and other projects
- Employee personal data
- Cost unreported

Intelligent Agents & Motivation

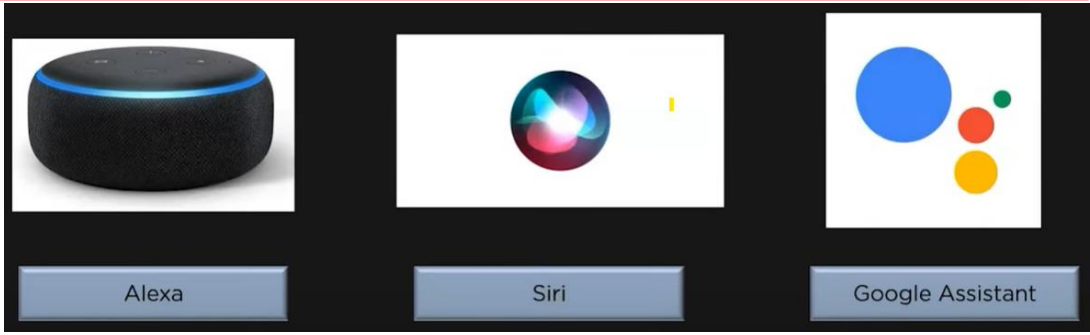
In the IoT of tomorrow, value between devices and across industries could be uncovered using **Intelligent Agents (IAs)**

that can add **autonomy**, **context awareness**, and **intelligence**

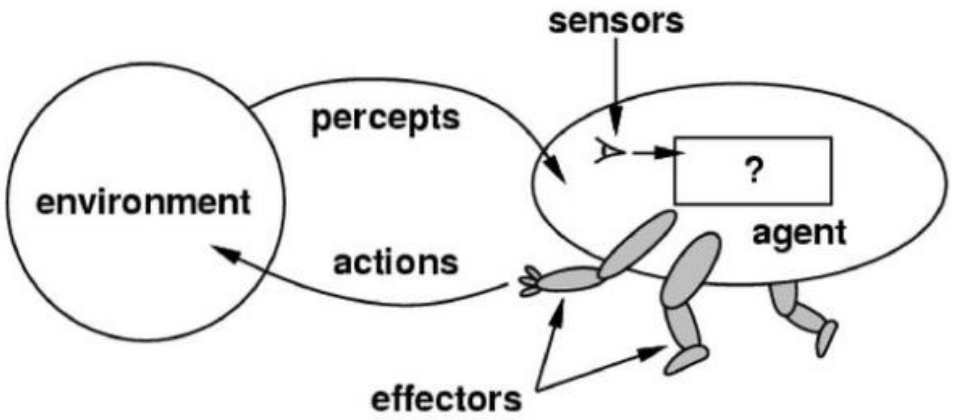
appropriate and promising technology forming an alternative to traditional interactions among people and objects

achieve automatic and dynamic behavior, high scalability and self- healing networking, promoting flexibility and trustworthiness

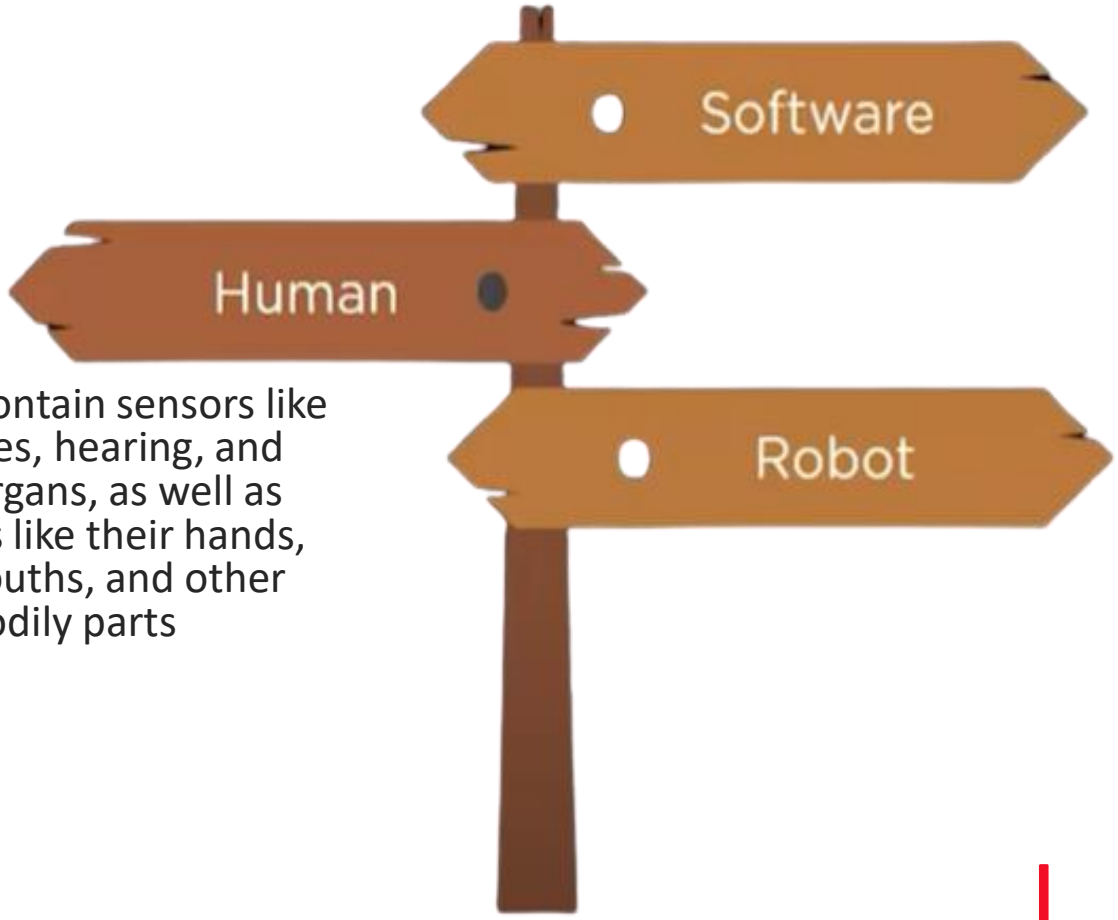
What are AI Agents?



It can be defined as a program that makes decisions and takes action based on the decisions



Examples of AI Agents



This Agent acts on sensory inputs, such as file contents and network packets it has received, by acting on those inputs and with the result on the screen

Humans contain sensors like their eyes, hearing, and other organs, as well as actuators like their hands, legs, mouths, and other bodily parts

These agents feature a variety of high-quality motors that serve as actuators, as well as cameras and infrared range finders that serve as sensors

Rules for AI Agents

Rule 1

An AI agent needs to have an environmental perception

Rule 2

Decisions must be based on observations of the environment

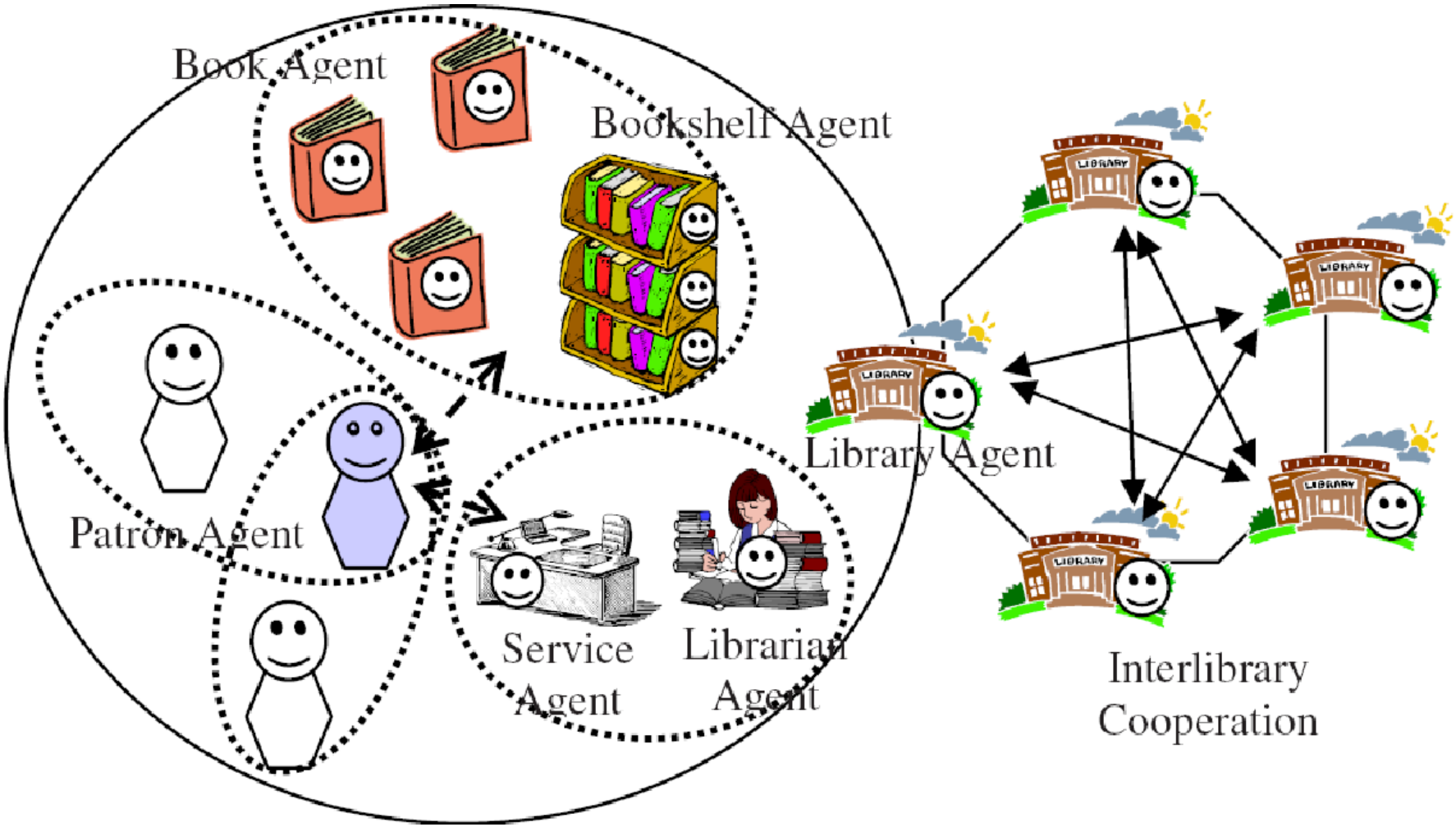
Rule 3

All the actions should be based on decisions

Rule 4

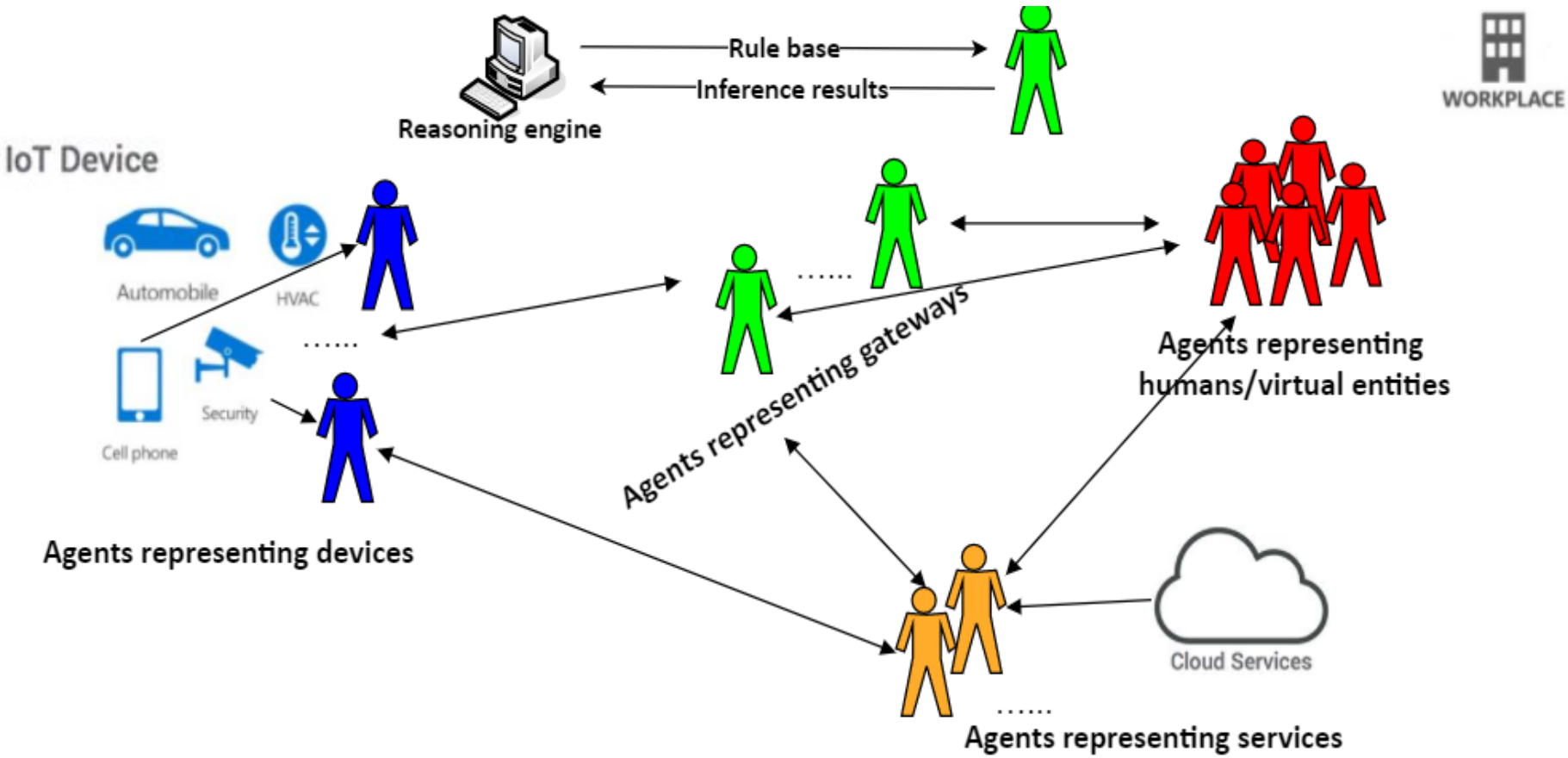
The AI agent's actions have to be logical.

A library case



Liu, G. (2011). The application of intelligent agents in libraries: a survey. Program, 45, 78-97.

IAs ecosystem



INBO: AR o VR o AI o IoT

3 step procedure

1st: Study the monument - site

2nd: Augment Reality / Virtual Reality (AR/VR)

3rd: Artificial Intelligence / Internet of Things (AI/IoT)

INBO is a three-stage methodology that included an INDEX and an IT Booklet, (**IN**DEX + **BO**OKLET = INBO) which allows both monument monitoring and real-time emergency response.

Ancient City of Philippi

INDEX

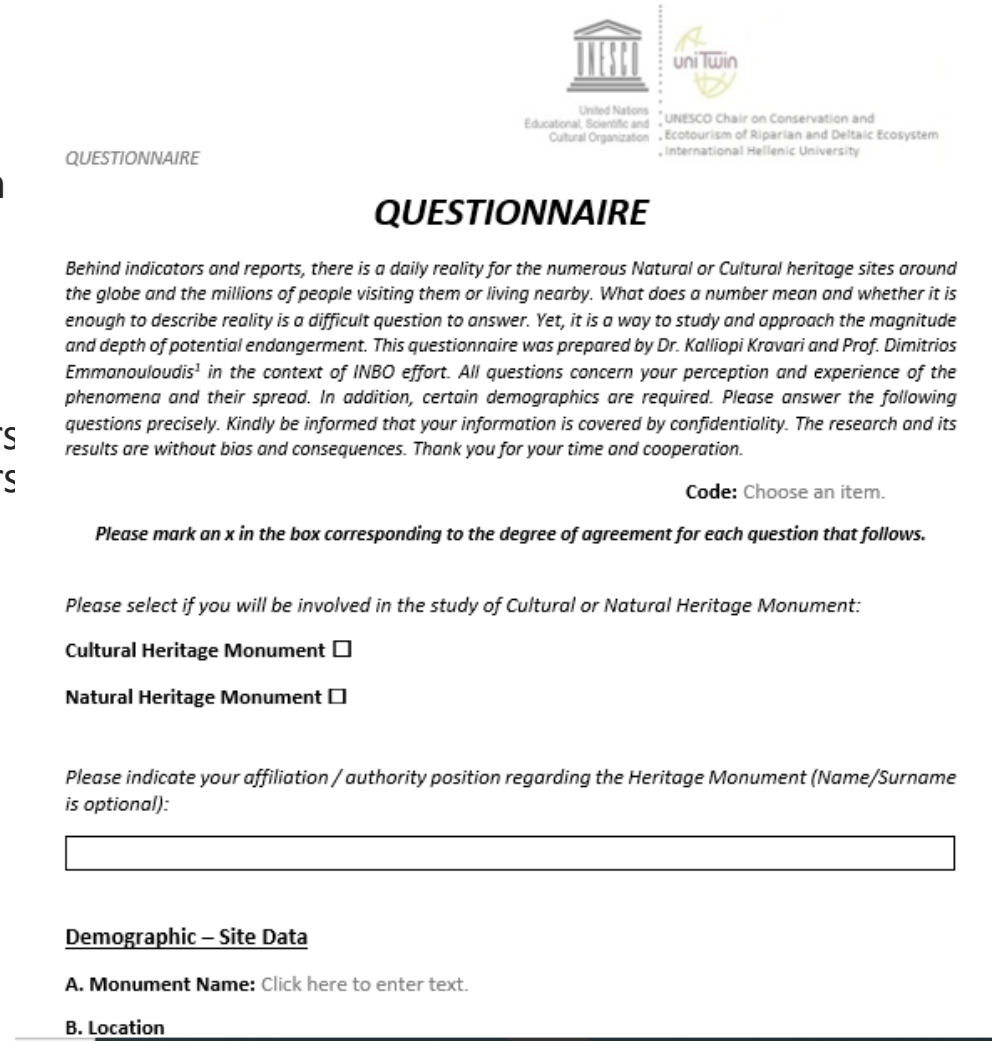
The first phase includes the development of an INDEX for each Monument.

- identify, record, classify and prioritize the dangers that threaten a Monument / site

A **questionnaire** will be shared to site managers and responsible stakeholders

This questionnaire will collect **data related to**

- **natural hazards**, such as hurricanes, lightning, flash floods, landslides etc.,
- **natural-human induced hazards**, such as agro and forest fires,
- **man – made hazards**, such as air, water pollution,
- **technological risks**, such as IT Protection Systems failure.



United Nations Educational, Scientific and Cultural Organization

UNESCO Chair on Conservation and Ecotourism of Riparian and Deltaic Ecosystem, International Hellenic University

QUESTIONNAIRE

QUESTIONNAIRE

Behind indicators and reports, there is a daily reality for the numerous Natural or Cultural heritage sites around the globe and the millions of people visiting them or living nearby. What does a number mean and whether it is enough to describe reality is a difficult question to answer. Yet, it is a way to study and approach the magnitude and depth of potential endangerment. This questionnaire was prepared by Dr. Kalliopi Kravari and Prof. Dimitrios Emmanouloudis[1] in the context of INBO effort. All questions concern your perception and experience of the phenomena and their spread. In addition, certain demographics are required. Please answer the following questions precisely. Kindly be informed that your information is covered by confidentiality. The research and its results are without bias and consequences. Thank you for your time and cooperation.

Code: Choose an item.

Please mark an x in the box corresponding to the degree of agreement for each question that follows.

Please select if you will be involved in the study of Cultural or Natural Heritage Monument:

Cultural Heritage Monument ☐

Natural Heritage Monument ☐

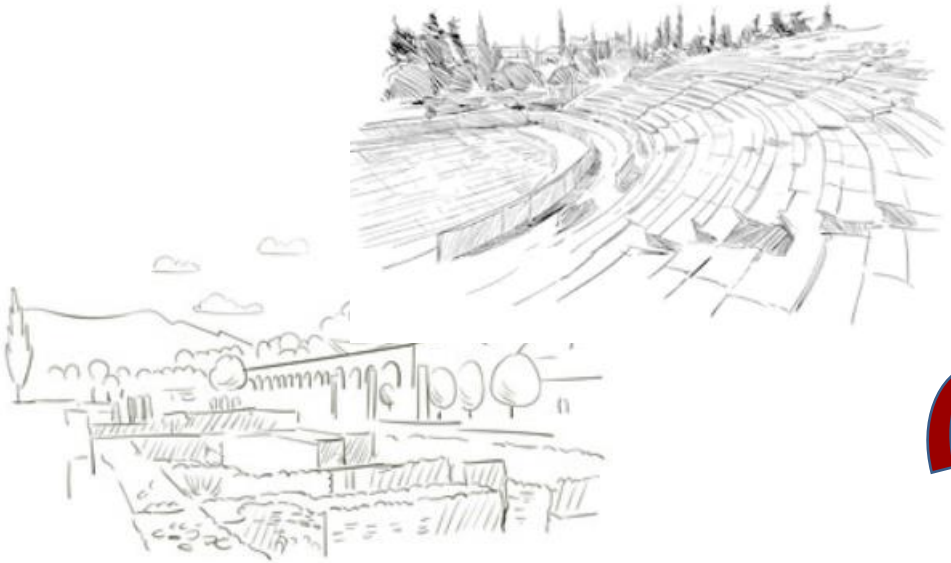
Please indicate your affiliation / authority position regarding the Heritage Monument (Name/Surname is optional):

Demographic – Site Data

A. Monument Name: Click here to enter text.

B. Location

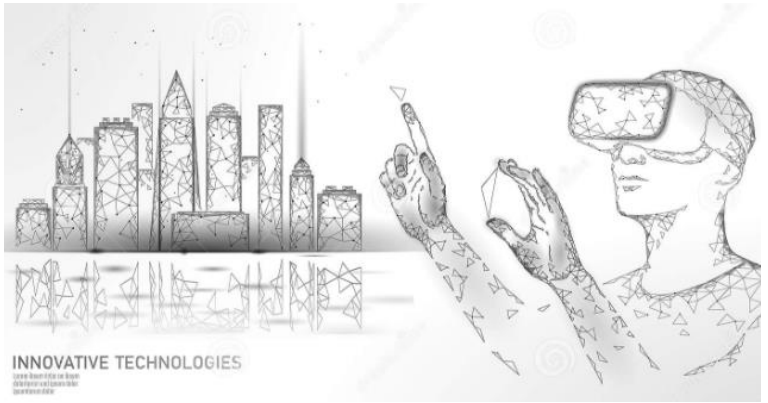
INDEX + BOOKLET



1. Study the monument (Ancient City of Philippi)

1a. Characteristics of site e.g. marshlands

2b. Potential types of hazards e.g. flooding



2. Reproduce site using **Augment Reality**

2a. Demonstrate risky locations etc

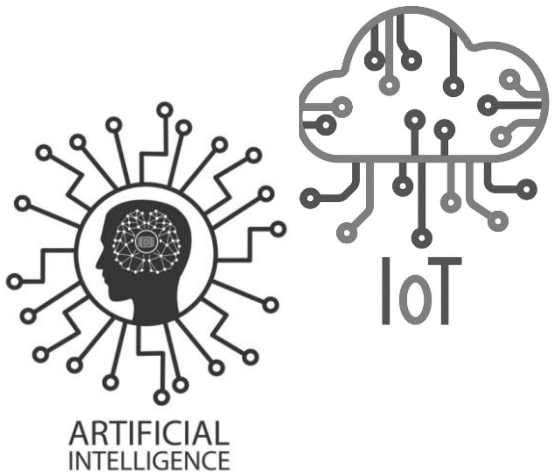
2b. Provide awareness to public/visitors/etc

2c. Provide guidelines e.g. evacuation of site

INDEX + BOOKLET

1. Study the monument

2. Reproduce site using **Augment Reality**



3. Monitor and manage site using **Internet of Things** **&** support collaboration and response via **Artificial Intelligence**

3a. IoT Equipment e.g. sensors, etc

3b. Collecting and **reasoning** on data

3c. Smart real time control application

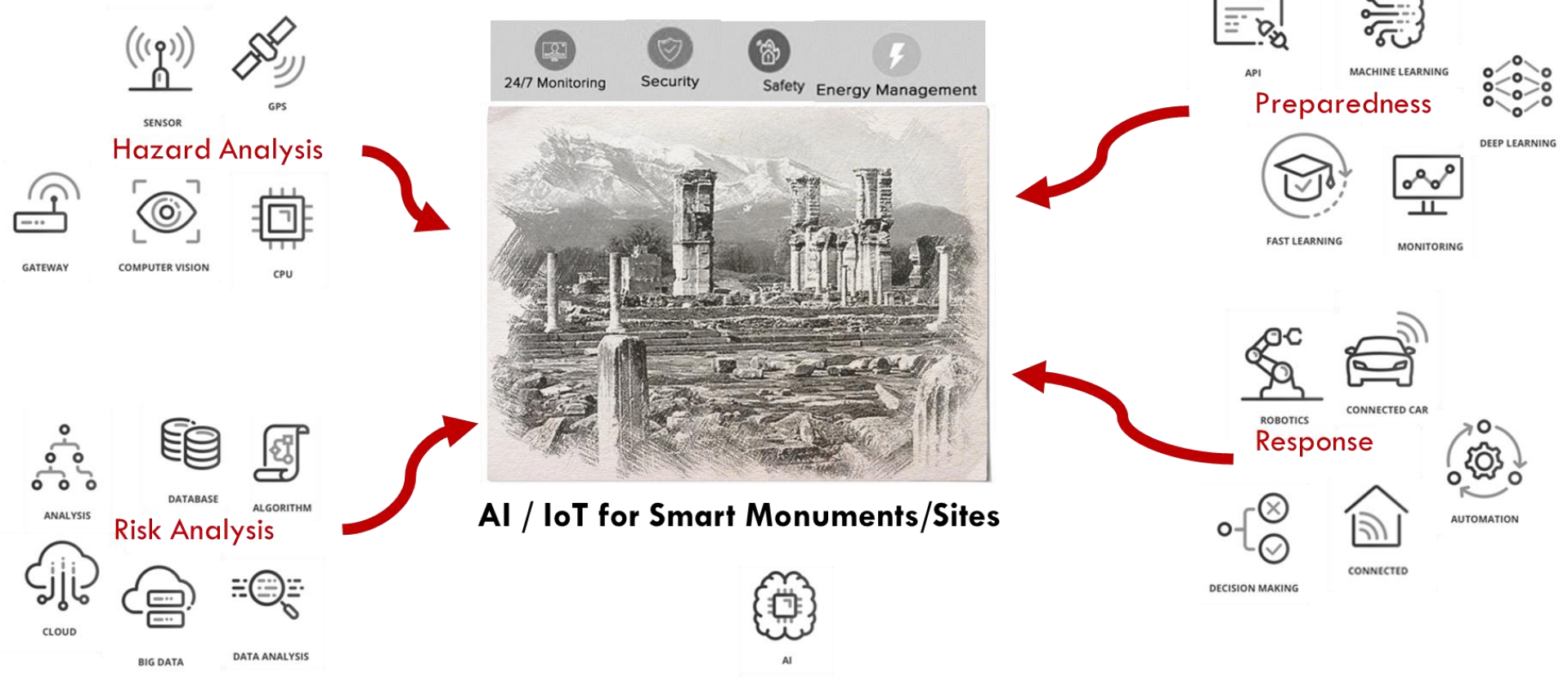
3d. AI techniques for stakeholders

INDEX (Risk Levels)

Smart real time system

- ✓Hazard Analysis
- ✓Risk Analysis
- ✓Preparedness
- ✓Response
- ✓Recovery

INBO Smart real-time system



Intelligent Agents & INBO System

The connecting link of the system is the intelligent agents which create a human-like artificial intelligence environment without the need for supervision

Autonomy	Migration
Adaptability	Learning
Social ability (Collaboration/ Coordination/Interaction)	Reactivity
Persistence (execution)	Proactivity
Communication ability	Mobility

Intelligent agents' properties

A Museum case

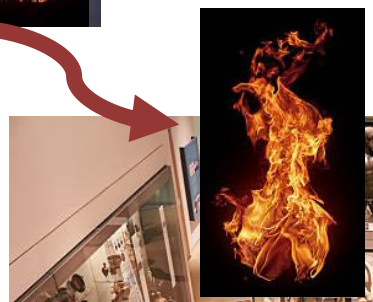
Hall 1

Hall 2

Hall 3

A Museum case

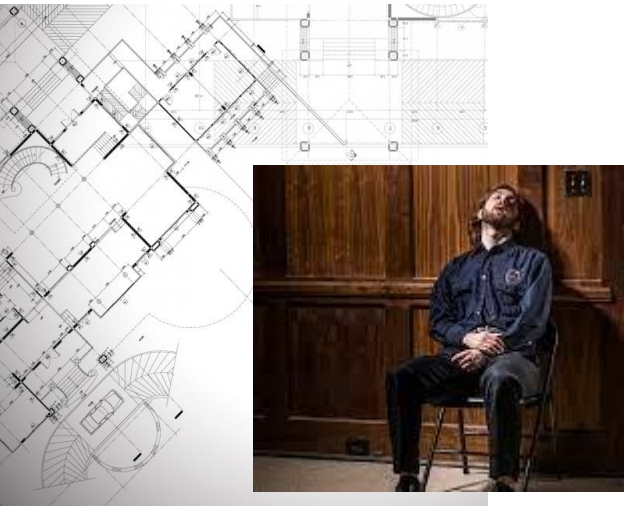
Hall 1



Hall 3

A Museum case

Hall 1



Hall 3

A Museum case

Agent representing human entities (e.g. guards)

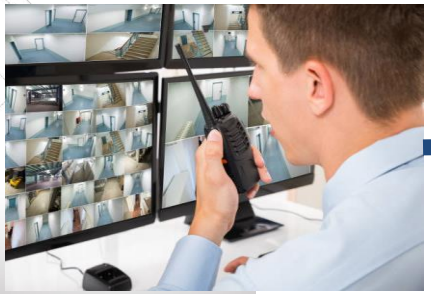
B

A Museum case

A

Agent representing devices

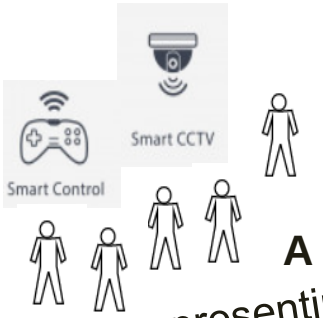
1



Agent representing human entities (e.g. guards)

B

A Museum case



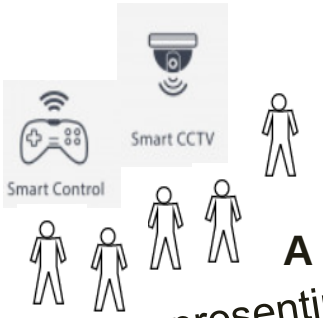
1

2

Agent representing human entities (e.g. guards)

B

A Museum case



A

Agent representing devices

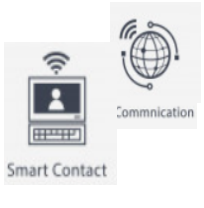
1

2

Agent representing human entities (e.g. guards)

B

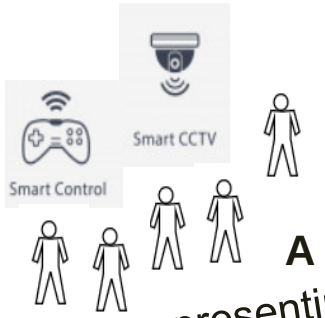
3



C

Agent representing gateways

A Museum case



A

Agent representing devices

1

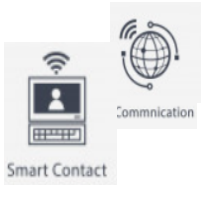
B

Agent representing human entities (e.g. guards)

2

4

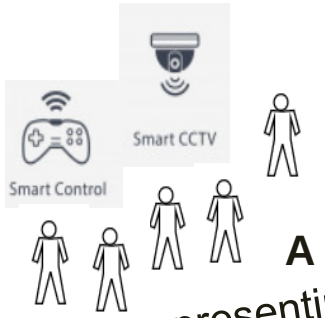
3



C

Agent representing gateways

A Museum case



A

Agent representing devices

1

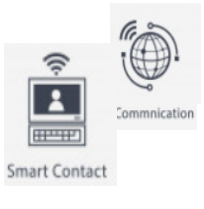
B

Agent representing human entities (e.g. guards)

2

4

3



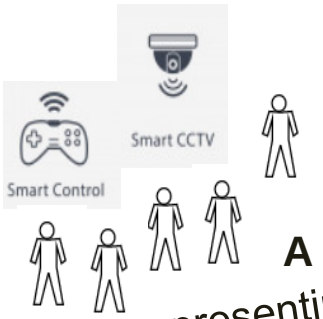
C

Agent representing gateways

A Museum case

B

Agent representing human entities (e.g. guards)



A

Agent representing devices

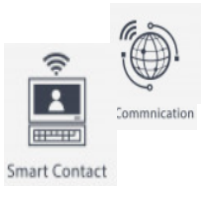
1

2

4

3

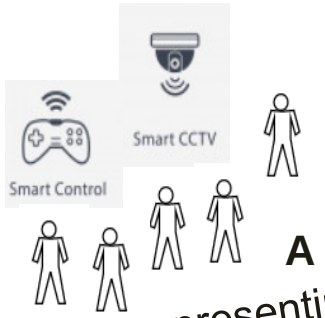
5



C

Agent representing gateways

A Museum case



A

Agent representing devices

1

B

Agent representing human entities (e.g. guards)

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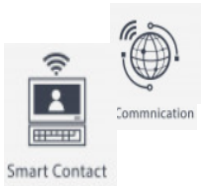
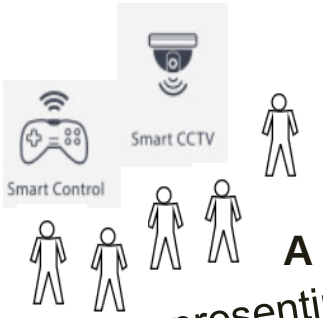


C

Agent representing gateways

A Museum case



A

Agent representing devices

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B

Agent representing human entities (e.g. guards)

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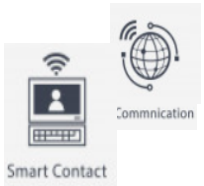


C

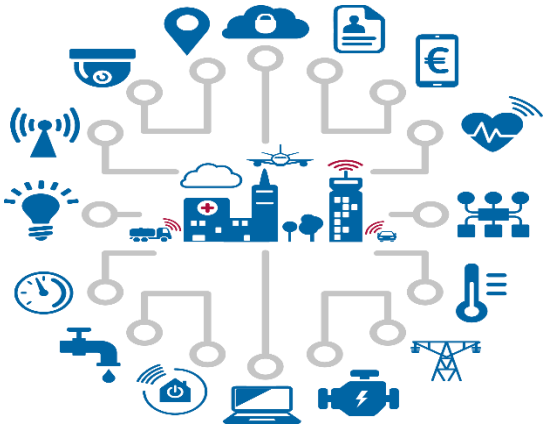
Agent representing gateways

Monitoring and Management

Need for **Monitoring and Management**

- ✓ **Smart devices** and **applications** from daily life could be used
- ✓ Synergy of **GIS** and **IoT** for **Weather Disasters**

- Data measured and collected by distributed sensors (in different locations)
- The system generates alerts
- Dissemination in near real-time to responsible entities and the public
- Multiple dissemination mechanisms



Smart World
meteorological - hydrological hazards

Natural weather events: hurricanes, forest fires, floods, volcanoes, tornadoes and earthquakes

- IoT (sensors) monitors natural weather events and notify about critical safety information
- Sensor technology offers real-time information during and after a natural weather event

For example, sensors are capable of monitoring:

- detect increased water levels before a hurricane
- track how quickly a forest fire is spreading

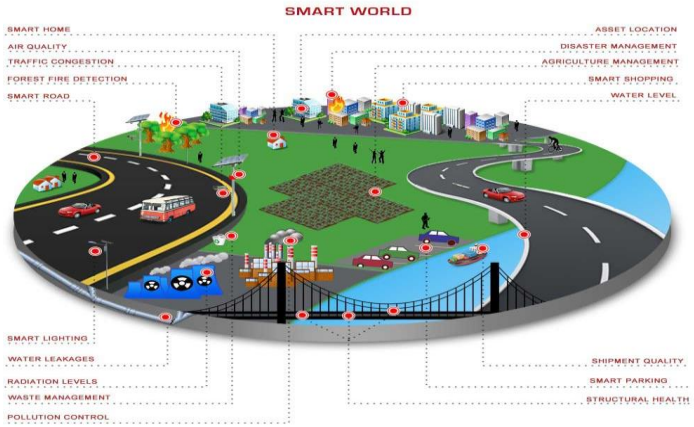
We have to go beyond that

Smart World
meteorological - hydrological hazards

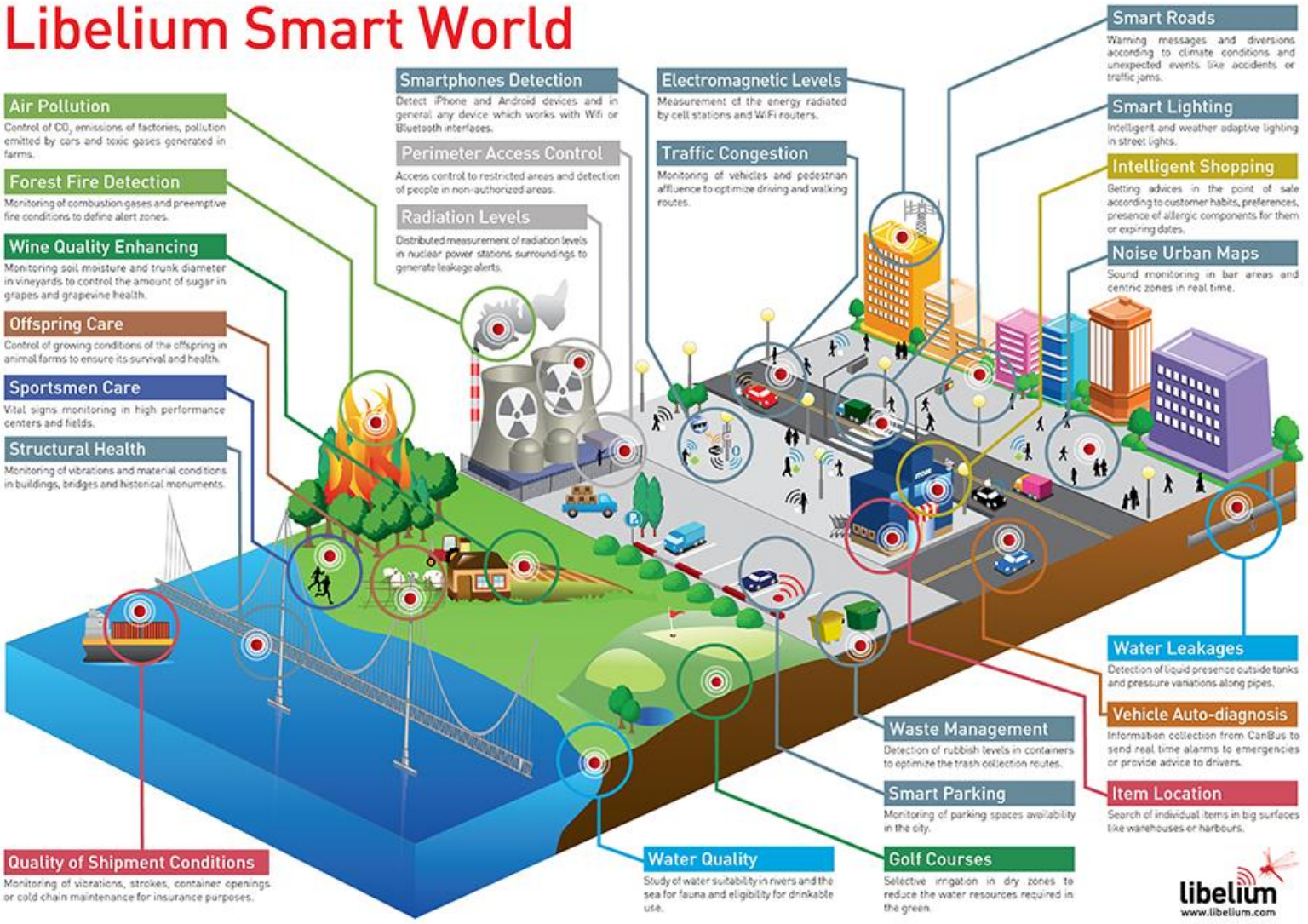
predict natural disasters?

Early warning systems:

- **Risk knowledge:** categorical system of hazard analysis
  - officials prioritize local response efforts and manage their resources (smart automation a step further!)
- **Monitoring:** hazard identified, up-to-date environmental track changes in order to reflect the severity and expected outcome of the natural disaster
- **Warning communication:** multi-channel communication protocols
- **Response capability:** Information alone cannot assure a positive outcome (we need more!)



Smart World
meteorological - hydrological hazards



EPILOGUE

From the above presentation, we hope that it can be easily understood the use and the role of New Technologies, especially the ones of Informatics, to the protection of Sites and Monuments especially from Natural and Manmade risks.

We believe that with their help, we could remarkably facilitate and strengthen the purpose of Sites and Monuments protection from tangible risks.

Thus, in this case, Science help us (the Global Community) walking towards the right direction

Thank you for your attention