



Sustainable Infrastructures in Culture

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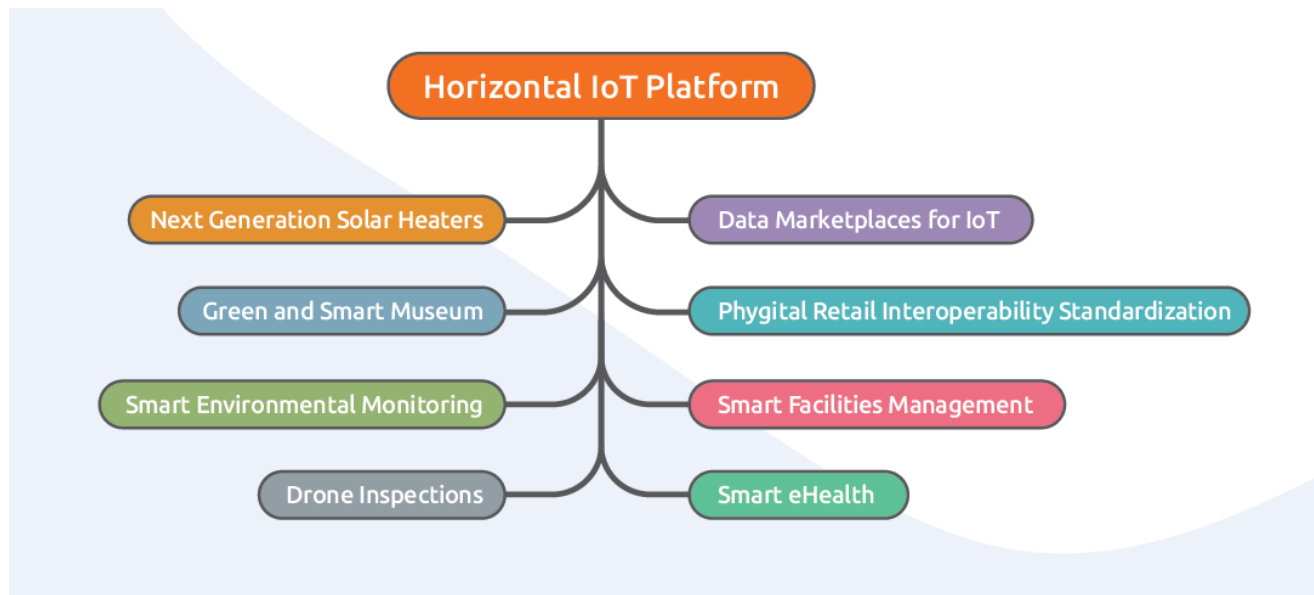
MSc Management

About Pleiades

Pleiades is an IoT Innovation Cluster:

the first large-scale effort to organize and develop an Internet of Things (IoT) ecosystem in Greece

It consists of
21 members in
9 working groups



About the Smart & Green Museum project

An holistic platform that allows the monitoring and management of cultural organizations' buildings and services, based on well-defined methodologies, best practices and international standards regarding:

- ♻ energy management
- ♻ environmental footprint
- ♻ indoor environment quality
- ♻ sustainability on every level

It is implemented within the framework of the Pleiades IoT Cluster

The **Smart & Green Museum** project Team

A team with great expertise and complementarity:

- Zarifopoulos (building management systems)
- MOBICS (IT)
- C2h Environmental Engineering (energy and environmental design)
- Uni Systems (coordination, cultural management, IoT platform)



The necessity for a **Smart & Green Museum** project

The sustainable operation of a cultural infrastructure is critical, however, the implementation of such an operation poses a great challenge:

- Destinations with a large number of visitors and with significant peaks in traffic (**effects on comfort and health conditions**)
- The **environmental footprint** of the infrastructures is especially aggravating on the area they are located compared to other infrastructures (e.g. visitor transportation)
- Space and exhibits are **more sensitive to changes in the conditions of indoor environment and climate change**
- **Renovation** and improvement of the organization's infrastructure **is not an option** ("static" elements)
- Directly related to financial **indicators for sustainable investments (EU Taxonomy, EU Green Deal)**

Cultural institutions must have a leading role in social responsibility regarding the increased impact of climate change.

The Goals of **Smart & Green Museum** project

The project aims to assist cultural infrastructures in reaching sustainable operations and growth by achieving the following targets:

- Formulation of methodology for the adaptation of International and European standards for the sustainable assessment of already built environments to the particularities of existing cultural spaces
- Development of a digital platform with IoT and automation subsystems for monitoring and intelligent (self-)management of an infrastructure regarding energy and indoor environment quality
- “Standardization” of the concept of “Sustainability” for cultural infrastructures
- Upgrading the experience and environmental awareness of employees and visitors

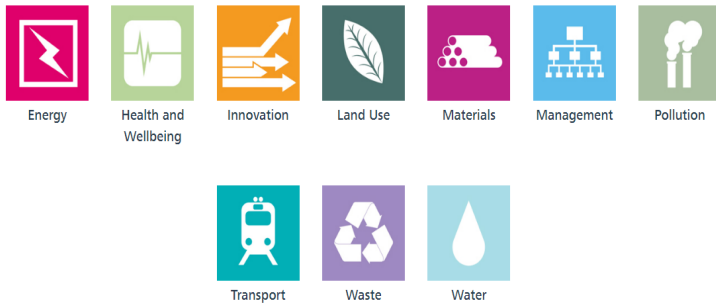
Basic Actions of the Project

1. Methodology and formulation of procedures and indicators for a “Smart & Green Museum”.
 - Adaptation and proposal based on international standards (e.g., BREEAM, LEED, WELL)
2. Design and development of an automation and infrastructure management subsystem.
 - BMS tailored to the specific requirements of a museum
3. Design and development of intelligence subsystem and applications.
 - Business intelligence system
 - Reports
4. Gamification and public awareness techniques on issues of sustainable operations.
 - Methods and digital applications
5. Pilot operation and assessment of the project.

1. Methodology and formulation of procedures and indicators for a Smart & Green Museum

BREEAM Certification

BREEAM is one of the most widely recognised methods internationally, for the sustainability assessment and certification of buildings, evaluating the environmental performance of a building, based on its design, construction and operation, assessing using a holistic approach, several environmental factors:



WELL Building Standard

WELL is the first building standard to focus exclusively on human health and wellness and it is based on years of research in health and scientific standards.

WELL Certified spaces are designed to improve, by addressing issues that impact health and wellness through design, operations and behaviour, the following areas:



1. Methodology and formulation of procedures and indicators for a Smart & Green Museum

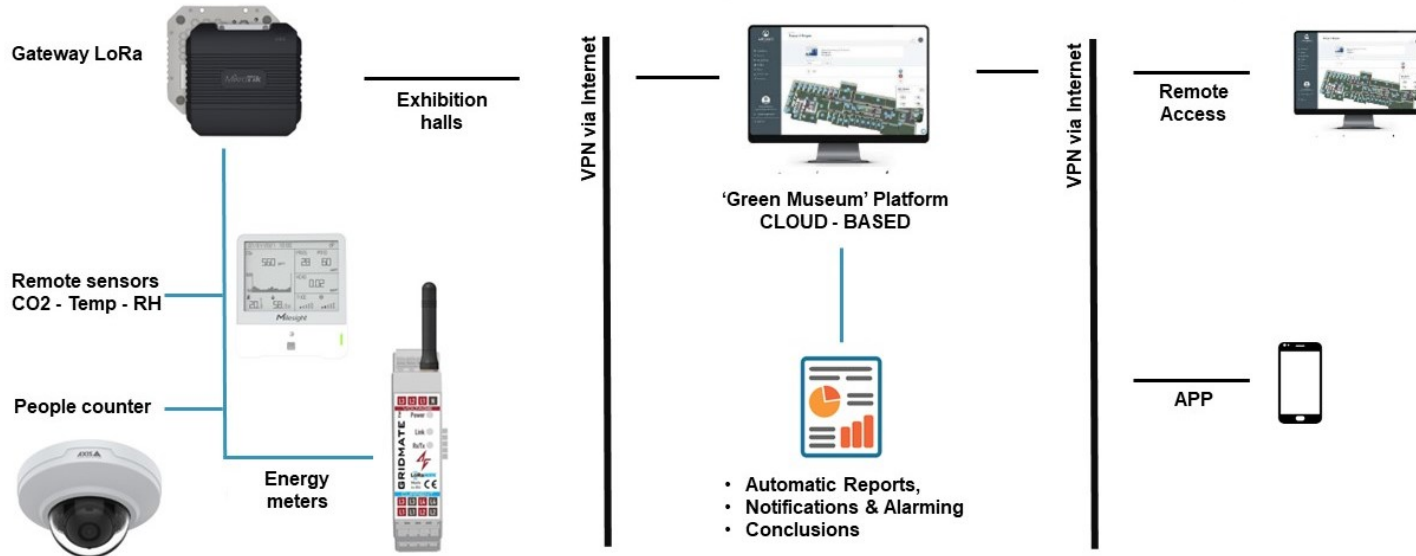
Thematic Factors	Criterion	Tracking Index - Explanation	Standard	KPIs
Air	Monitoring Air Conditions / Parameters	CO ₂ , VOC (Volatile Organic Compounds), PM _{2.5} and PM ₁₀ measurements should be within the limits prescribed by the criteria	WELL	CO ₂ PM _{2.5} VOC PM ₁₀
Nourishment	Supply of Nutritional Ingredients	Record specific information per menu item in cases where there is a cafeteria (total calories per serving, total sugar per serving or beverage)	WELL	-
Thermal Comfort	Providing Acceptable Thermal Environment	Temperature and humidity measurements should be within the limits prescribed by the criteria	WELL	Temperature Relative Humidity
Energy / Equipment Performance	Energy Usage Monitoring	The installation's important energy usages should be monitored separately (Air conditioning, lighting, special equipment, etc.)	BREEAM in Use Part 1	kWh / Usage Lt (Oil) / Usage Nm ³ (Natural Gas) / Usage
Water / Equipment Performance	Water Consumption Monitoring	The installation's water consumption should be monitored	BREEAM in Use Part 1	Lt
Energy / Management Performance	Consumption Monitoring	The installation's consumption should be monitored in a way that correlates with the factors that affect it	BREEAM in Use Part 2	kWh / m ² kWh / visitor
Energy / Management Performance	Carbon Footprint Monitoring	The installation's carbon footprint should be monitored	BREEAM in Use Part 2	CO ₂ equiv
Energy – Water / Management Performance	Consumption Reporting	Regular reporting should be sent to administrators, so that they can make energy related decisions. Targeted CO ₂ reduction actions	BREEAM in Use Part 2	Automatic Reporting with the above indexes

2. Design and development of an automation and infrastructure management subsystem

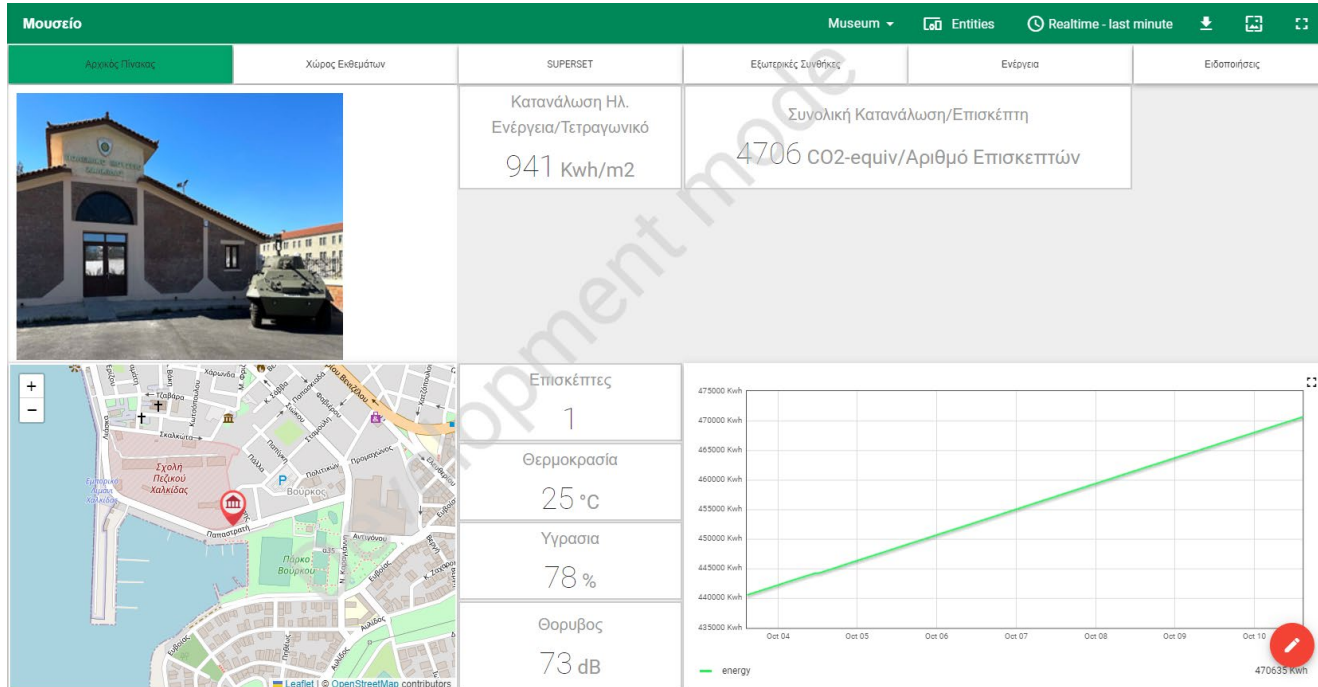
1. Museum Energy Measurement System
 2. Museum Comfort Conditions Measurement System
 - CO₂ levels
 - Temperature
 - Humidity
 - Noise levels
 - Movement / Traffic
 - Barometric pressure
 - Lighting
 - VOCs (volatile organic compounds)
 - Particles PM_{2.5} & PM₁₀
 3. Museum People Counter System
- Ability to aggregate data via multiple and modern IoT protocols (MQTT, LoRa, BACnet etc.)
 - Fully scalable and with support for interoperability
 - Easy installation
 - Low cost
 - Wide range
 - Discrete design

2. Design and development of an automation and infrastructure management subsystem

System architecture

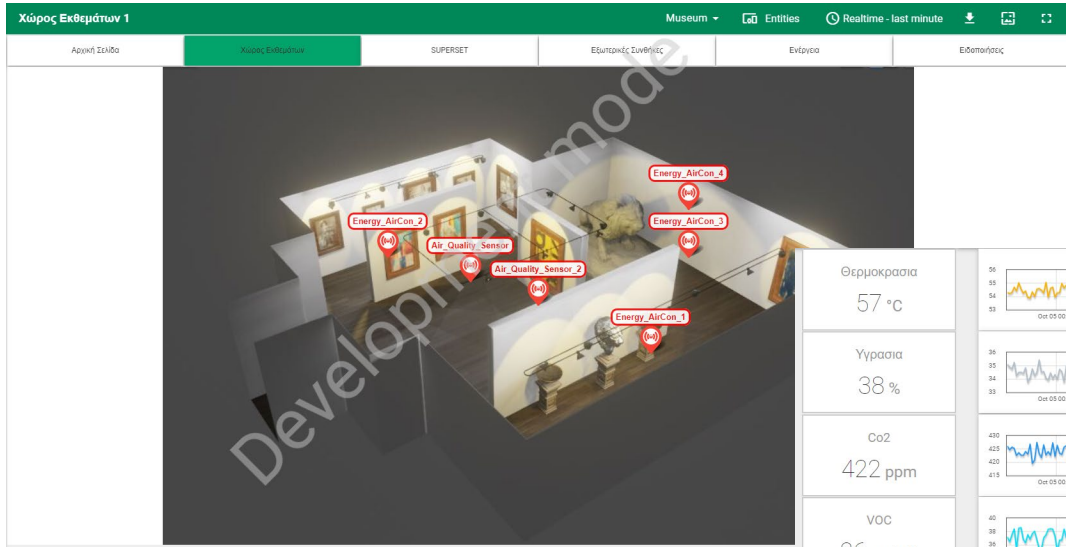


3. Design and development of intelligence subsystem and applications



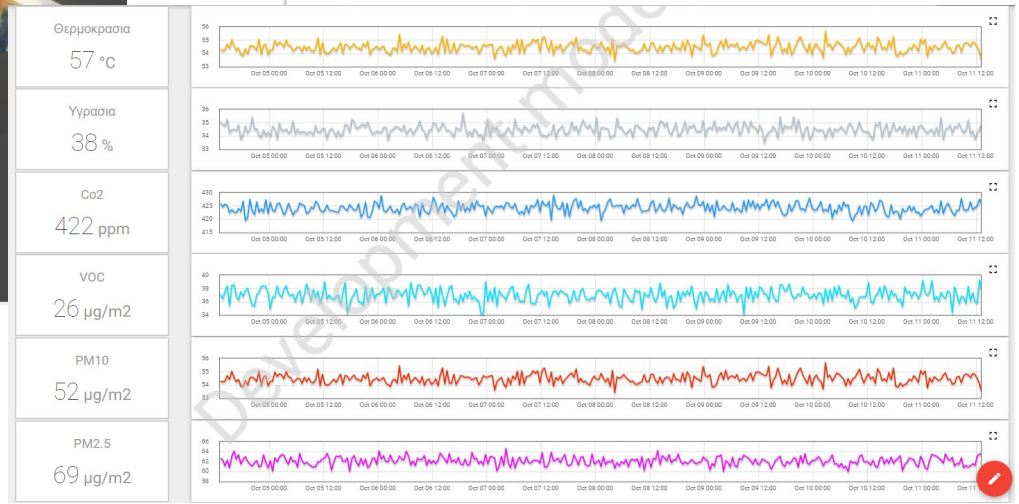
Device
Management
Platform

3. Design and development of intelligence subsystem and applications

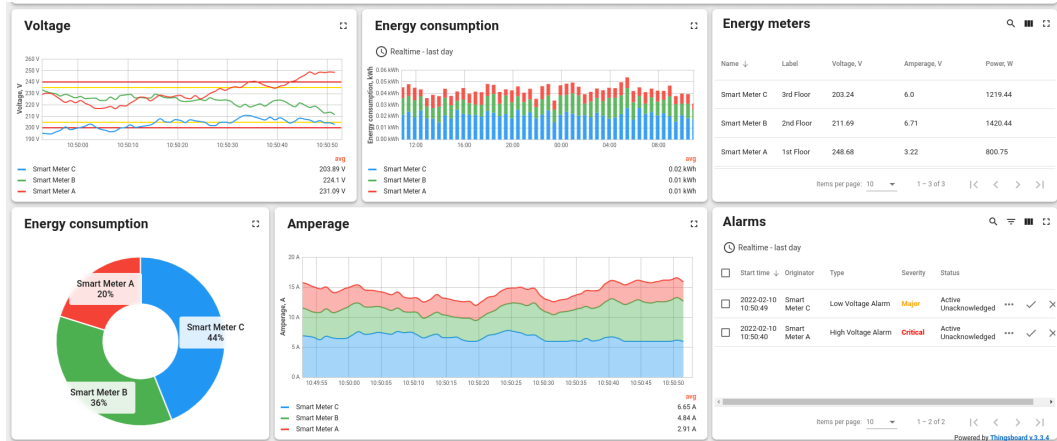


Museum Layout

Sensor Data – Air Quality



3. Design and development of intelligence subsystem and applications

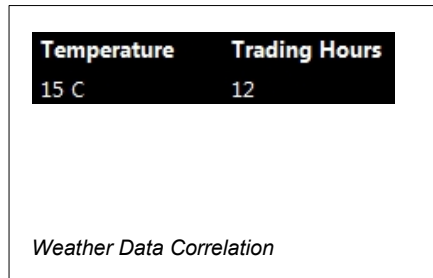
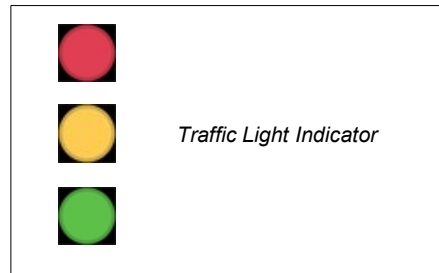
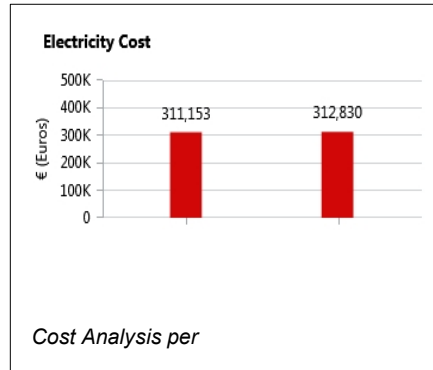
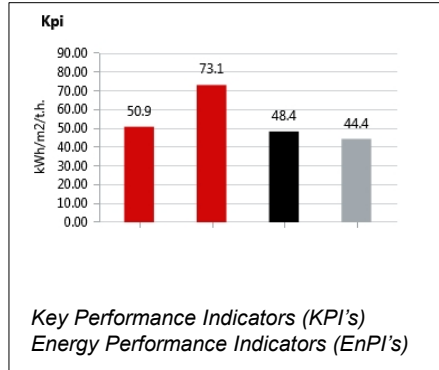


Sensor Data – Energy

Sensor Data – Outdoor Air Quality



3. Design and development of intelligence subsystem and applications



Decision Making Subsystem

Business Intelligence Platform for Correlation with non-building Data:

- Weather Services
- Number of Guests
- Financial Data

Automated Scheduled Reporting

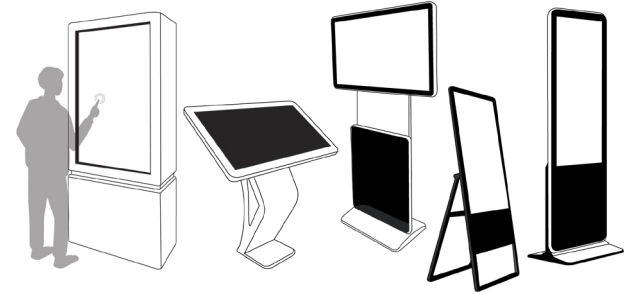
- 1-pager method
- Thresholds and Notifications
- Automated Consulting

4. Gamification and public awareness techniques on issues of sustainable operations

Application specifications for interactive displays (digital signage)

The gamification mechanisms that will be supported are:

- **Multiple choice questions**
- **True-False questions**
- **Puzzles**



Application specifications for mobile phones

The mobile app will serve two purposes:

The first is to have basic info related to the museum, before, during and after their visit, such as exhibitions and events, ticket costs and sales, contact info, access to the museum etc. In the access section, the app will provide sustainable ways to visit the museum

The second purpose is to integrate gamification elements into the interaction with the environment.

5. Pilot operation and assessment of the project

Implementation at the War Museum (Chalkida Branch)

1. Selection of spaces for implementation according to available resources
2. Review of the existing conditions and strategies of the institution
3. General and specific* requirements of the institution
4. Detailed design/planning of the solution
 - equipment, applications, operations



5. Pilot operation and assessment of the project

5. Implementation and application
6. Promotion and public awareness actions
7. Design and execute a performance evaluation of the solution



Benefits - Advantages

- Highlight the pilot implementation as a pioneering case study on a National and European level
- Added value / recognition – certified quality and performance of materials and systems
- Gain a positive opinion from local authorities and population
- Promotion of innovation
- Reduction of energy and water related operational costs, as well as reduction of human resources related costs
- Gain a comfortable and healthy indoor environment for users and guests
- Environmental benefits – Reduction of CO₂ emissions
- Corporate Social Responsibility

Thank you



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