Digital cultural heritage: from OAIS until the Personalised Augmented Experiences. Perspectives

International Seminar on Archiving in Performing Arts, Coimbra 16 Nov. 2017

Adérito Fernandes Marcos aderito.marcos@uab.pt

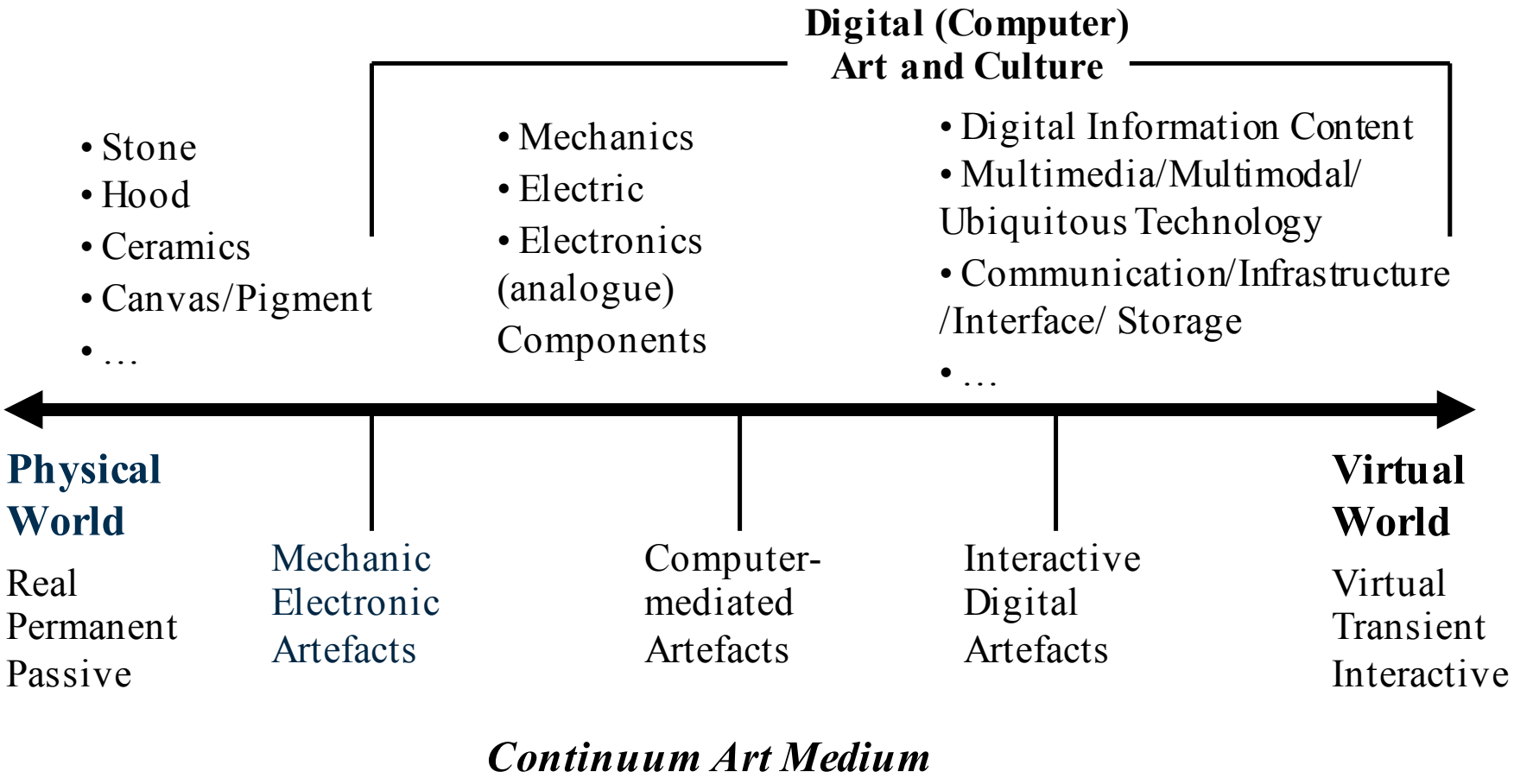
UNIVERSIDADE ABERTA
www.uab.pt

ARTECH INTERNATIONAL

Agenda

1. Foreword
2. CASPAR – the OAIS Project
3. Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project
4. Culturally Enhanced Augmented Realities – CultAR project
5. Conclusions

Foreword – about the Digital Medium



Foreword – **about the Digital Medium**

- ✓ Art and culture are social phenomena, resulting from the social interaction, of the individual and collective imaginary manifestations, that together establish a common **communicational and informational space** embracing **artefacts or events** said to be cultural and artistic.

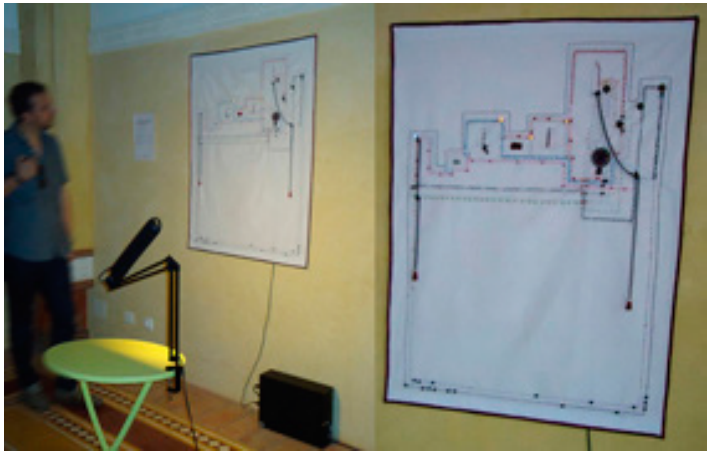
- ✓ These **artefacts**, where some are non-tangible, constitute, in fact, the resulting product from the artistic and cultural phenomenon. They are expressions of our common imaginary.

Foreword – **about the Digital Medium**

… common **communicational and informational space**, supported by art and culture artefacts

i.e, the central element here is **INFORMATION (or informative content)**

… and the artistic and cultural artefacts can be defined as **Informational Objects**

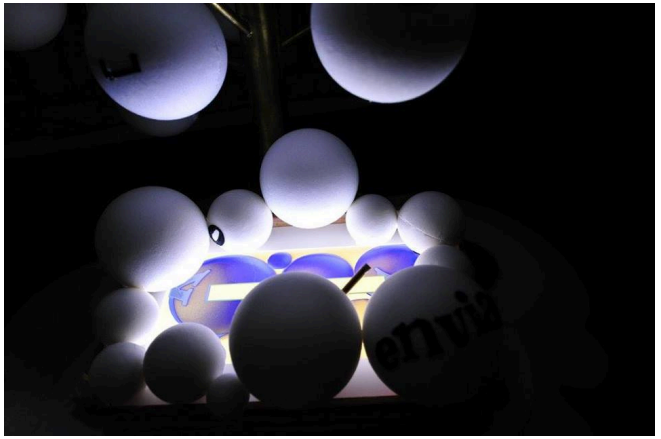


Foreword – **about the Digital Medium**

- ✓ **Art objects** might be described as symbolic objects that aim at stimulating emotions (not only).

- ✓ They reach us **through our senses** (visual, auditory, tactile, or other).

- ✓ They are displayed by **means of physical material** (stone, paper, wood, etc.) or **computer-based device** via digitally encoded information and combine some patterns to produce an aesthetic composition.



Foreword – **about the Digital Medium**

Digital art and culture object =

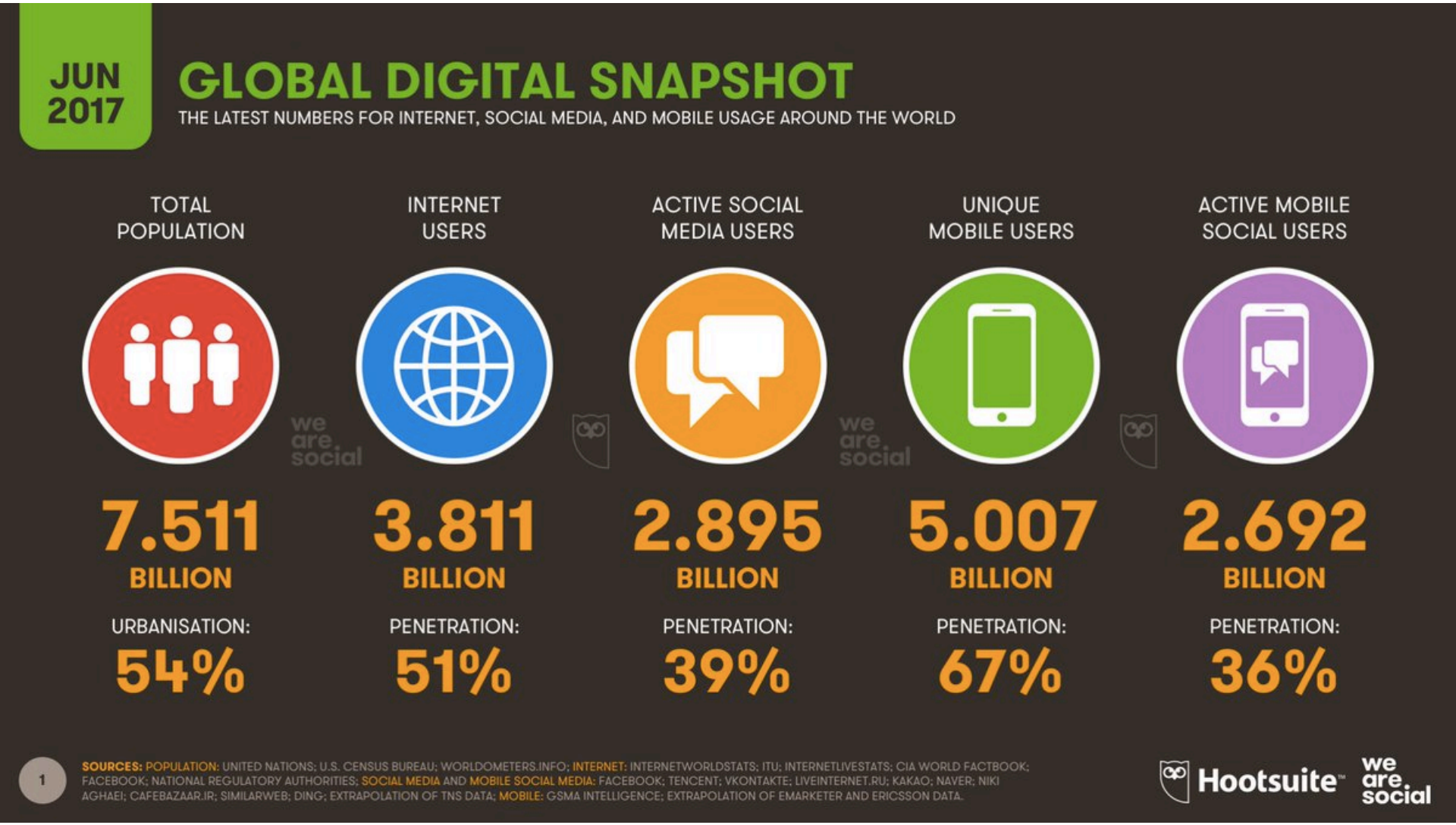
Digitally coded Information Content of a Specific Nature (visual, aural, tactile, etc.)

+

Physical/Digital Display (screen, virtual space, hall, stone,…, etc.)

Foreword – **Digital Data today – figures (www.waterfordtechnologies.com)**

- ✓ **2.7 Zetabytes** of data exist in the digital universe today (at least 1/3 are cultural objects);
- ✓ Facebook stores, accesses, and analyses **30+ Petabytes of user generated data**;
- ✓ YouTube users upload **48 hours of new video every minute** of the day;
- ✓ Data production **will be 44 times greater** in 2020 than it was in 2009.


JUN 2017
GLOBAL DIGITAL SNAPSHOT
THE LATEST NUMBERS FOR INTERNET, SOCIAL MEDIA, AND MOBILE USAGE AROUND THE WORLD
TOTAL POPULATION
INTERNET USERS
ACTIVE SOCIAL MEDIA USERS
UNIQUE MOBILE USERS
ACTIVE MOBILE SOCIAL USERS
we are social
we are social
7.511 BILLION
3.811 BILLION
2.895 BILLION
5.007 BILLION
2.692 BILLION
URBANISATION: 54%
PENETRATION: 51%
PENETRATION: 39%
PENETRATION: 67%
PENETRATION: 36%
1
SOURCES: POPULATION: UNITED NATIONS; U.S. CENSUS BUREAU; WORLDOMETERS.INFO; INTERNET: INTERNETWORLDSTATS; ITU; INTERNETLIVESTATS; CIA WORLD FACTBOOK; FACEBOOK; NATIONAL REGULATORY AUTHORITIES; SOCIAL MEDIA AND MOBILE SOCIAL MEDIA: FACEBOOK; TENCENT; VKONTAKTE; LIVEINTERNET.RU; KAKAO; NAVER; NIKI AGHAEI; CAFEBAZAAR.IR; SIMILARWEB; DING; EXTRAPOLATION OF TNS DATA; MOBILE: GSMA INTELLIGENCE; EXTRAPOLATION OF EMARKETER AND ERICSSON DATA.
Hootsuite
we are social

Foreword - **what is Digital Preservation and why is it difficult?**

- ✓ Digital information technology is **barely 60 years old**;
- ✓ Digital information (digitally coded object) **is fragile**;
- ✓ We should plan that our digital information / digital objects will **still be safe and accessible** in the next (10, 50, 100) years;
  - ✓ This involves a time span over which all of our existing hardware technology **is likely to be obsolete**, and also much of the software;
  - ✓ A **distinction** is made between **preservation** and **access**.

Foreword - **what is Digital Preservation and why is it difficult?**

- ✓ Society's growing dependence on the digital for its smooth operation implies a **real urgency for its preservation**;
- ✓ There is a need to be able to preserve **the understandability** and **usability** of the information encoded in digital objects.
  - ✓ We may preserve the object but be unable to understand it afterwards.
- ✓ **Material preservation is unimportant**, because digital copies are perfect or indistinguishable from the original;
- ✓ It is certain that the **technological means** for storage of digital information **will change over time**.

Foreword - **what is Digital Preservation and why is it difficult?**

- ✓ Long-lived media become unreadable long before they decay because the **devices** to read them **become obsolete and unmaintainable**.
  - ✓ Digital **posterity** is here the target!

- ✓ Thus, the goal is that digital information can be **preserved indefinitely**

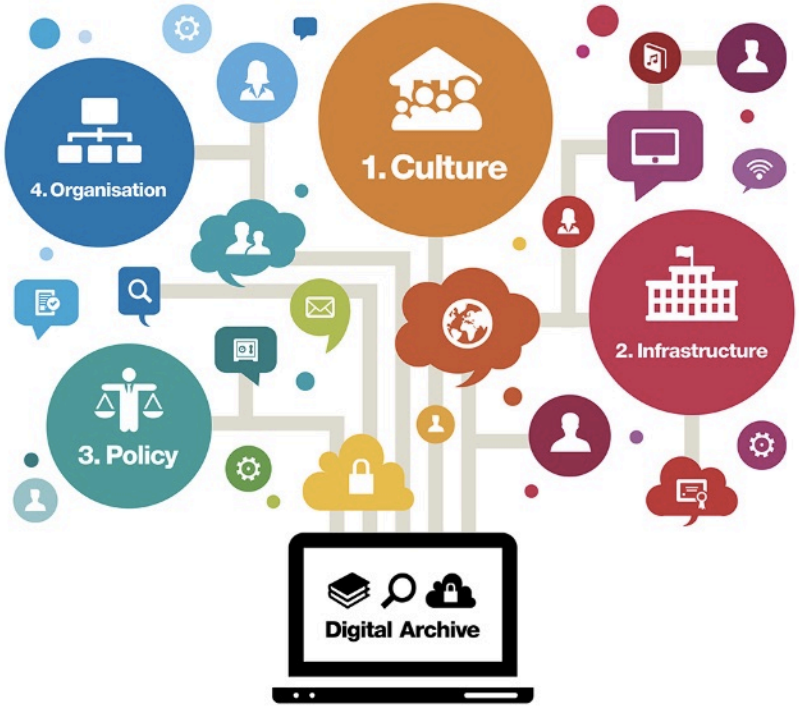
- ✓ And when the preserved object is **meaningfully accessed** along with a guarantee of its **authenticity**
  - ✓ There is the **object itself**, represented in binary format (**byte-streams**)
  - ✓ There is information describing the object and the technical media supporting it: the **metadata**

Foreword - **what is Digital Preservation and why is it difficult?**

- ✓ Main difficulties here are:
  - ✓ How to deal with **several formats** and different platforms (hw/sw)?
  - ✓ How to conceive a generic **format for the metadata** (semantic description of the object + technical description of the content and algorithm for its retrieval) ?
    - ✓ Digital data as **abstract quantity** divorced from the **storage medium** (this last will change over time)
  - ✓ How to ensure **authenticity**?
  - ✓ How to **search and find** the preserved objects in a satisfactory time?

Foreword - **what is Digital Preservation and why is it difficult?**

- ✓ The challenge is to maintain the ability to **extract the information content** of the stored byte-streams (about the object itself) even if the **data format and devices** used for its creation and representation became obsolete and disappeared over time, along with an **acceptable level of certainty** the information extracted is **authentic**.



(Digital Preservation Coalition)

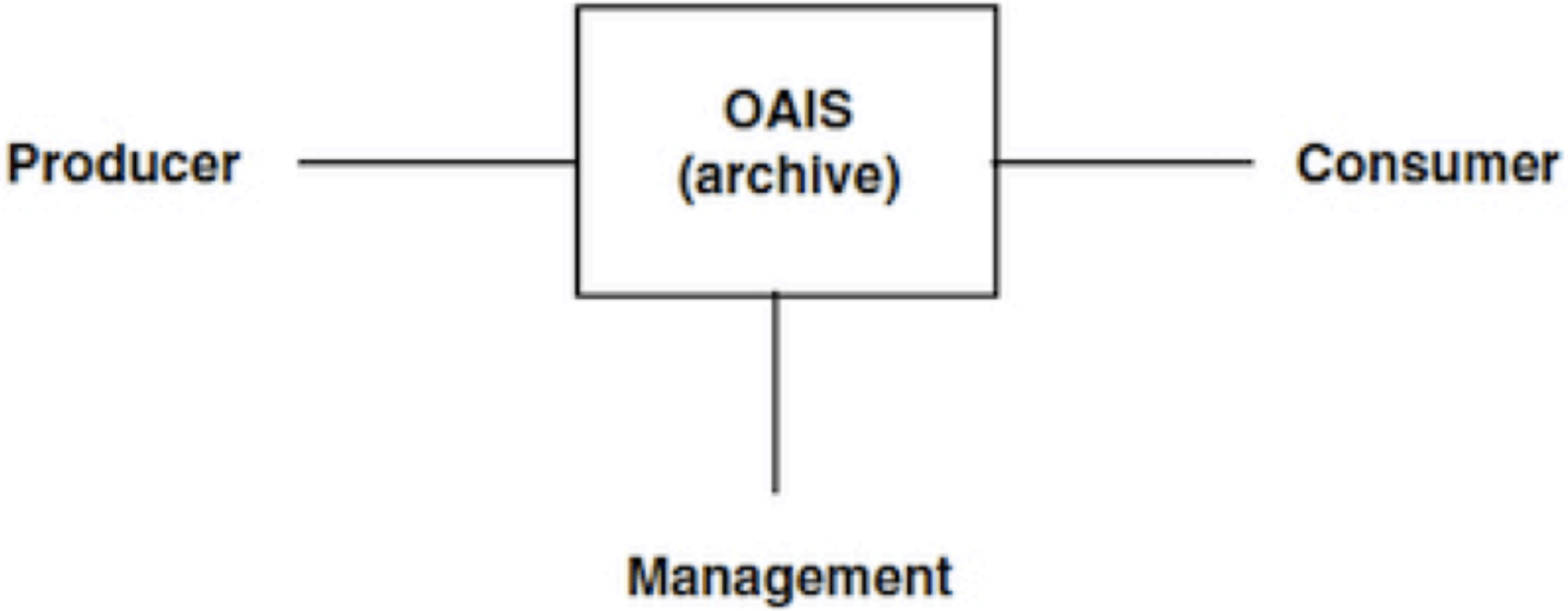
CASPAR – the OAIS Project

- ✓ **OAIS - Open Archival Information System**
  - ✓ ISO 14721 also known as "**OAIS reference model**"
  - ✓ Designed by Consultative Committee for Space Data Systems (CCSDS)
  - ✓ There are other (close) standards: CIDOC-CRM, Dublin Core, etc.

- ✓ An OAIS is understood to mean any organization or system charged with the task of **preserving information over the long term** and making it accessible to a specified class of users known as the **Designated Community**.

- ✓ **CASPAR** – Cultural, Artistic and Scientific knowledge for Pese Access and Retrieval - was the major European project targe implementation of a framework for OAIS

OAIS fundamental concepts



(CCSDS 650.0-B-1 - BLUE BOOK)

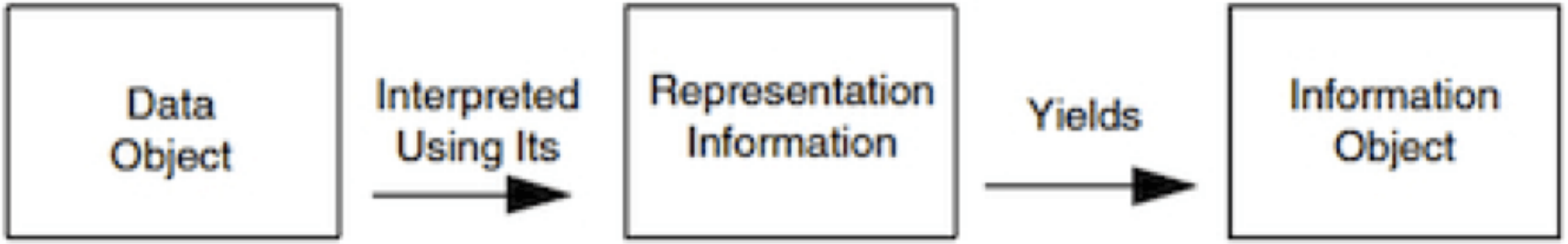
OAIS fundamental concepts

- ✓ **Producer** is the role played by those persons, or client systems, which provide the information to be preserved.

- ✓ **Management** is the role played by those who set overall OAIS policy as one component in a broader policy domain.
  - ✓ Not involved in day-to-day archive operations!

- ✓ **Consumer** is the role played by those persons, or client systems, that interact with OAIS services to find and acquire preserved information of interest (within the **Designated Community)**

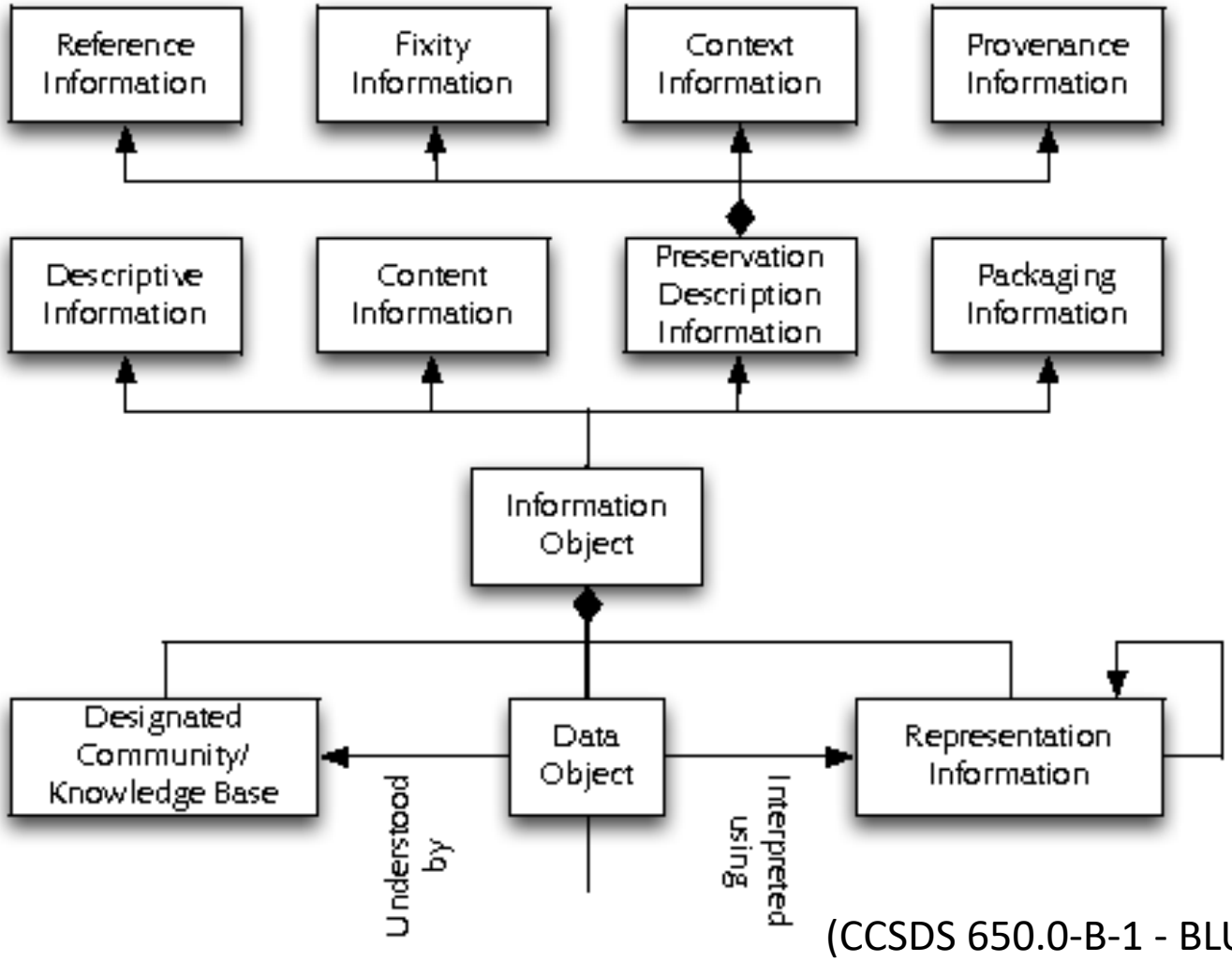
OAIS fundamental concepts



(CCSDS 650.0-B-1 - BLUE BOOK)

- ✓ **Data Object:** the bit/byte-streams.
- ✓ **Representation Information:** information needed to interpret the bit/byte-streams
- ✓ **Information Object**: the meaningful digital object

The OAIS information model



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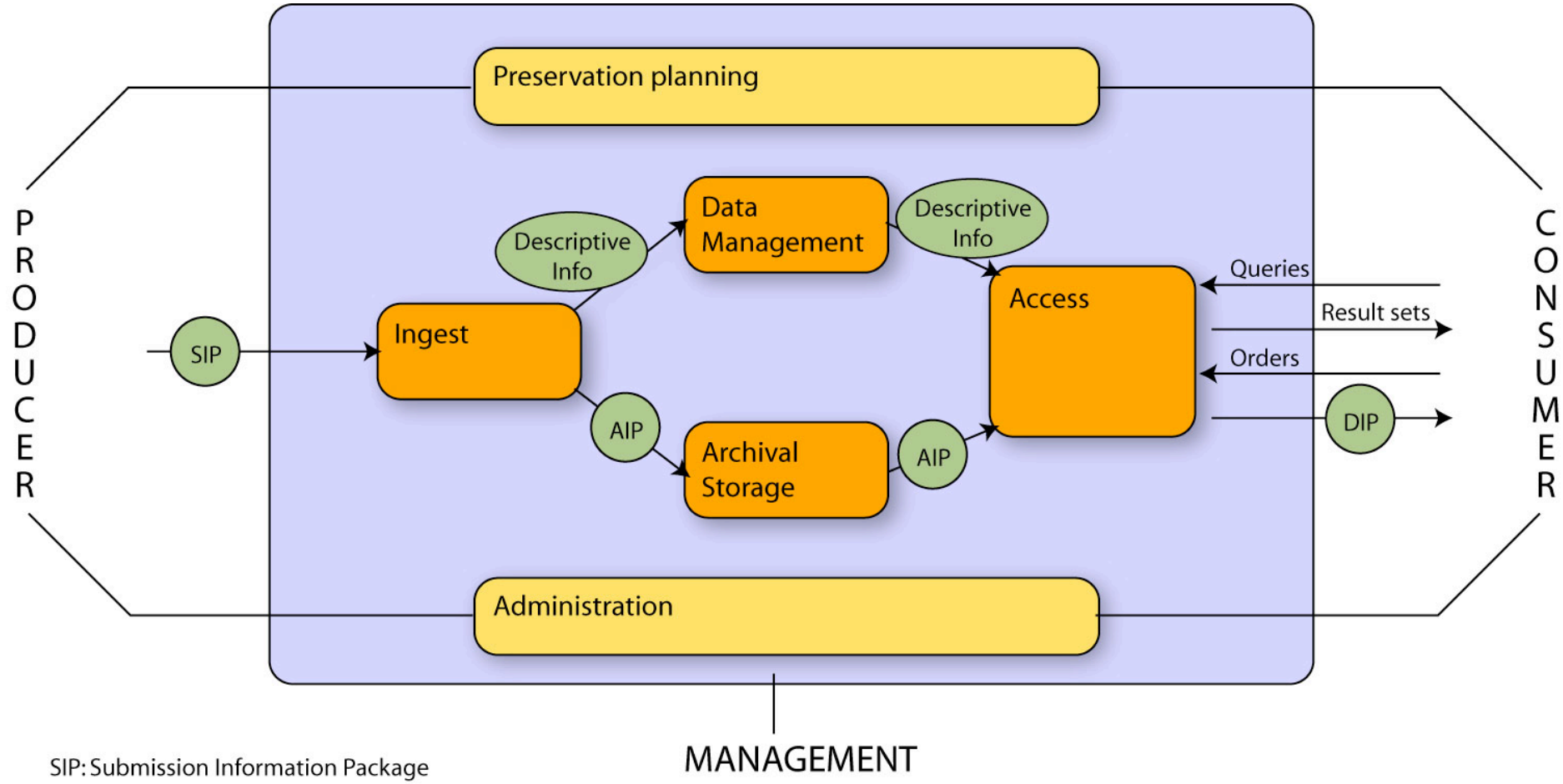
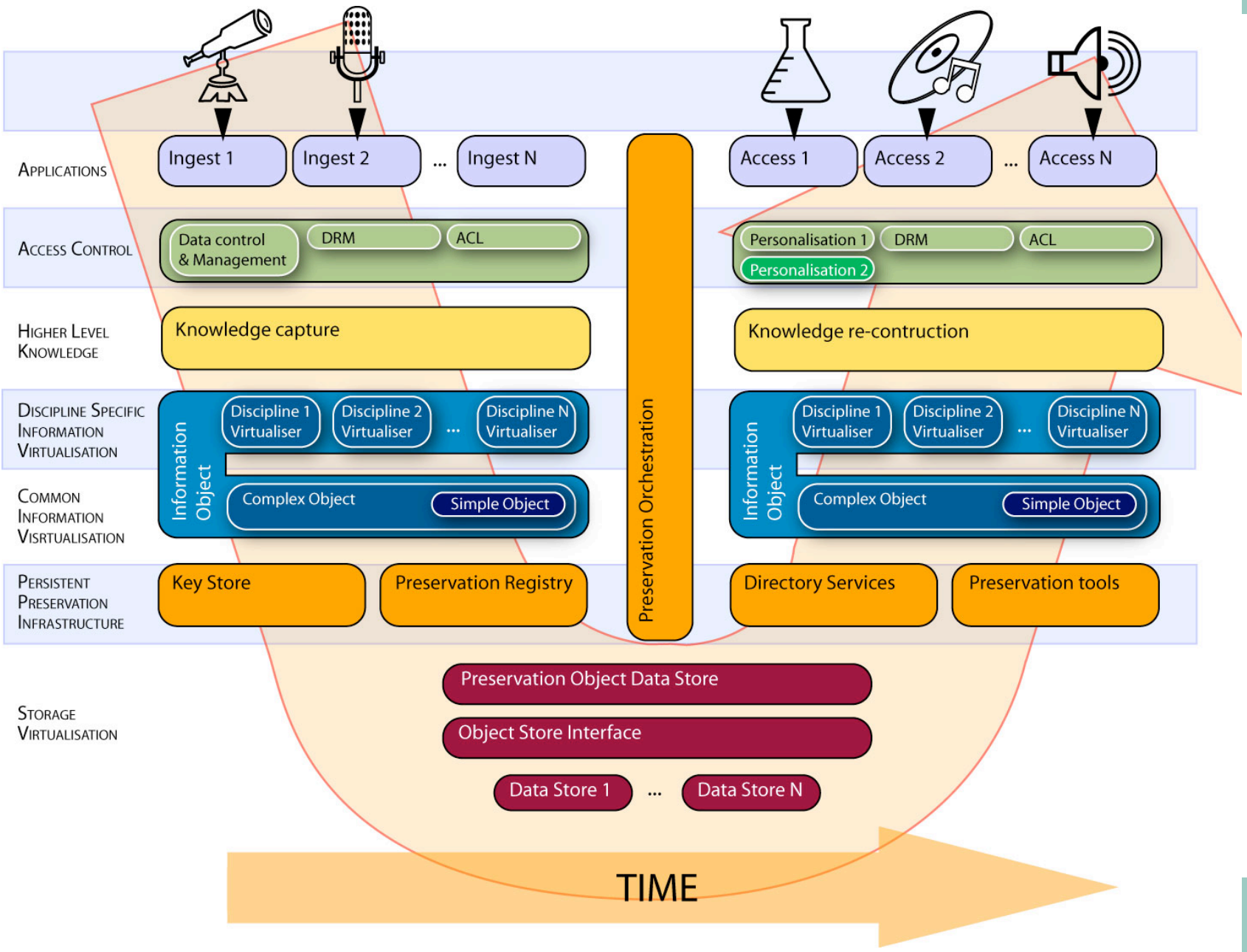
The OAIS functional model



SIP: Submission Information Package
AIP: Archival Information Package
DIP: Dissemination Information Package

Figure 1: CASPAR Workflow



CASPAR – the OAIS Project

- ✓ **Storage Virtualisation** layer: which consists of the **Preservation Object Datastore** blocks; this is the foundation block for storing objects (both metadata objects and content data objects) in a persistent manner.
- ✓ **Persistent Preservation Infrastructure**; this layer contains all the necessary ancillary blocks (such as registries and directories) that are required in order to obtain the Representation Information of a given Information Object.
- ✓ **Information Virtualisation** layer is responsible for creating (during Ingest) and using (during Access) a unified, standardised view of the Information Object to the application layer; the ability to present a unified Information Object (whether simple or complex) builds upon the layers below it.

CASPAR – the OAIS Project

- ✓ There is the layer dealing with the creation (during Ingest) and the usage (during Access) of the **Knowledge** required for understanding and using the object.

- ✓ Data **Access and Control** layer undertakes the operations for collecting the data to be preserved upon Ingestion.

- ✓ Upon Access there may be **Personalisation**, aimed at capturing specific user preferences and using them to provide a different experience for each different class of users.

- ✓ **Preservation Orchestration** that provides a set of tools and software needed to control the lifecycle of data in this architecture.

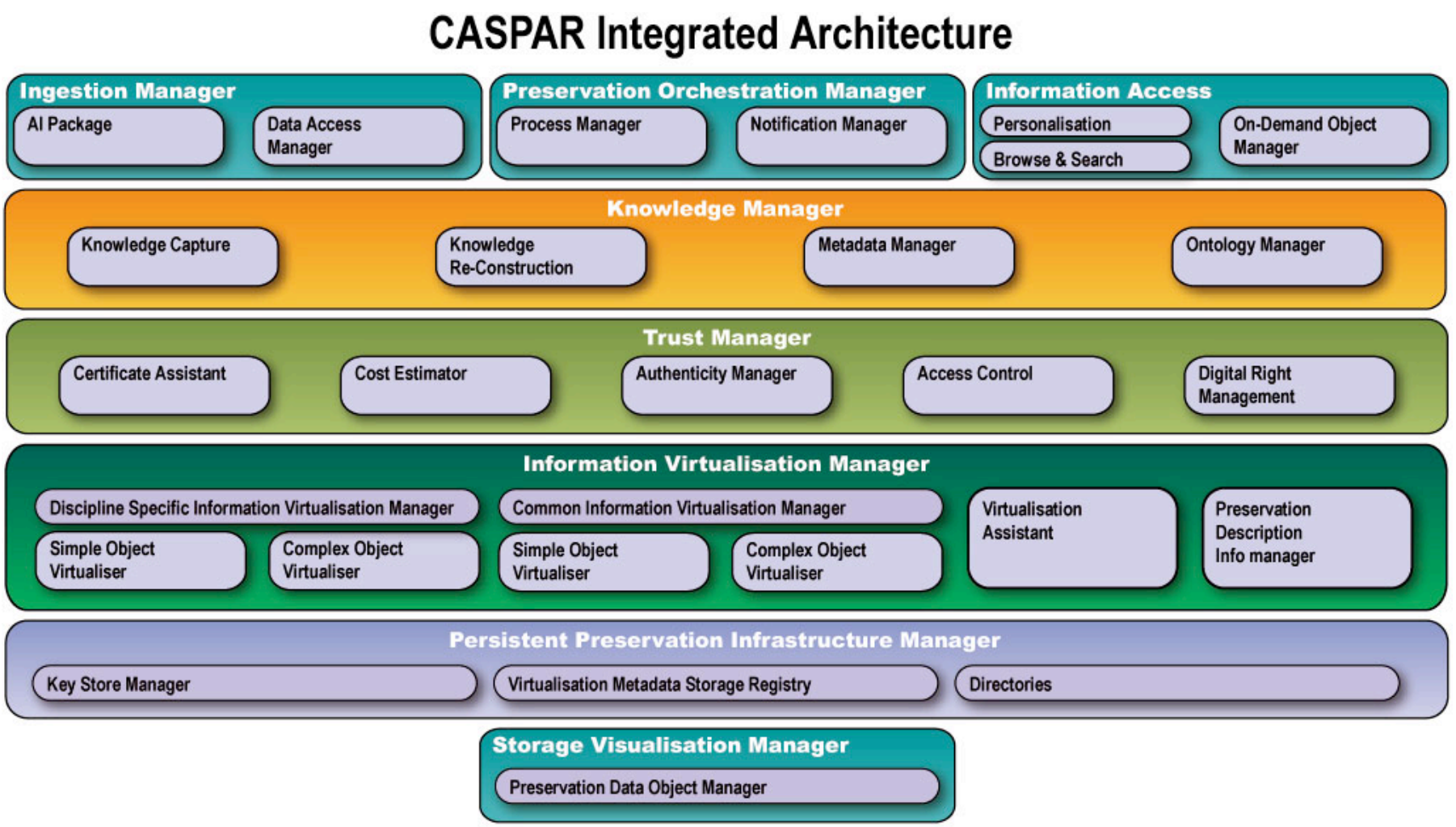


Figure 1: CASPAR Integrated Architecture

CASPAR – the interactive multimedia performances preservation

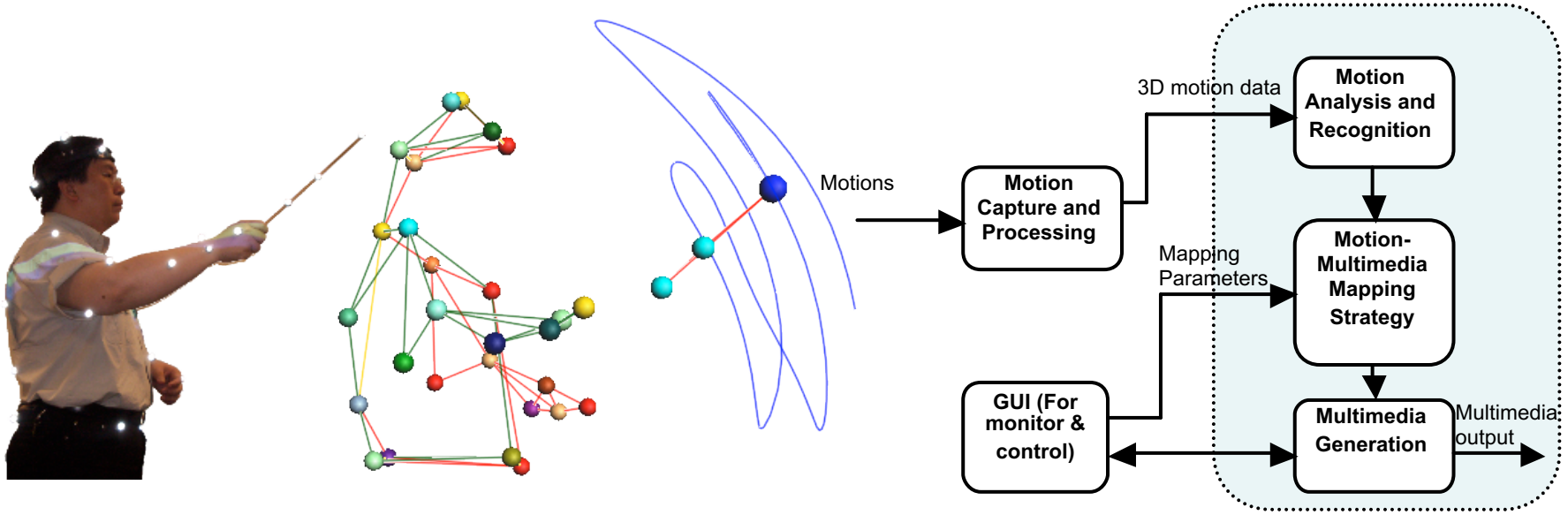


Figure 2: Preservation of interactive multimedia performances

CASPAR – the interactive multimedia performances preservation

- ✓ **If only the output multimedia content** and the performance itself are interested, the preservation will includes preserving **still images**, **audio** and **video images** captured during the performance.

- ✓ For analysis purpose, **3D motion captured** during the performance also needs to be preserved.

- ✓ For **reproduction purpose** (with or without performers' involvement), the preservation will cover the **whole creation process**.
  - ✓ This involves preserving **exact performers' creative gestures/motions** (via captured motion data), mapping parameters and the software components that generate the music.

CASPAR – authenticity issues

"Maintaining the authenticity (**trustworthiness**) and **provenance** (history of creation, ownership, accesses and changes) of the preserved objects for the long term is of great importance, since users must be confident **that the objects** in the changed environment are **authentic**" (Factor et al 2009)

CASPAR:

- Authenticity Management tools to ensure authenticity by identifying, managing and preserving information aimed to describe and possibly evaluate its identity and integrity.
  - ✓ Create Identity Information
  - ✓ Create Integrity Information
  - ✓ Create Protocol and Procedure Information

CASPAR – conclusions

- A **robust framework** and **architecture** for digital preservation has been implemented and tested for several use scenarios
  - Cultural, Artistic and Scientific specific data components
  - OAIS standard recommendations have been applied

- The system developed has been adapted for **several end-user institutions** requiring digital preservation
- It is compliant with **any type of formats**, including ones applied in Cultural Heritage Preservation (ex. 3D capture, CIDOC-CRM)
- It has **paved the way** for further development in the field.

Reference site: Digital Curation Centre (http://www.dcc.ac.uk/about-us)

Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

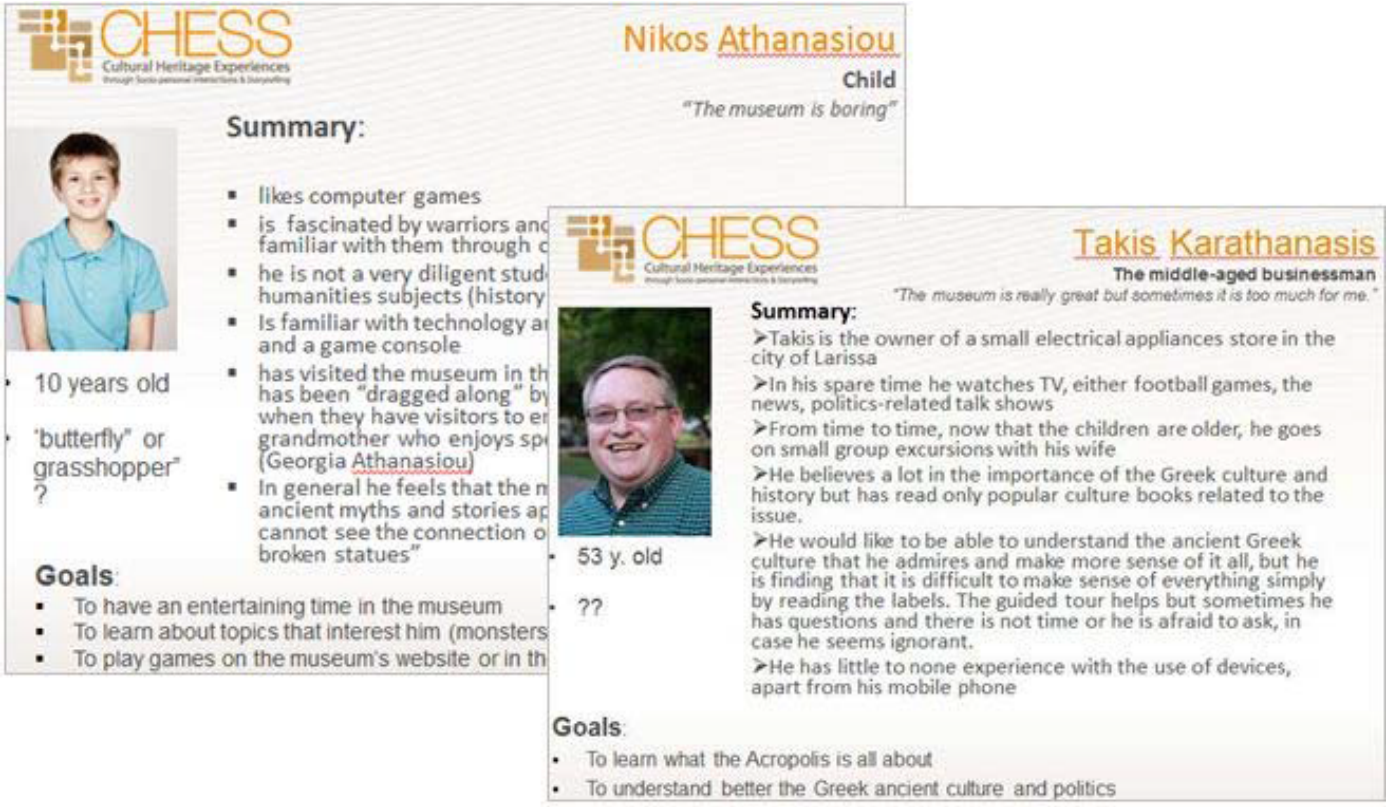
- ✓ Cultural heritage institutions nowadays face the important challenge of making their collections **more engaging to visitors**, especially the young 'digital natives', while exploiting, new forms of cultural interactive experiences.

- ✓ To create **narrative-driven cultural "adventures"** through hybrid structures, which adapt continuously to their visitors, extend over space and time, and involve multiple users with different interfaces

- ✓ To integrate interdisciplinary research in personalization and **adaptivity**, **digital storytelling**, **interaction methodologies**, and **narrative-oriented mobile** and **mixed reality** technologies.

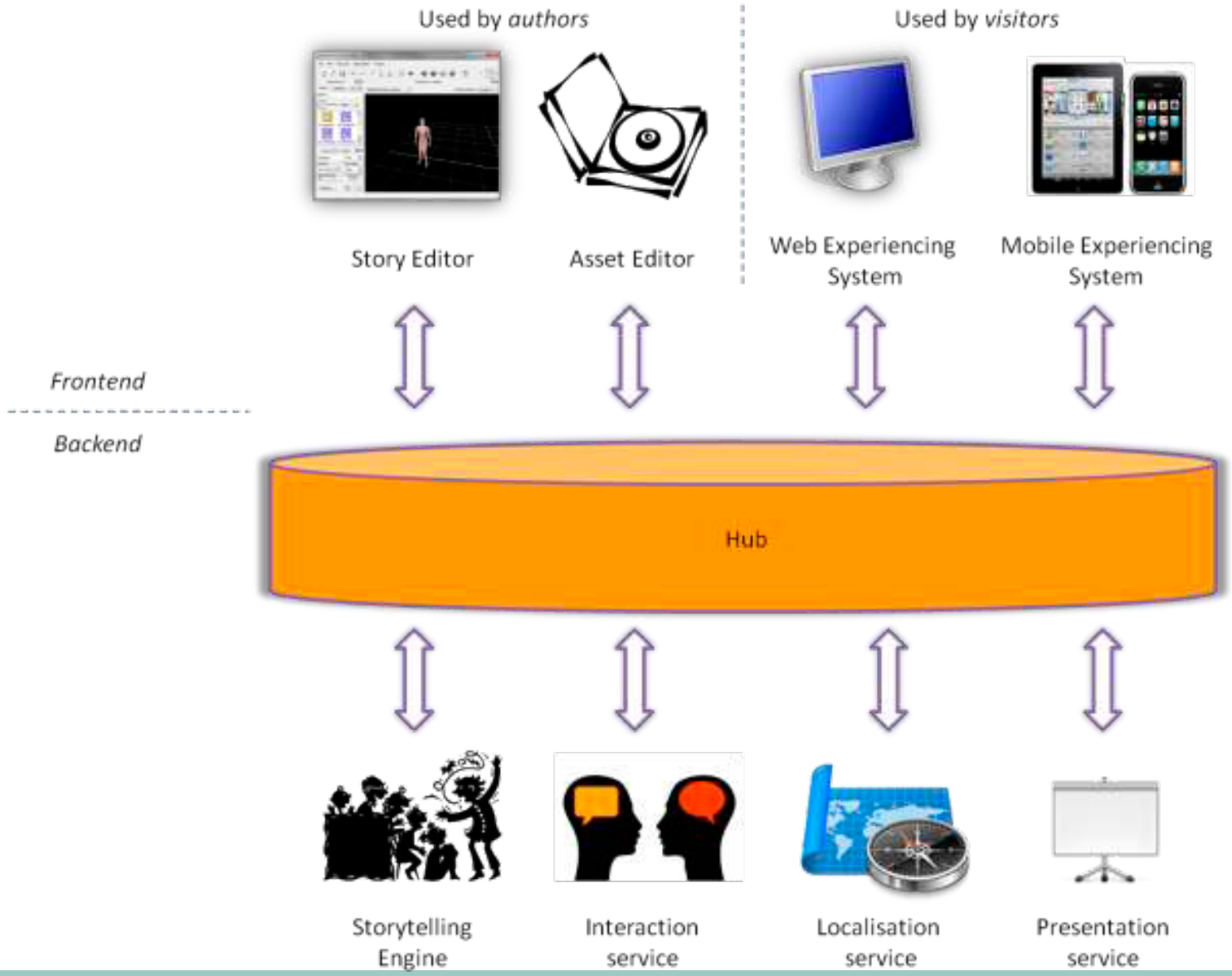
Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

- ✓ Explored the concept of **persona** to establish **profile-driven** interactive experience to visitors of cultural spaces



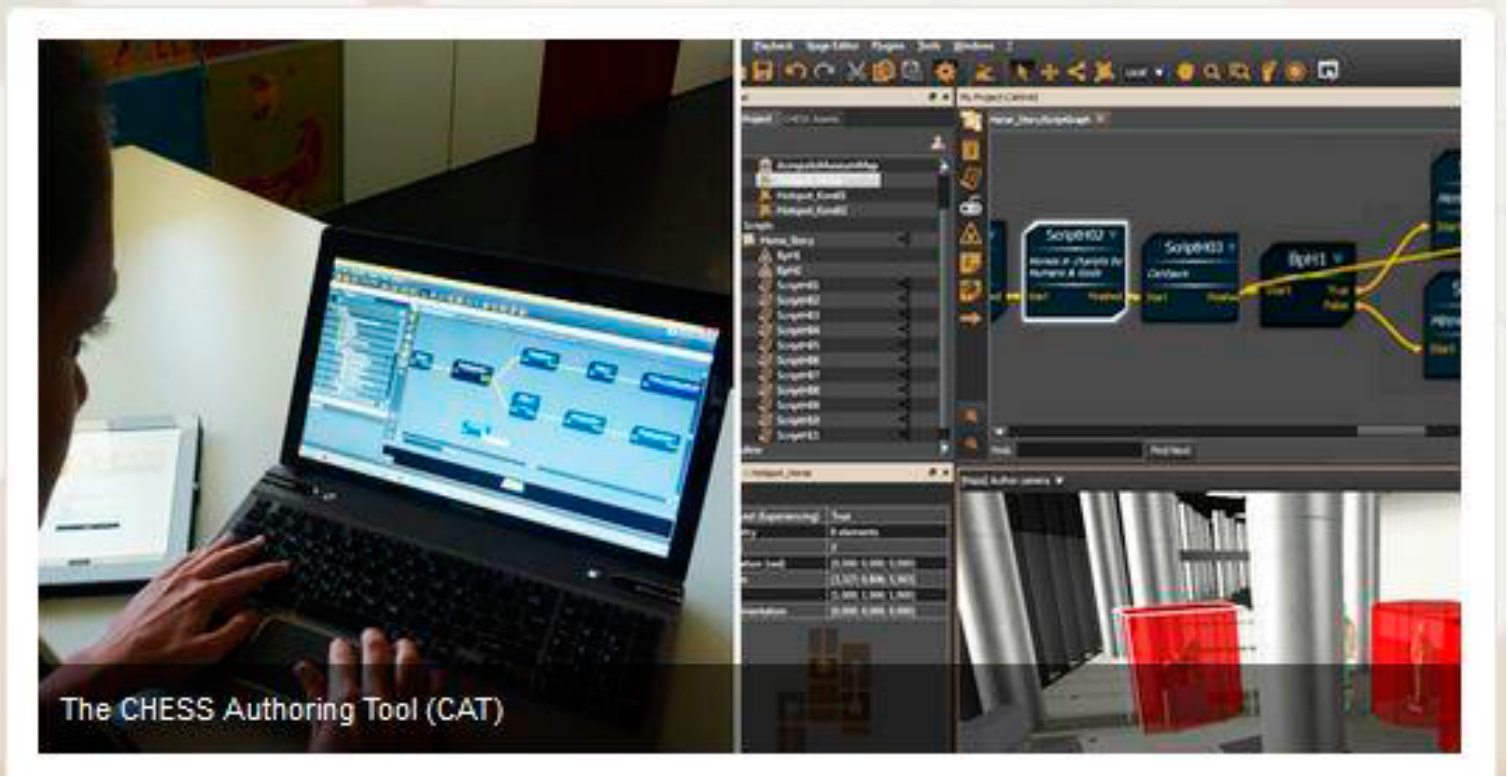
Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

- ✓ End-user scenarios: **Acropolis Museum** (left) and the **Cité de l'espace** (right)


Used by *authors*
Used by *visitors*
Story Editor
Asset Editor
Web Experiencing System
Mobile Experiencing System
Frontend
Backend
Hub
Storytelling Engine
Interaction service
Localisation service
Presentation service

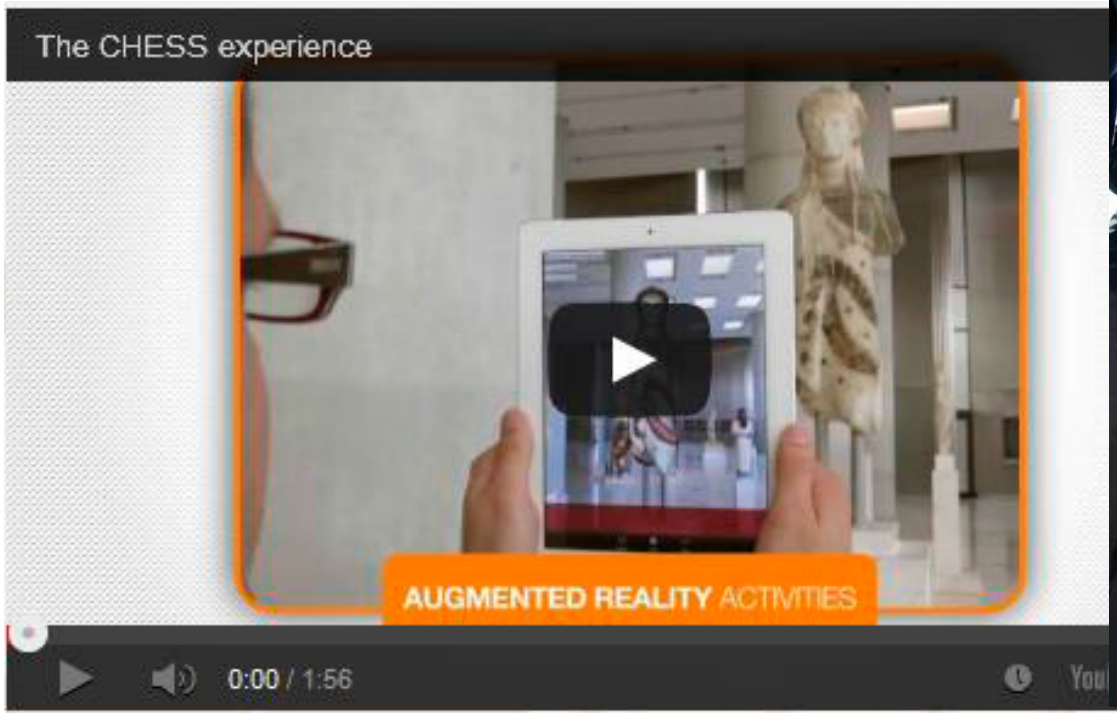
Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

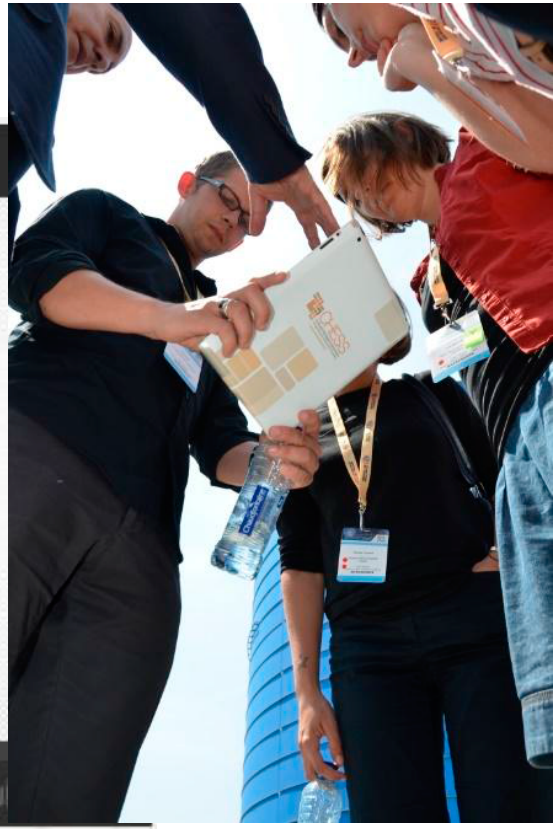
- ✓ Museum curators and managers to **become authors** of stories supporting each visiting experience



Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

- ✓ End-user devices: **tablet**, **mobile phones** and **PC** (at home)
- ✓ A **narrator** helps out during the visit





Cultural Heritage Experiences through Socio-personal interactions and Storytelling – CHESS project

- ✓ Focus on **engaging visitors** through persona-specific narrative-driven stories delivered to the end-users' devices;
- ✓ **Curators, cultural managers** at the museum **became authors** or authors' supervisors of digital stories to enrich and support each visit
- ✓ Nowadays **mobile devices** have been explored, including **augmented reality** ones
- ✓ **Trials** demonstrated fully involvement of all stokeholds within the museums
- ✓ Web site: http://www.chessexperience.eu

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Culturally Enhanced Augmented Realities – CultAR project

- ✓ CultAR to advance the **mobile 3D**, **augmented reality** and **tactile technologies**, combining them into a new mobile experience interface to achieve **personalised** and **engaging digital cultural experiences**.

- ✓ **Adaptability** and **context awareness** enhanced through **dynamic 3D models** of urban environments, including dynamic content such as the presence of **other users** (real and virtual)

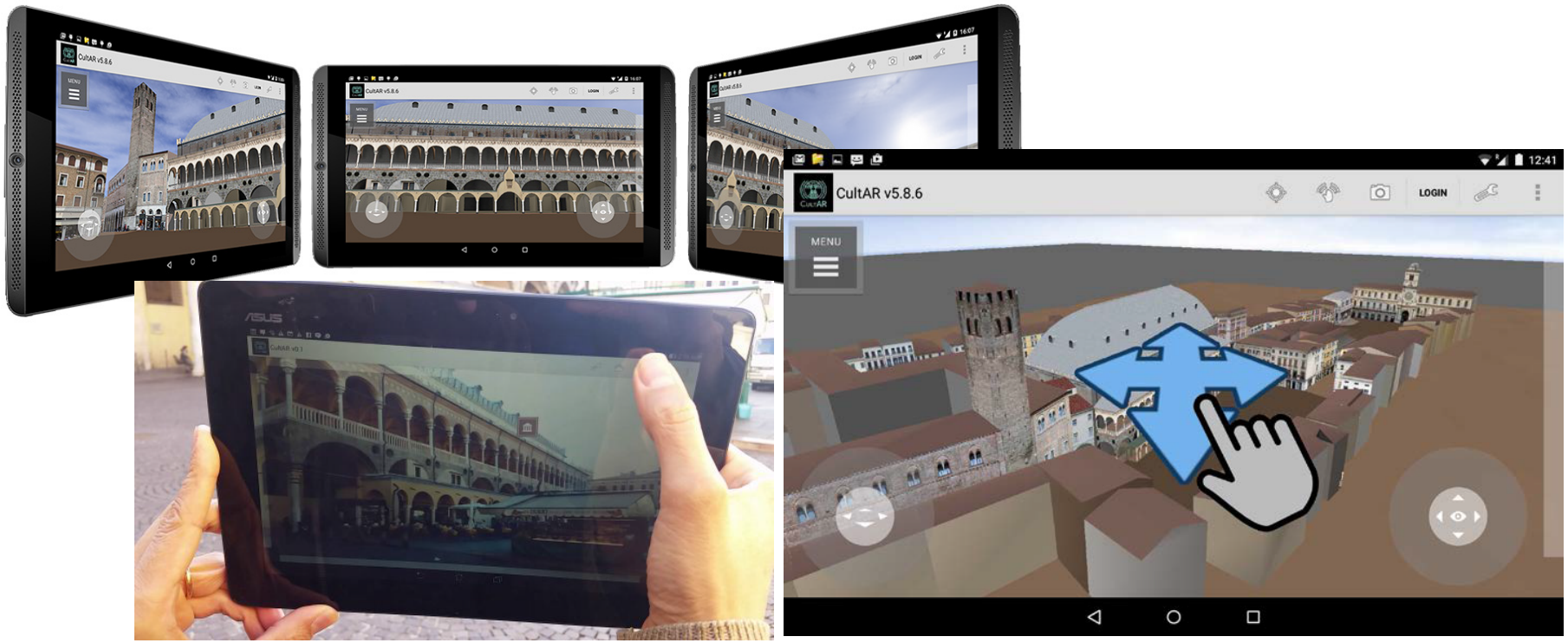
- ✓ **Explore** the concept of user created **Culture Ghosts**, applying various emphasis methods that draw the attention of the user to potentially **interesting cultural content**.

Culturally Enhanced Augmented Realities – CultAR project

- ✓ Front-end devices: **tablet**, **oculus rift**, **tactile vest**; **binaural headset**; **tactile glove**

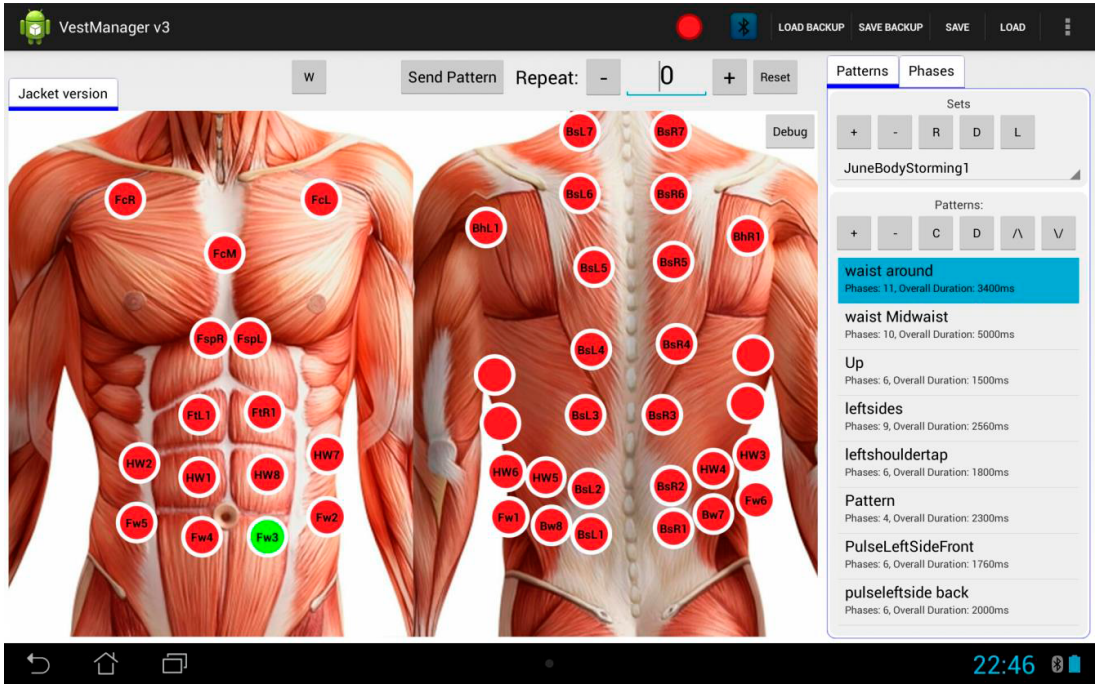
Culturally Enhanced Augmented Realities – CultAR project

- ✓ Personalised 3D Interaction and Social Engagement
  - ✓ **Egocentric** Interaction (I am the center)
  - ✓ **Exocentric** Interaction (I can see from outside my position)



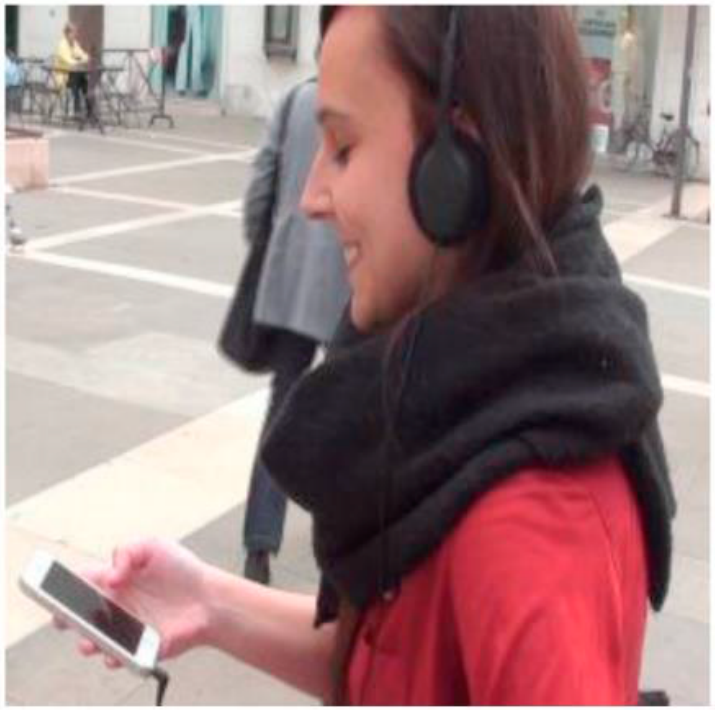
Culturally Enhanced Augmented Realities – CultAR project

- ✓ **Tactile vest** based on a tactile code/language to guide the visitor
  - ✓ 28 actuator stimulate patterns looking for the “feel good” sensations



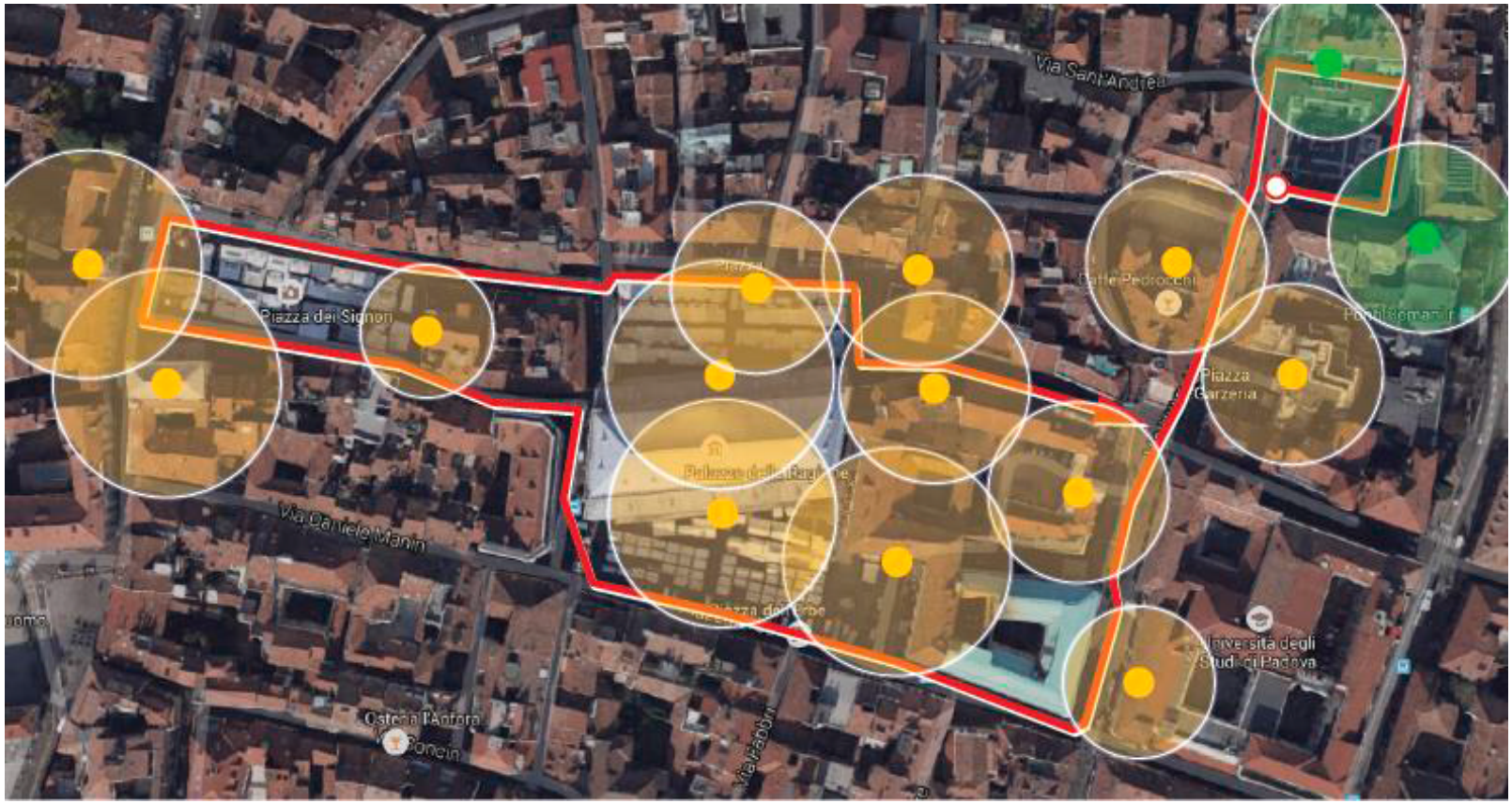
Culturally Enhanced Augmented Realities – CultAR project

- ✓ Tactile glove
  - ✓ 8 actuators, 9-axis motion tracking sensor, is composed of a gyroscope, an accelerometer, and a compass



Culturally Enhanced Augmented Realities – CultAR project

- ✓ Point of Interests as helping cues for the visit

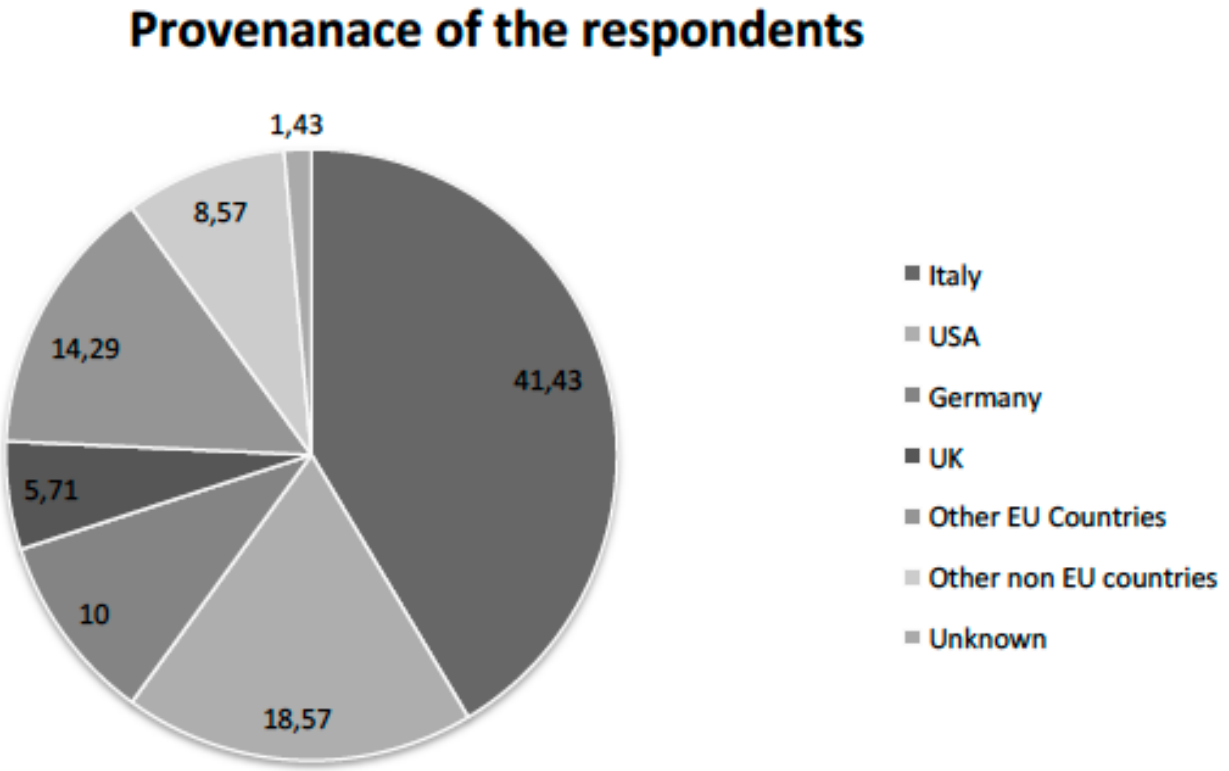


Culturally Enhanced Augmented Realities – CultAR project

- ✓ Ghosts: provide a means to **propagate cultural experiences** from one person to other users. They are formed from **recorded trips** that have been curated and shared further.

Culturally Enhanced Augmented Realities – CultAR project

- ✓ Trial in Padua and Bologna: “vibrotactile vest as an affective cue”
  - ✓ 70 people (40 women); Mean age of the sample was 44.34



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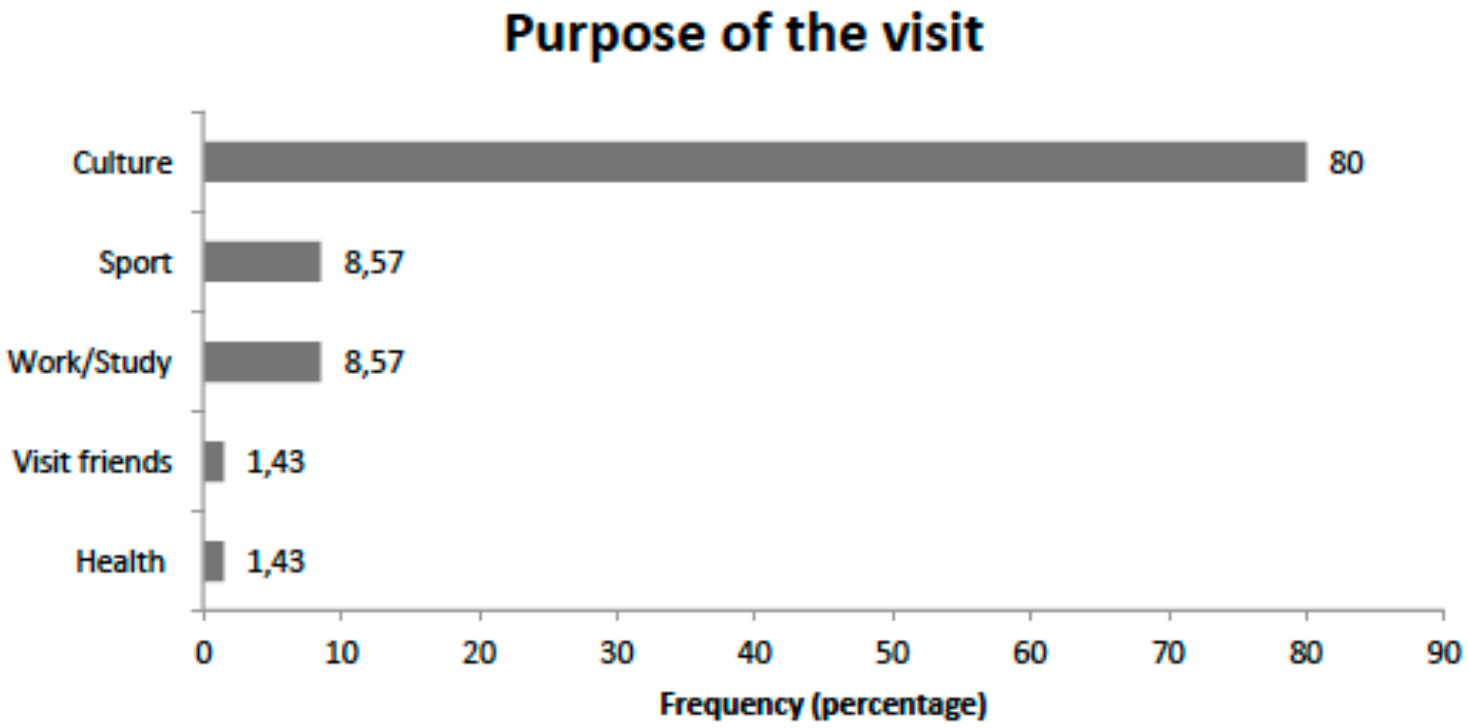

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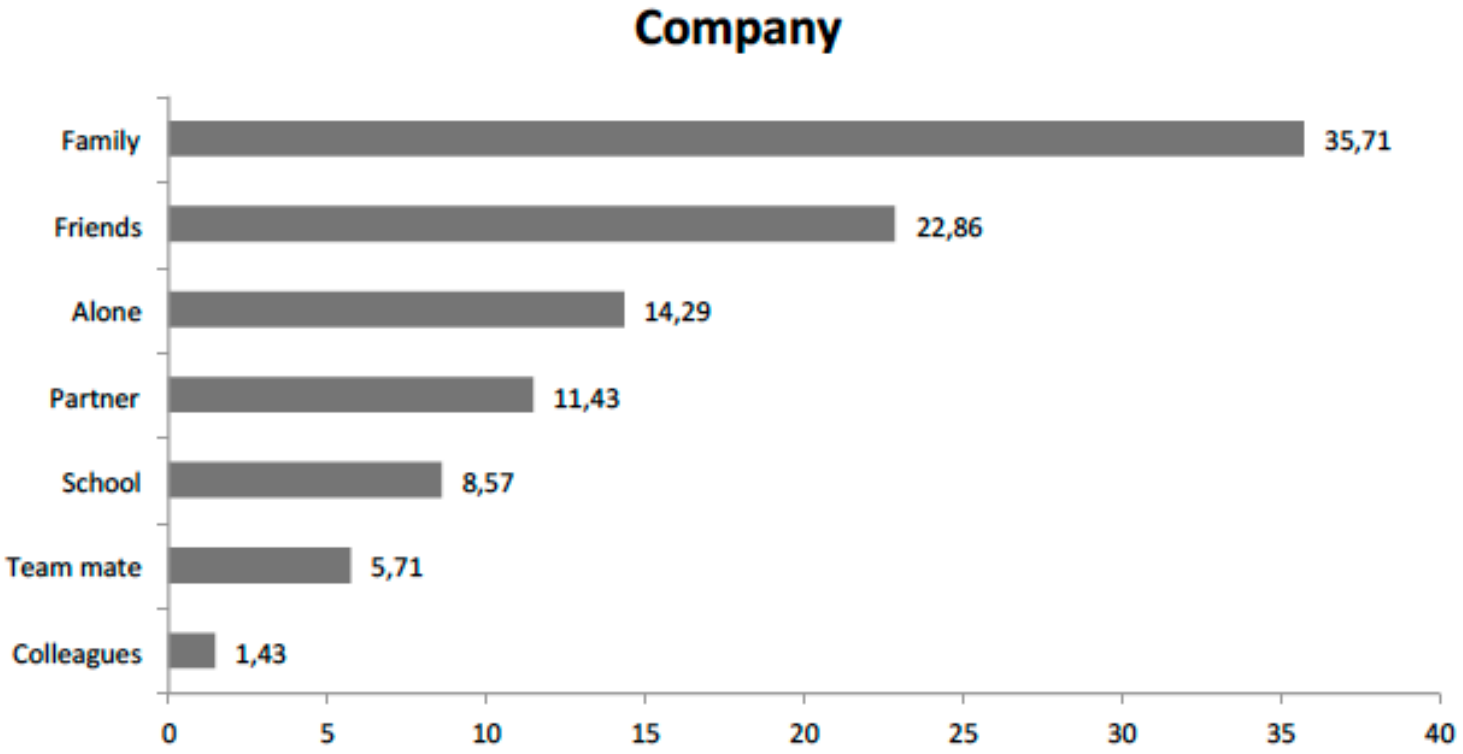


Category	Affective Connotation			In the field	Examples
	Positive	Negative	Ambivalent		
Start	88%	12%	-	✔	*"Getting the atmosphere"*
POI reached	92.9%	7.1%	-	✔	*"The most touching moments are when you are in front of the pieces you planned to see"*
I got lost	43.9%	34.1%	22%	✔	*"It's part of the fun" "I get anxious "*
In line	11.7%	41.2%	47.1%	✔	*"It's part of the game"*
Too crowded	-	88.9%	11.1%	✔	*"people that not have manners...the crowd"*
Meals	81.8%	9.1%	9.1%	✔	*"I like trying something typical"*
Accessing the city	9.3%	91.7%	-	✔	*"It stressful because indications were missing"*
Night hours	-	100%	-	✔	*"When you're tired or hungry"*
Unexpected	78.9%	21.1%	-	✔	*"It is beautiful when you see something unexpected"*

Culturally Enhanced Augmented Realities – CultAR project

- ✓ Focus on **trying and advancing technology** in enhanced augmented realities;
- ✓ **New interaction** devices have been developed by exploring other senses such are tactile or sound 3D
- ✓ New content approaches have been created such are Ghosts, tactile proto-language, etc.
- ✓ **Trials** in Padua/Bologna (Italy), Utzon park (Denmark) demonstrated the huge potential of the new developments.

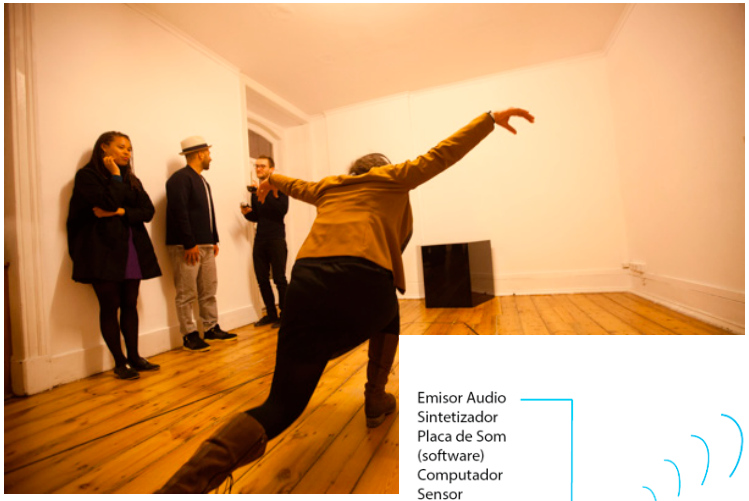
Conclusions

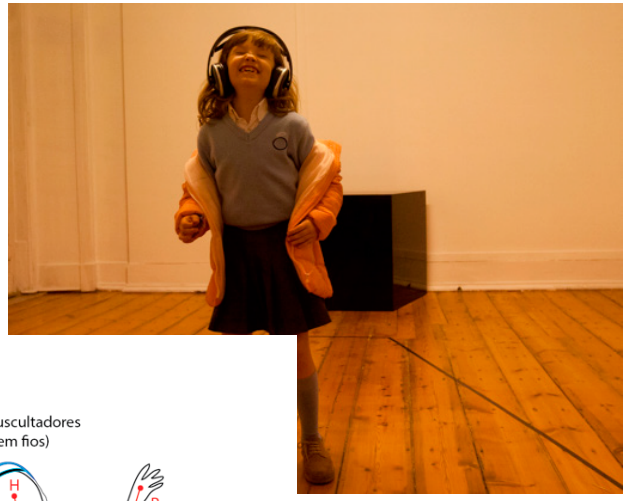
- ✓ **Preservation standards** and their concrete implementation is granted – robust approaches are implemented and being improved

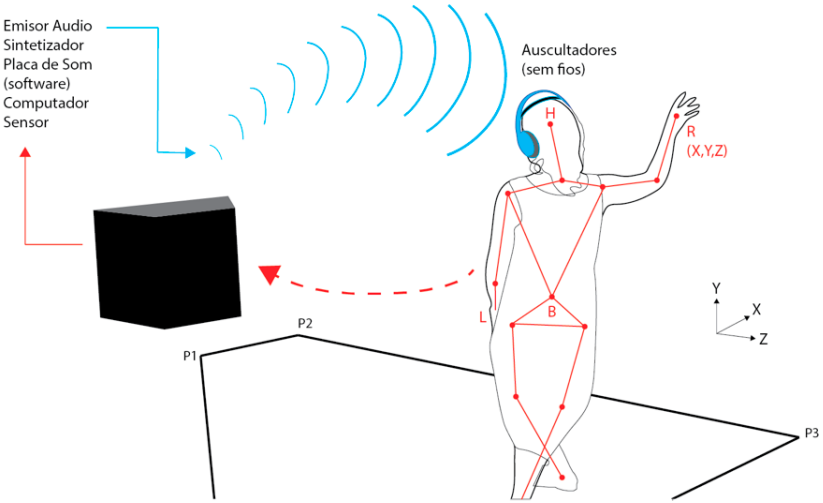
- ✓ **Cultural Heritage technologies** are enhancing multisensorial experiences where tactile or 3D sound are being embraced;
  - ✓ 3D tracking devices are becoming common place (ex. XSens, Perception Neuron with up to 32 sensors – under 1k USD)

- ✓ **Digital art and culture objects (artefacts)** are being created from cross-platform / cross-media devices, systems, environments, adopting multidisciplinary approaches

Recent Artefact example: *"**Présence Sculpture**"* (Rudolfo Quintas)







Preserved:

- audio-visual
- 3D tracking
- Performer info

https://youtu.be/PMaUHHCq66U

Some references

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- ✓ (Factor et al 2009) Michael Factor, Ealan Henis, Dalit Naor, Simona Rabinovici-Cohen, Petra Reshef, Shahar Ronen, Giovanni Michetti, and Maria Guercio. 2009. Authenticity and provenance in long term digital preservation: modeling and implementation in preservation aware storage. In *First workshop on on Theory and practice of provenance* (TAPP'09). USENIX Association, Berkeley, CA, USA, , Article 6 , 10 pages.

- ✓ (Antoniou et al 2016) Antoniou, A., Katifori, A., Roussou, M., Vayanou, M., Karvounis, M., Kyriakidi, M., & Pujol-Tost, L. (2016). Capturing the Visitor Profile for a Personalized Mobile Museum Experience: an Indirect Approach. In *Proceedings of the 24th ACM Conference on User Modeling, Adaptation and Personalisation (UMAP 2016), Workshop on Human Aspects in Adaptive and Personalized Interactive Environments (HAAPIE)*.

- ✓ (Langlotz et al 2013) Tobias Langlotz, Holger Regenbrecht, Stefanie Zollmann, and Dieter Schmalstieg. 2013. Audio stickies: visually-guided spatial audio annotations on a mobile augmented reality platform. In *Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration* (OzCHI '13), Haifeng Shen, Ross Smith, Jeni Paay, Paul Calder, and Theodor Wyeld (Eds.). ACM, New York, NY, USA, 545-554. DOI: http://dx.doi.org/10.1145/2541016.2541022

Thank you