DIGITIZING BOROBUDUR
A Perspective on Sociotechnological Co-Production

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A Collaboration project of the Indonesian Institute of Sciences, Ritsumeikan University, and Borobudur Conservation Office
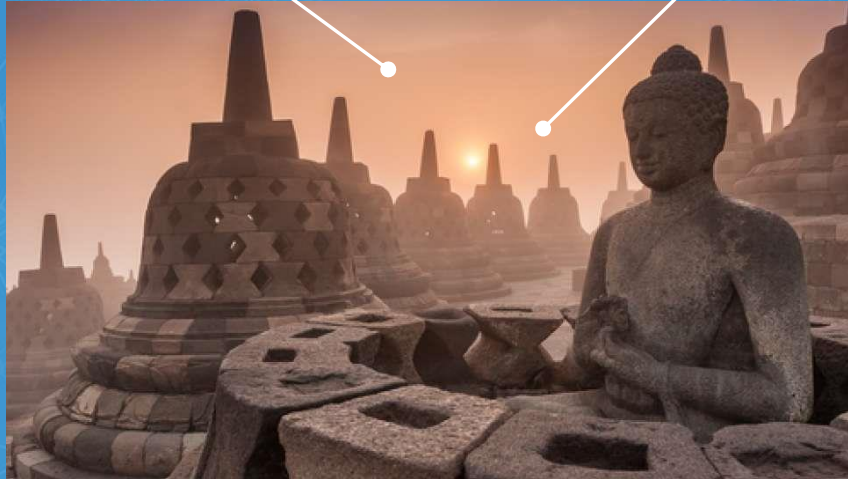
Borobudur as a Global Sociotechnical Imaginary

World Heritage Site (1991)

Memory of the World (2017)

Archive of Borobodur reconstruction and restoration since the Dutch Colonial time

Sociotechnical Imaginary and Co-Production – Two Related STS Concepts

Sociotechnical Imaginary:

…. *collectively held*, *institutionally stabilized*, and *publicly performed* visions of **desirable futures**, animated by shared understandings of forms of social life and social order attainable through, and supportive of, **advances in science and technology** (Jasanoff, 2015: 4)

Co-Production:

… is shorthand for the proposition that the ways in which *we know and represent the world* (both nature/technology and society) are **inseparable** from the ways in which *we choose to live* in it (Jasanoff, 2015: 3)

HERITAGE
TECHNOLOGY

How we represent heritage materials through technology emerges from how we stabilize value and assess our experience of the materials

The desired future of the nation (sociotechnical imaginary) is envisioned and attainable through advances in heritage technology

VISUALIZATION

DATABASE

Sociotechnical Imaginaries and Co-Production: STS Perspective (adapted from Jasanoff)

Hardware

Infrastructures
Machines

Agency

Actors
Institutions

Technological

Material domain

Socio-technical Imaginaries

Social

Practical domain.

Software

Algorithm
Coding
Design

Norm

Legal
Religius
Political
Cultural
Gender
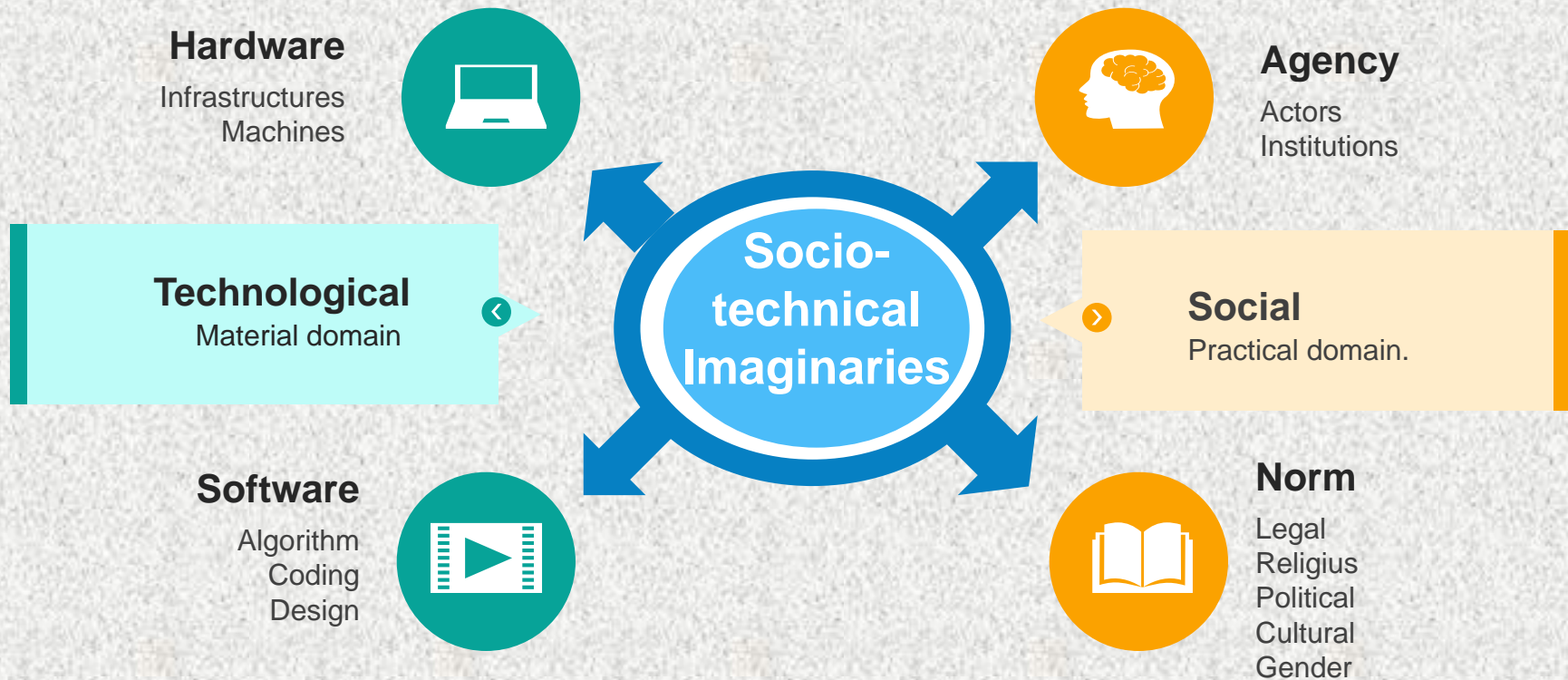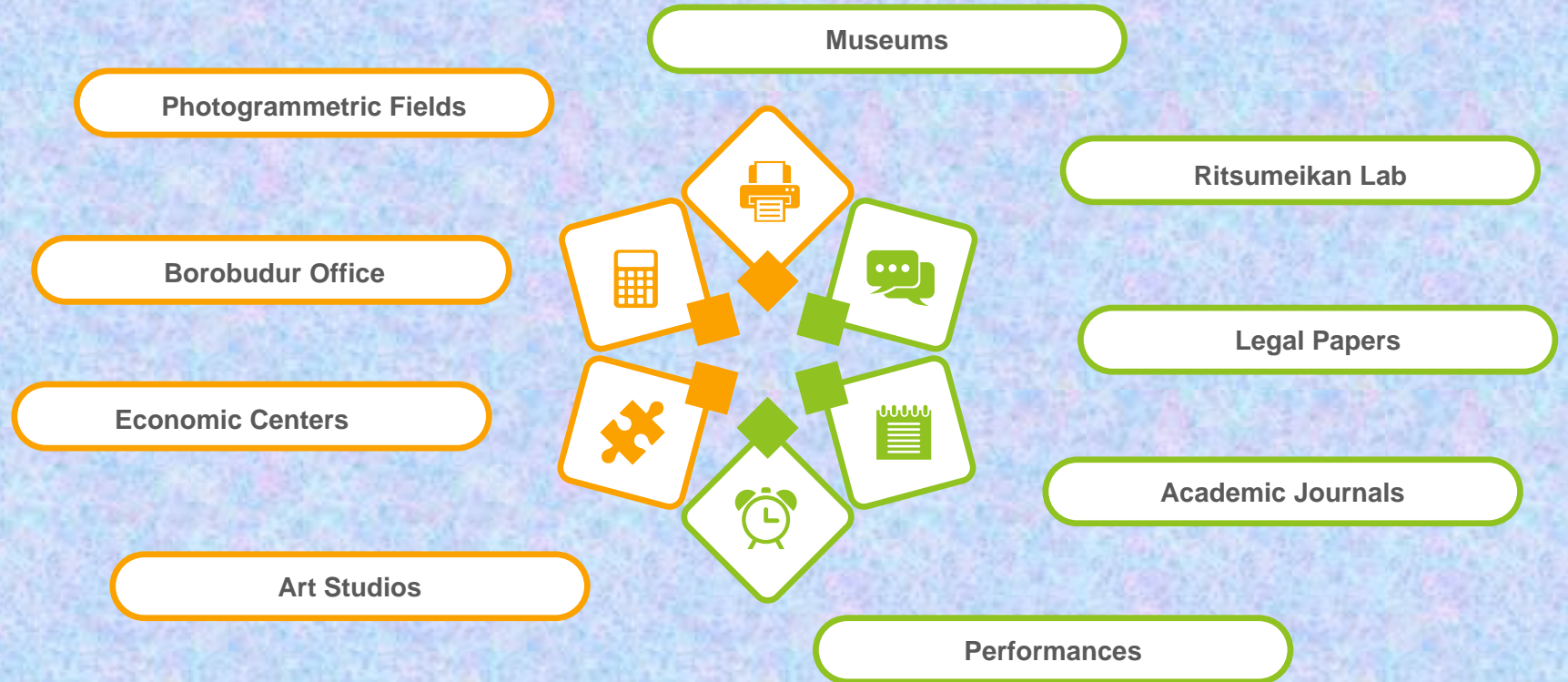
Practical Sites of Co-Production
(Borobudur Project and Other Projects)
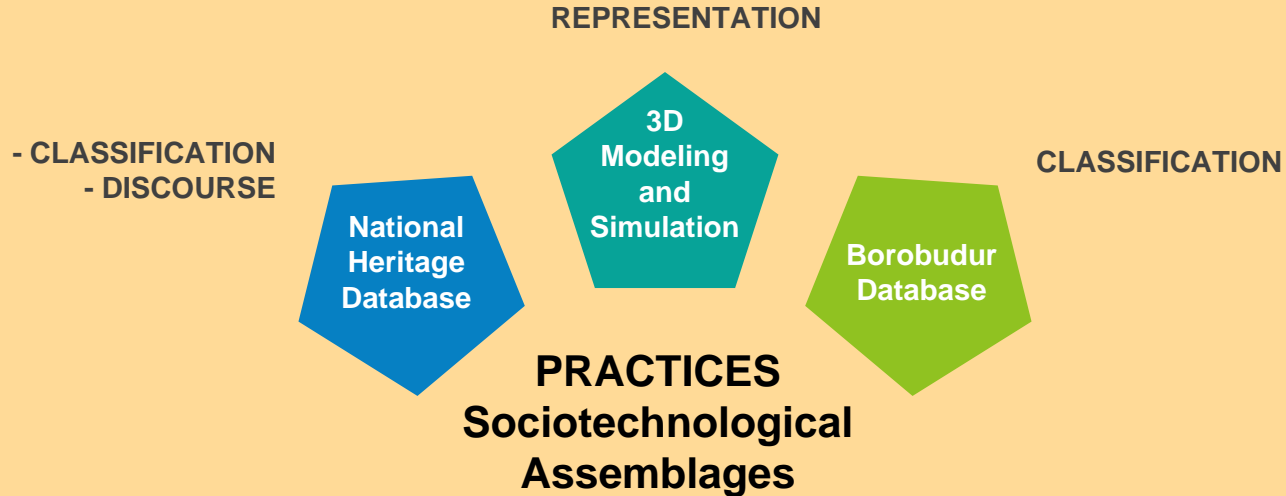
VISUALIZATION

CO-PRODUCTION AND ASSEMBLAGE OF VISUALIZATION

Photogrammetry; Laser scanning; Photo scanning

Data recording

Softwares (Photoscan, Metashape, etc.)

Platform

3D Model and Simulation

Development policy

Institutional program

National heritage policy; Local and regional tourism policy; Community / economic development

Conservation; Virtual museum; Public education; Site and tourism management
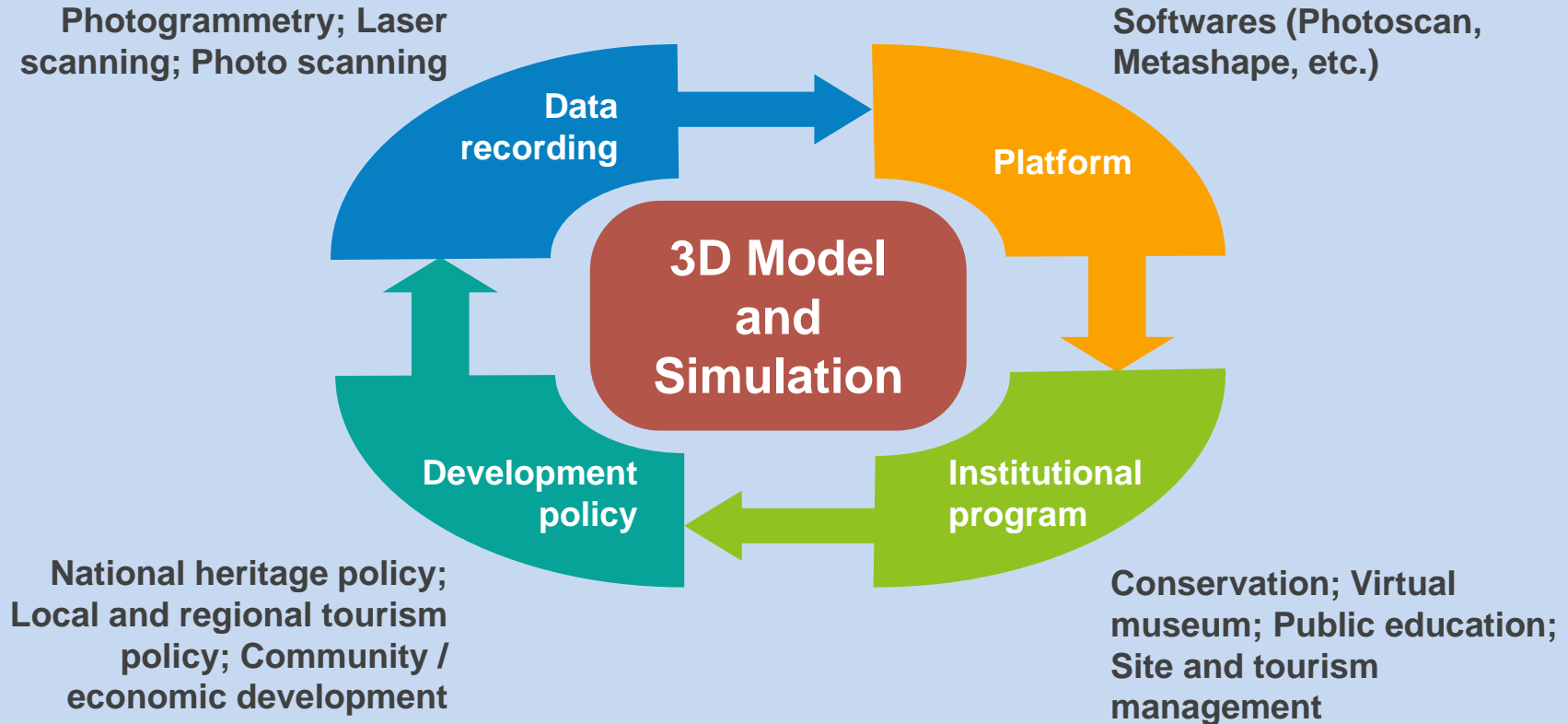
Technological Materials and Co-Production Process
3D Model

Landscape

Models of temple's surrounding:
vegetation, topography
Taken with aerial scanning
Legends of place-name

Global Temple

Model of entire temple
Time-lapse of construction / restoration
Taken with aerial scanning, photogrammetry
Restoration history
Cultural heritage policies

Relief - Narrative

Models of relief story or event
Taken with photogrammetry
Archaeological research
Educational function
Religious function

Partial Temple (Exposed)

Models of corridors, walls, floors, gates
Taken with photogrammetry
Architectural function
Religious function
Tourism function

3D MODEL

Relief - Item

Models of specific item of material culture or behavior
Taken with photogrammetry
Archaeological research
Educational function
Economic development

Partial Temple (Buried)

Model of buried parts
Taken with photo scanning
Architectural function
Conservation
Myth
Cultural heritage policy

Assemblage and Co-Production of Temple Visualization
(Global and Partial, Analog to Digital)

Van Erp — **1907**

Dutch Colonial Government

- Restore the damaged building
- Conservation purpose
- Sociotechnical imaginary of antiquariat – specific knowledge of the past
- Archaeology means conservation

Office of Antiquity — **1960**

Indonesian Government (Sukarno Administration – Lembaga Purbakala)

- Conservation: repairing and reconstruction
- Sociotechnical imaginary of Sukarno (?)
- Archaeology means conservation

UNESCO — **1973**

Indonesian Government

- Collaboration with Institut Géographique National (IGN)
- Mapping and cadastral measurement
- Conservation: structural reinforcement
- Sociotechnical imaginary of heritage value
- Archaeology means scientific recording and conservation
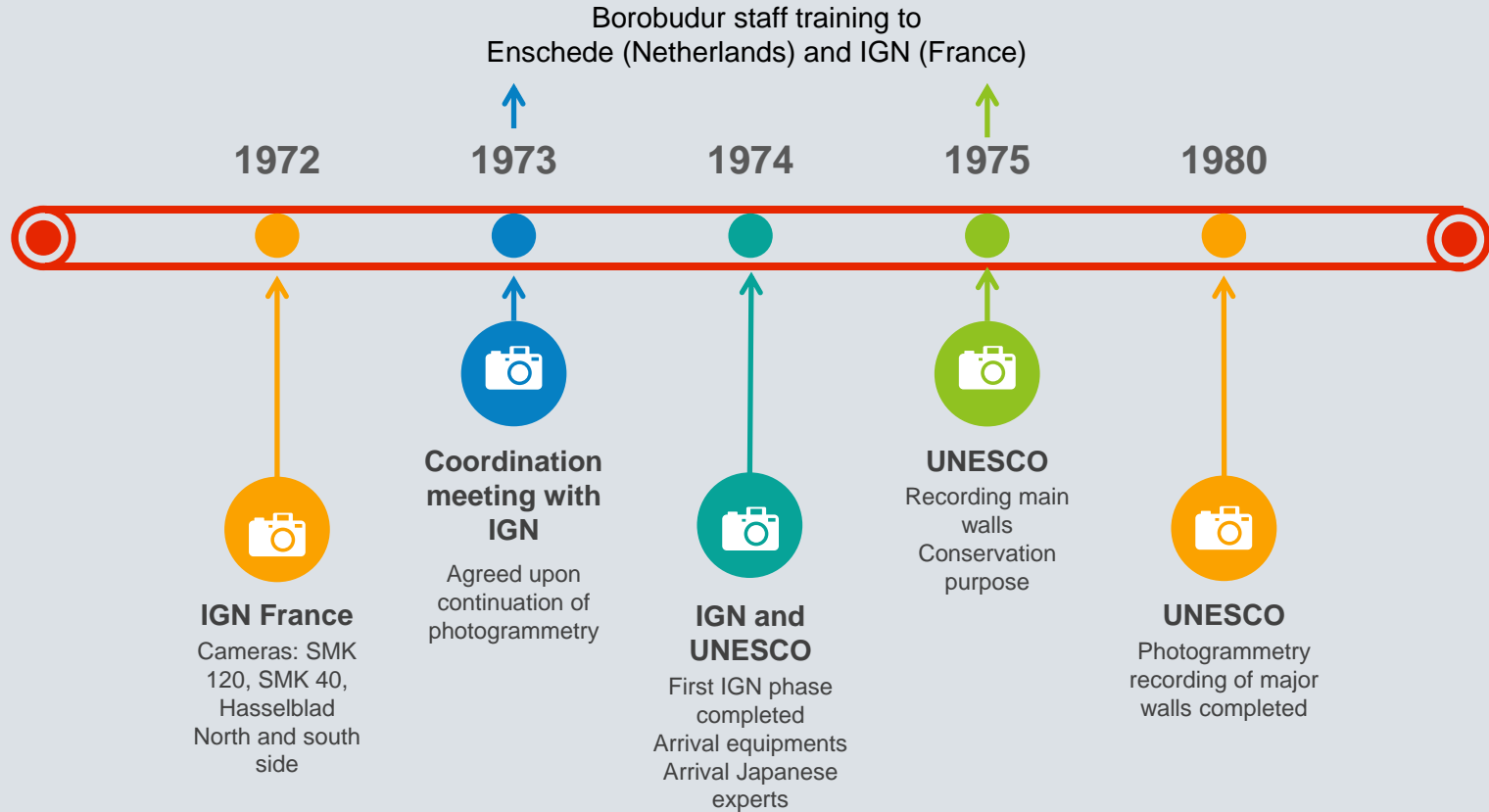
Borobudur Office — **2005**

Indonesian Government (Directorate General of Culture)

- 2005 Partial recording with TLS (Terrestrial Laser Scanning)
- 2009 First digital photogrammetry
- Sociotechnical imaginary of scientific recording
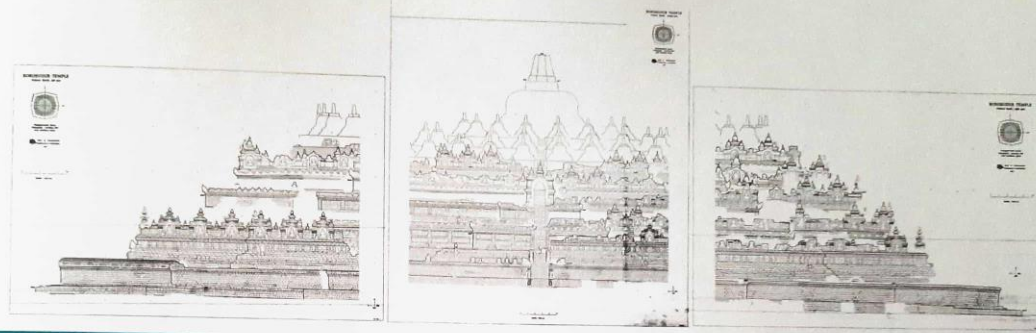- Archaeology means cultural heritage management

# 1973 Restoration by Indonesian Government and UNESCO

Timeline of Analog Photogrammetry

Borobudur staff training to
Enschede (Netherlands) and IGN (France)

1972   **1973**   **1974**   **1975**   **1980**

IGN France

Cameras: SMK 120, SMK 40, Hasselblad North and south side

Coordination meeting with IGN

Agreed upon continuation of photogrammetry

IGN and UNESCO

First IGN phase completed
Arrival equipments
Arrival Japanese experts

UNESCO

Recording main walls
Conservation purpose

UNESCO

Photogrammetry recording of major walls completed
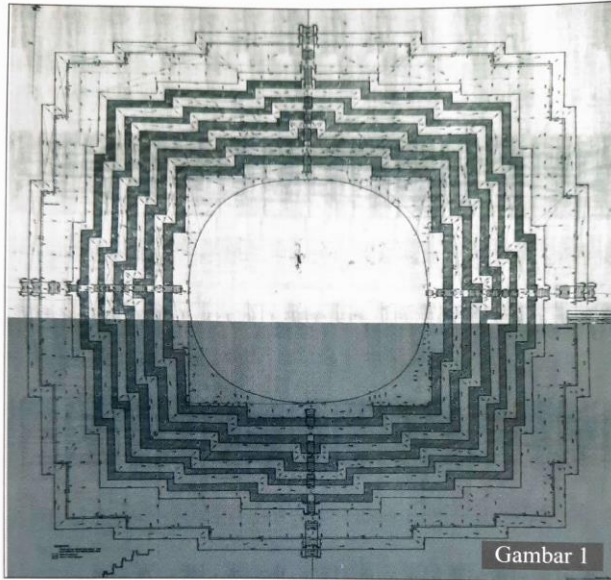
1973 Borobudur Analog Photogrammetry

Kondisi Candi Borobudur sisi *barat* sebelum pemugaran II
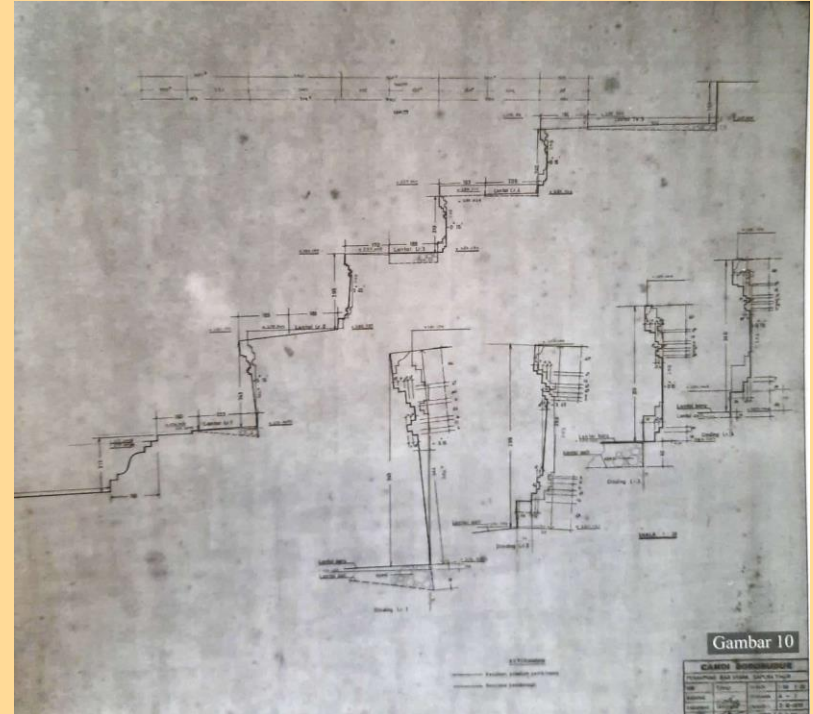Hasil penggambaran fotogrametry analog
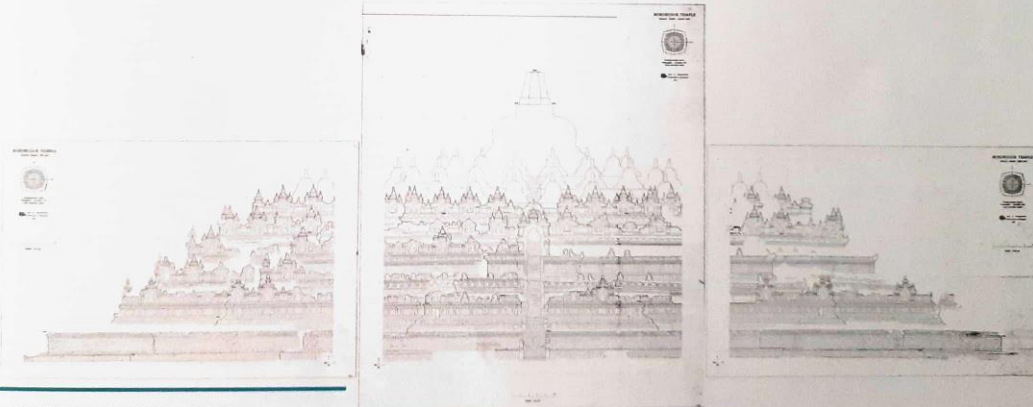
Kondisi Candi Borobudur sisi *timur* sebelum pemugaran II
Hasil penggambaran fotogrametry analog

Application of Analog Photogrammetry (1973)

Gambar 1. Pengukuran denah candi sistem diagonal (Mulyono Supardi, 1971)

Diagonal measurement

Measurement of tilted wall

Digital Recording

Arrival of Terrestrial Laser Scanning (Supplied by UNESCO)

2005

Staff training, TLS recording of Borobudur

2006

Application of digital recording to other heritage sites (e.g. Vredeburg, Bukittinggi Clock, Prambanan Temple, etc.)

From 2006

(Recording is carried out by Borobudur staff who have received training)

2009

Digital Photogrammetry of Borobudur
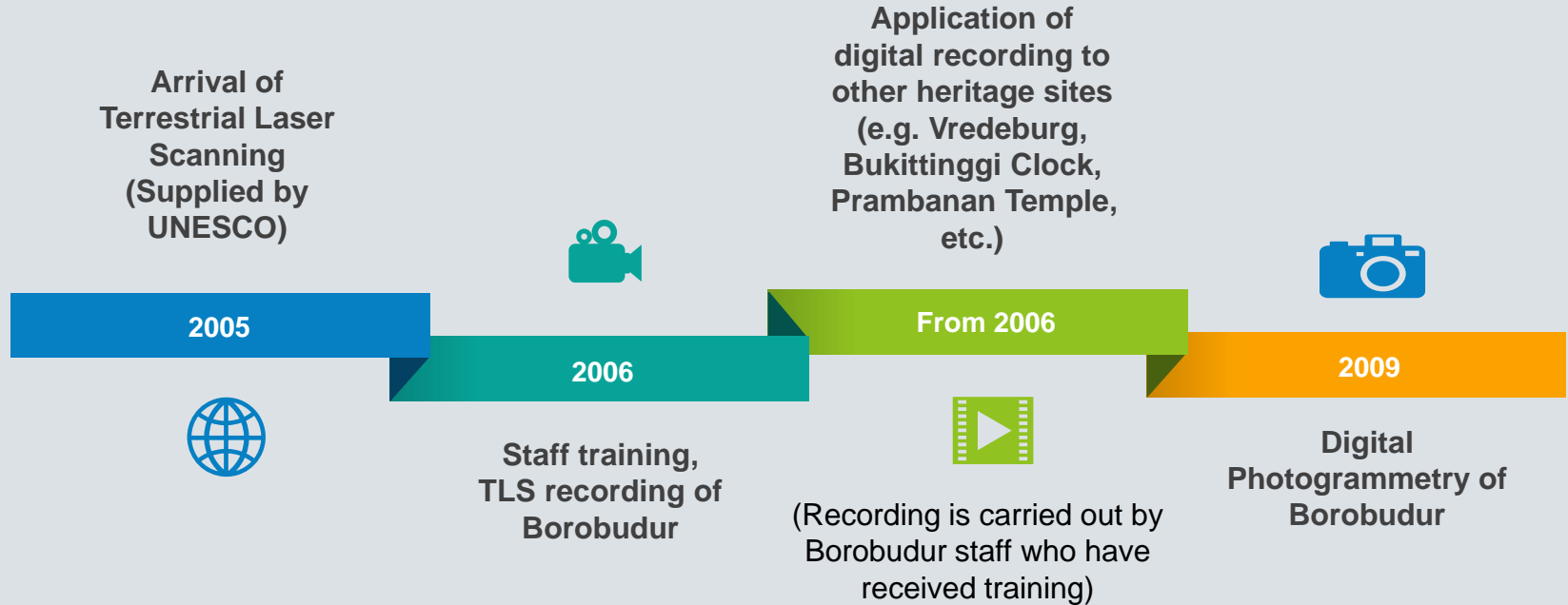
図 5.5　埋まったレリーフとその拡大図

図 5.6　寺院全体の融合透視可視化結果(周辺環境付け)

On-going 3D Visualization by Ritsumeikan Scientists and Borobudur Office Staff (led by Prof. TANAKA Satoshi)

Since 2018

Composite transparent visualization of Karmawibhangga buried part

Transparent visualization of inner mound
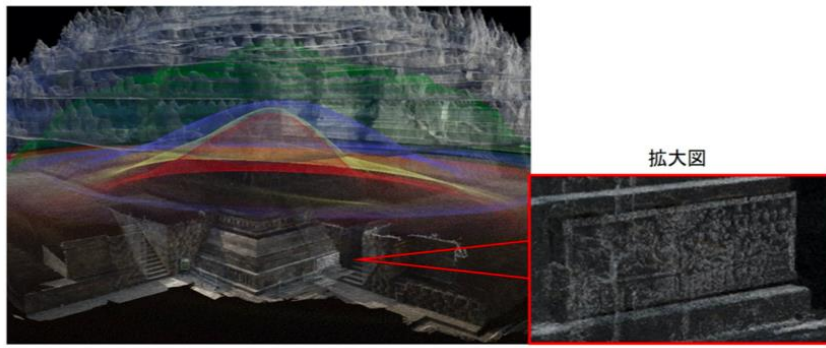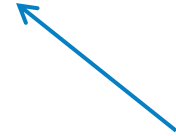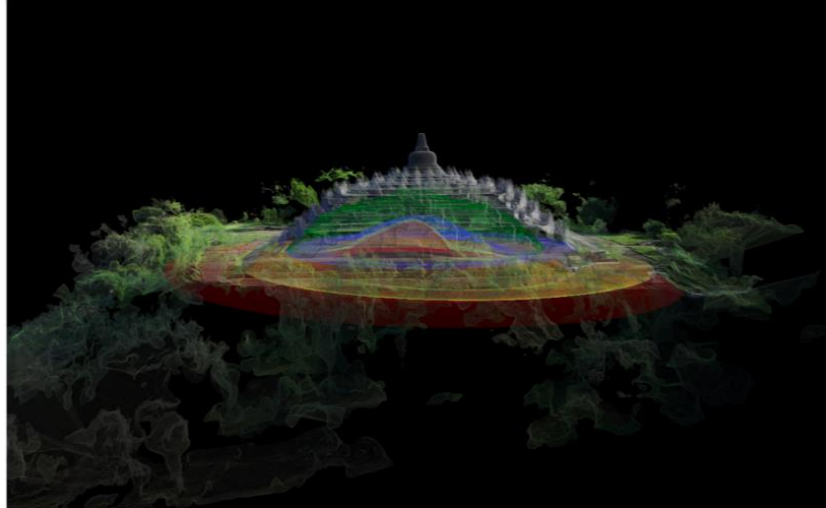
**On-going 3D Visualization
by Ritsumeikan Scientists and
Borobudur Office Staff
(led by Prof. TANAKA Satoshi)**

Since 2018
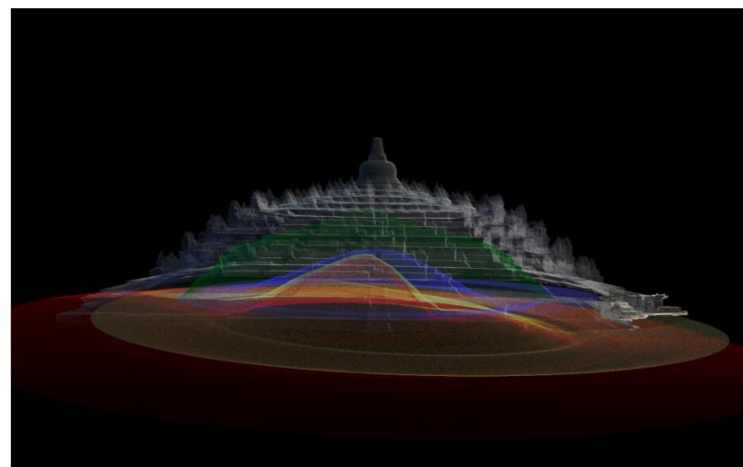
図 5.3　寺院全体の融合透視可視化結果その一
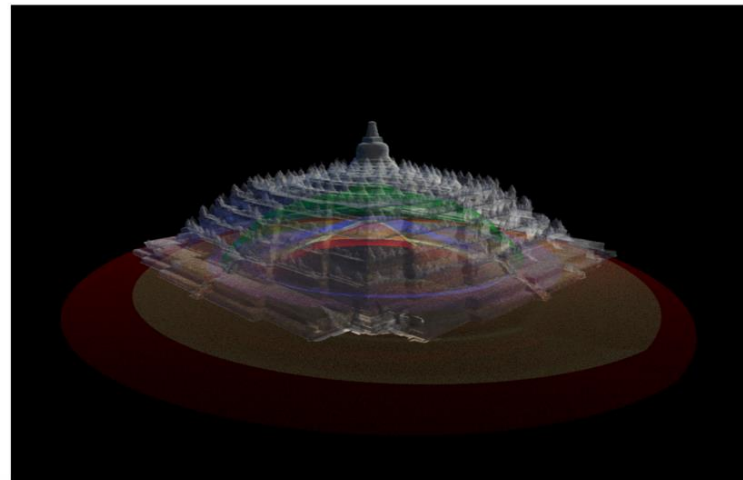
Few questions on 3D visualization……

Question

-How does the 3D visualization interpellate (Althusser) us?

-How does the transparent visualization open up emerging affordances with regard to interpretation of the building structurally and symbolically?

Question

- Does the 3D model and transparent visualization change the affective relation of people (visitors, archaeologists, painters, etc.) to the temple?

Question

- Would this digital visualization create interpretive flexibility among archaeologists and heritage managers?

- Would the visualization help stabilize a particular type of interpretation?
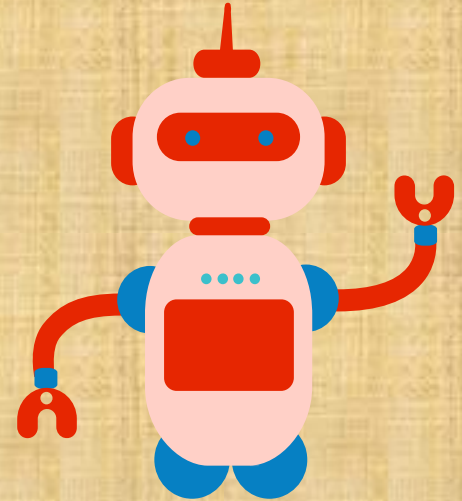
Community Development and Co-Production Process
(How visualization relates to communities)

Heritage Tourism Narrative
-Experimental project of Gadjah Mada University
-Identified 8 narratives related to the temple
-Digital visualization planned

Village Economic Center (Balkondes)
-Relation between business (CSR) and village government
-Have not yet involved digital models
-E-commerce: marketing platform

Public Education - Museum
-Borobudur Park Museum (Ministry of Tourism)
-Digital representation of Samudraraksa ship

Art Gallery / Art Group
-Temple as visual object
-Temple as background
-Temple as spiritual source
-No digital visualization

Relief - Itemized
Models of specific item of material culture or behavior
Taken with photogrammetry
Archaeological research
Educational function
Economic development

Ruwat Rawat Ritual
-Private initiative of a cultural figure (Sucoro)
-Involving groups from local and outside Borobudur
-Maintain YouTube channel
-Producing digital visual recording

VISUAL-IZATION

Distribution of 15 Village Economic Centers
(Balkondes – バルコンデス)
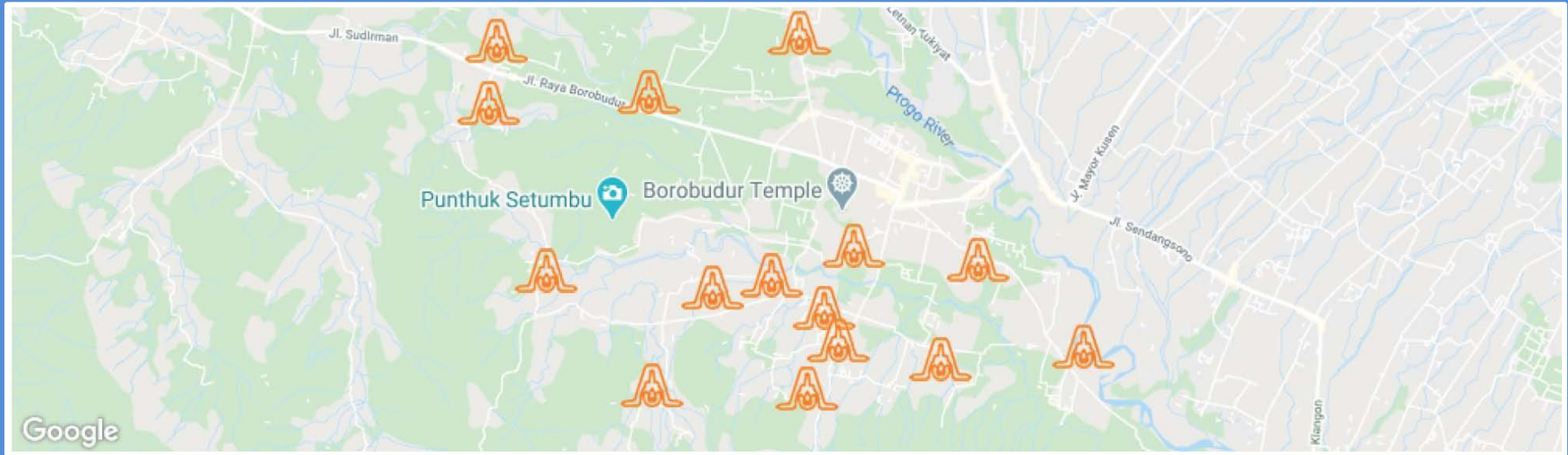
Each village has one Village Economic Center

**A center collaborates with and receives financial assistance
from a state-owned company (banks, telecommunication, power plant, etc.)
in the form of CSR program**

Balkondes Ngadiharjo Village

Balkondes Borobudur Village

Balkondes in Resort Style

State Electricity Company
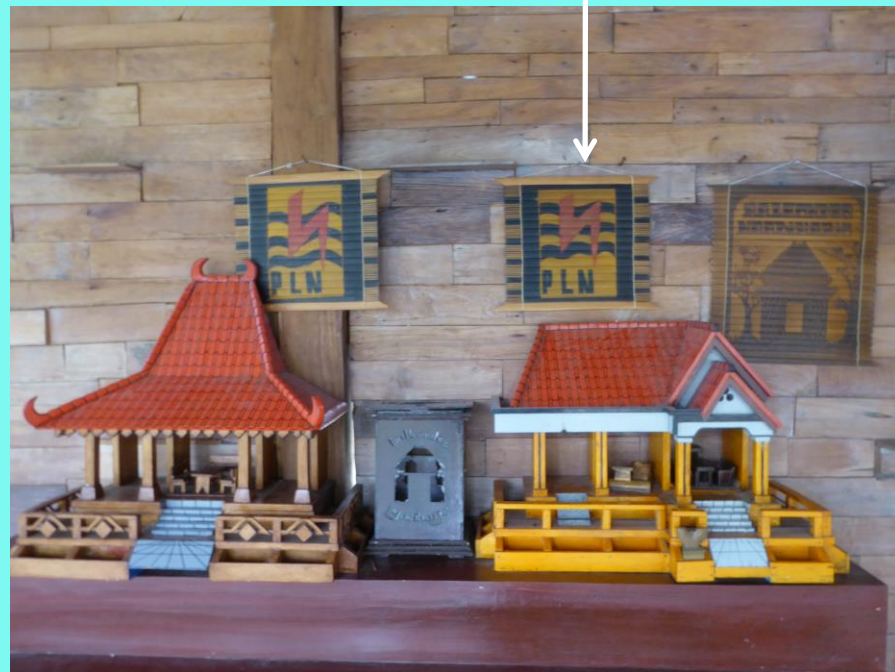
Borobudur Park

Heritage Tourism Narratives of Borobudur
(Gadjah Mada University)

NARRATIVES

01 — Maritime Culture
Narrative of maritime technology and story

02 — Sacred Myth: Folklore and Ritual
Beliefs related to the temple and its surrounding

03 — Technological and Scientific Knowledge
Architectural technique, astronomy, and natural science

04 — History of Borobudur Reconstruction
Narrative of reconstruction processes

05 — Flora and Fauna
Narrative of local ecological diversity

06 — Geology
Narrative of local geological change

07 — Spiritual Being
Story of symbolic creatures

08 — Pilgrimage
Narrative of past and present spiritual journeys

Manual reconstruction of architectures depicted on Borobudur reliefs

(Reconstructed by Yogyakarta Archaeological Office)

Bentuk bangunan pada panil-panil relief di Candi Borobudur

Panel Seri O.15, atap kampung, kolom, umpak

Panel Seri O.119, atap kampung, kolom, umpak

.... Lanjutan Gambar 5.10

Panel Seri O.47, atap kamung dan limasan, kolom, umpak
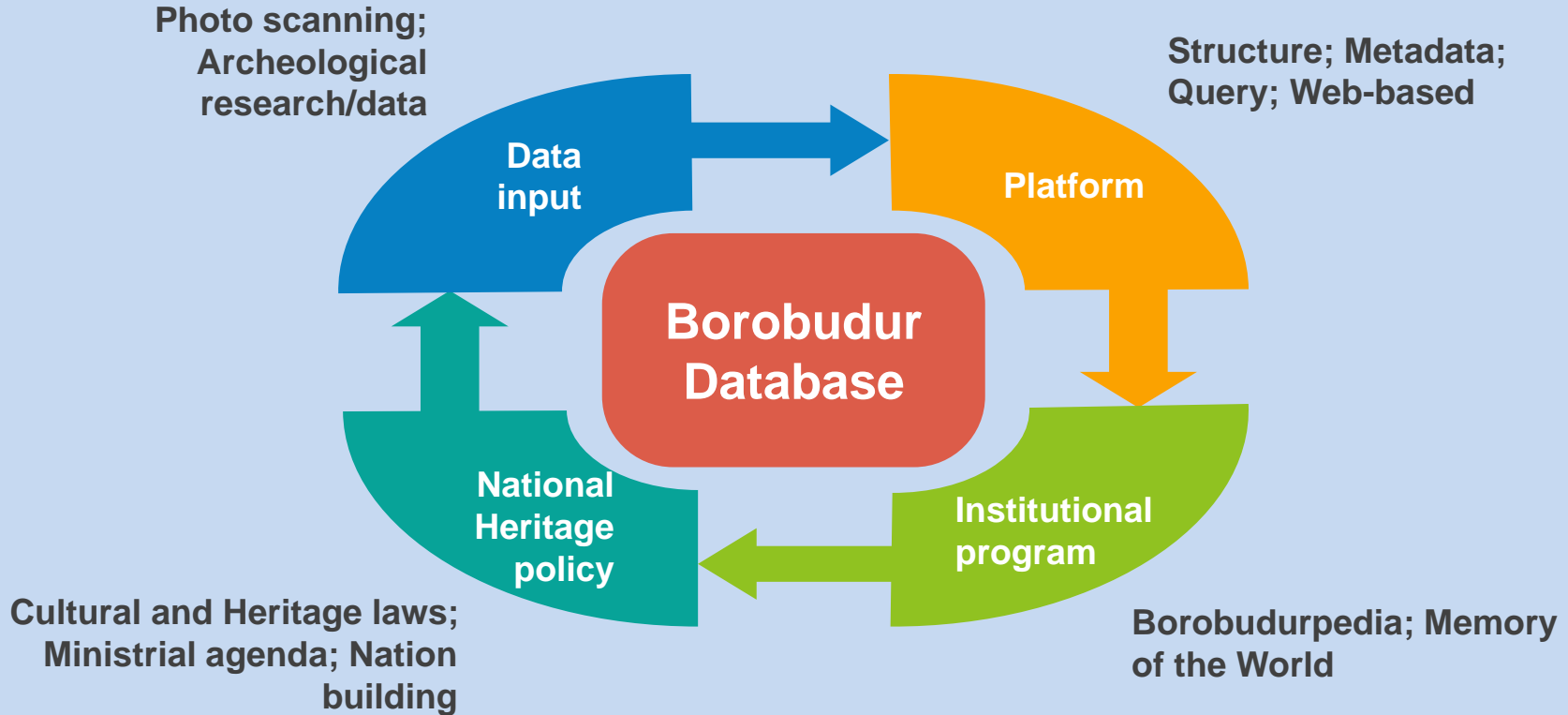
Panel Seri O.30, atap limas an, kolom, umpak

CO-PRODUCTION AND ASSEMBLAGE OF BOROBUDUR DATABASE

Photo scanning; Archeological research/data

Data input

Platform

Structure; Metadata; Query; Web-based

Borobudur Database

National Heritage policy

Institutional program

Cultural and Heritage laws; Ministrial agenda; Nation building

Borobudurpedia; Memory of the World

"Laboratories" of Borobudur Database

BOROBUDUR-PEDIA

RITSUMEIKAN (planned)

MEMORY OF THE WORLD

BOROBUDUR DATABASE

Assemblage and Co-Production of Databases (Borobudur and National)

Borobudurpedia
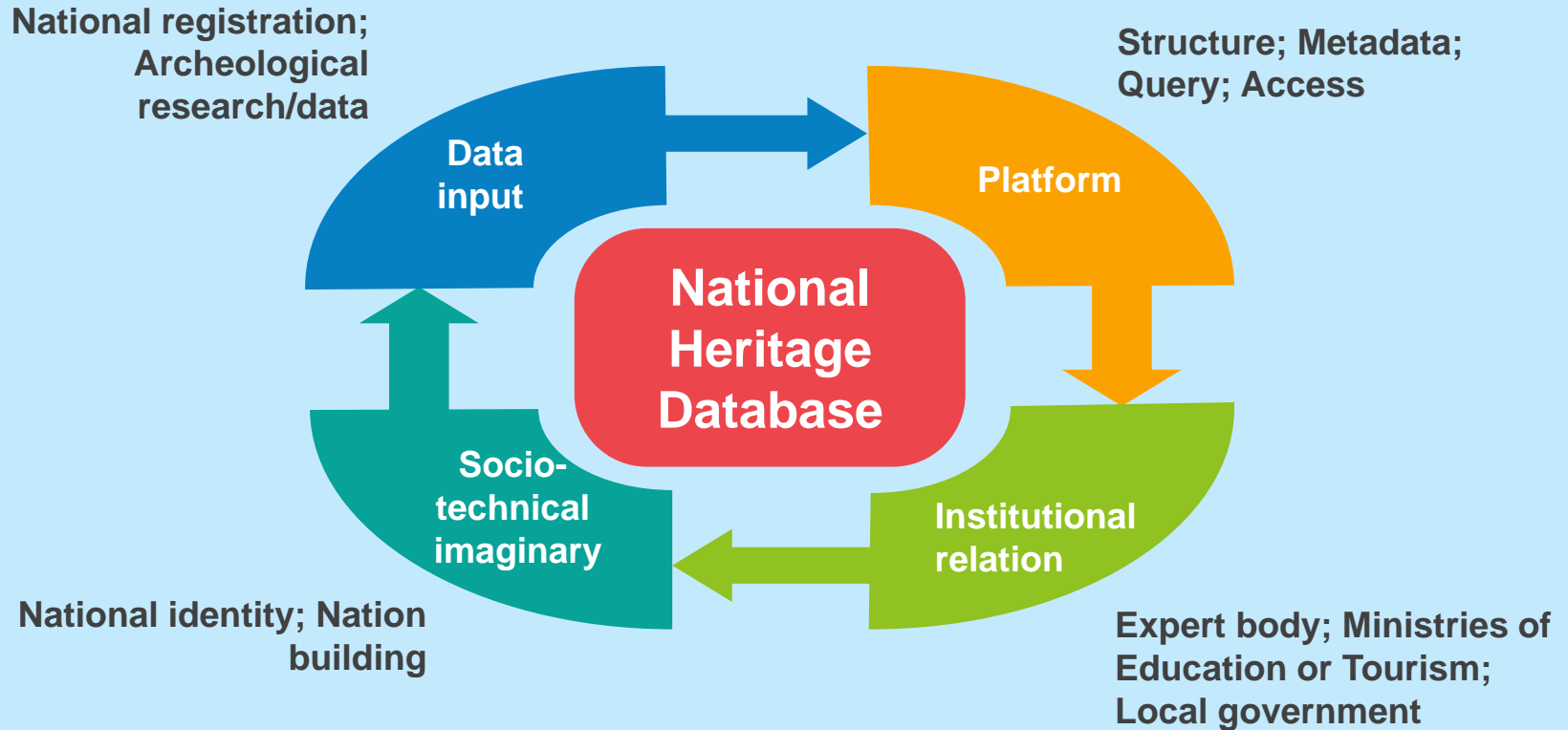
Borobudur Office Program

- Initiated by Borobudur Director
- Launched in 2017
- Online wiki platform
- Public Database: open encyclopedia, publications, images
- Targeted to become public educational platform
- Sociotechnical imaginary: Scientific informational center for anything related to Borobudur

Memory of the World

Borobudur Office and Ministry of Culture Program

- Initiated collaboratively by Borobudur Director and Director General of Culture
- Database: Images of restoration process by the Dutch and Indonesian
- Sociotechnical imaginary: Knowledge of building and restoration of the temple as universal value

CO-PRODUCTION AND ASSEMBLAGE OF NATIONAL HERITAGE DATABASE

National registration; Archeological research/data

Data input

Structure; Metadata; Query; Access

Platform

National Heritage Database

Socio-technical imaginary

Institutional relation

National identity; Nation building

Expert body; Ministries of Education or Tourism; Local government

Institutional Governance, Expert Authority

Ministry of Education and Culture

UNESCO National Representative

Directorate General of Culture

Other Ministries

Borobudur Conservation Office

National Heritage Expert Review Board

Cultural Heritage Preservation Offices (Province)

Expert Review Boards (District/City)

University Experts

LEGAL GOVERNANCE

Standardization of Heritage Technology embedded in National Imaginary

Law No. 11/2010 on Cultural Heritage (National)

Law No. 5/2017 on Cultural Advancement (National)

Regional Laws
-Law of Cultural Heritage Protection
-Law of Regional Expert Board
-Law of Urban Planning
-Etc.

… some reflexive thoughts and questions

Borobudur as an actant

Emerging actor-networks:
-Scientific networks
-Organizational networks
-Spiritual networks
-Economic networks
-Legal networks

Digitizing project as assemblages of co-production, each constituting social – technological relation

From the fieldsites to laboratories, experimental projects (database, VR, etc), legal papers, etc. Each creates controversies and black-boxes (stabilizations)

Does making digital models mean disembodying oneself from the temple?

Understanding subjective relation to digital and non-digital models, what remains, what disappears

終わり…