

# **A Digital Twin-based Approach for Cultural Heritage Tourism and Customary Land Administration**

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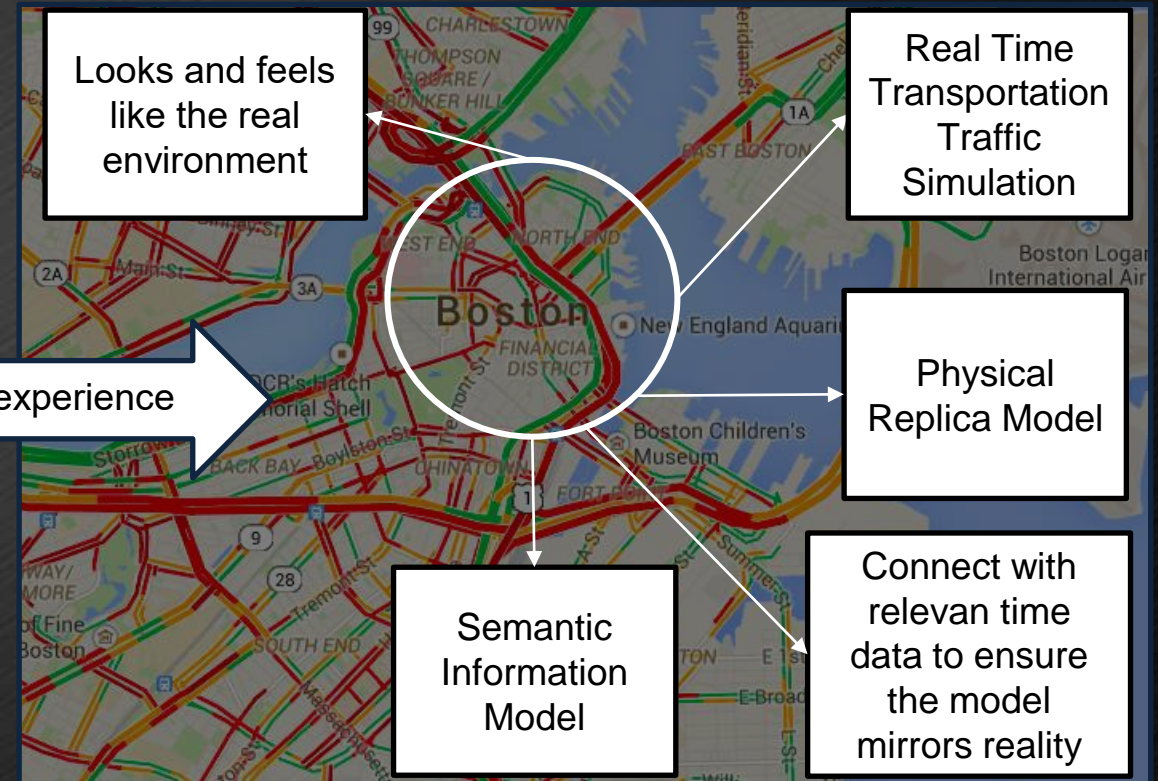
**Institut Teknologi Nasional Malang**

**2023年6月27日**

## Digital Twin?



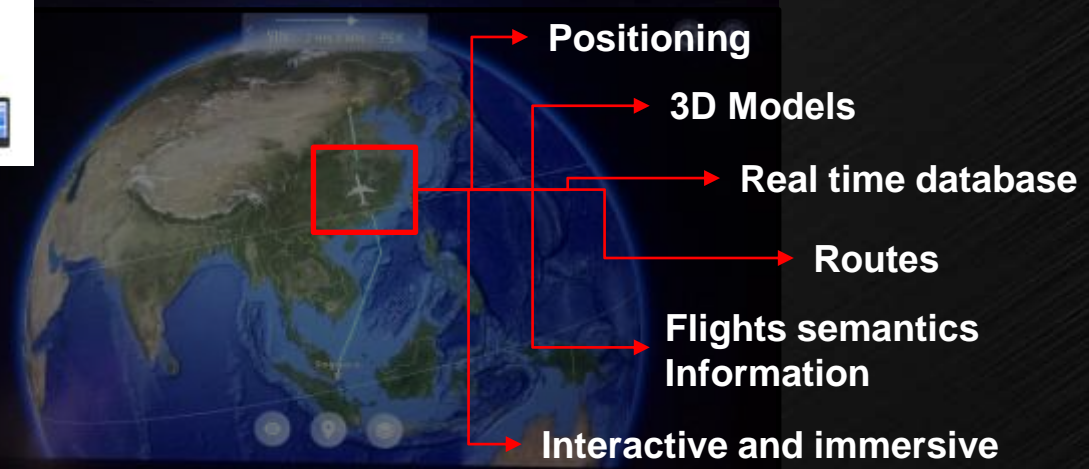
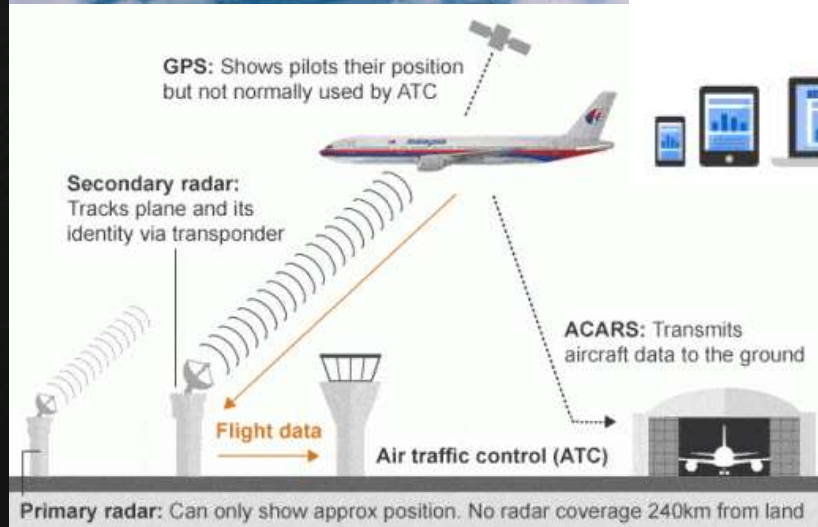
Real World



With Digital Map models (Such as Beidu map, Google Map or etc)

# Digital Twin?

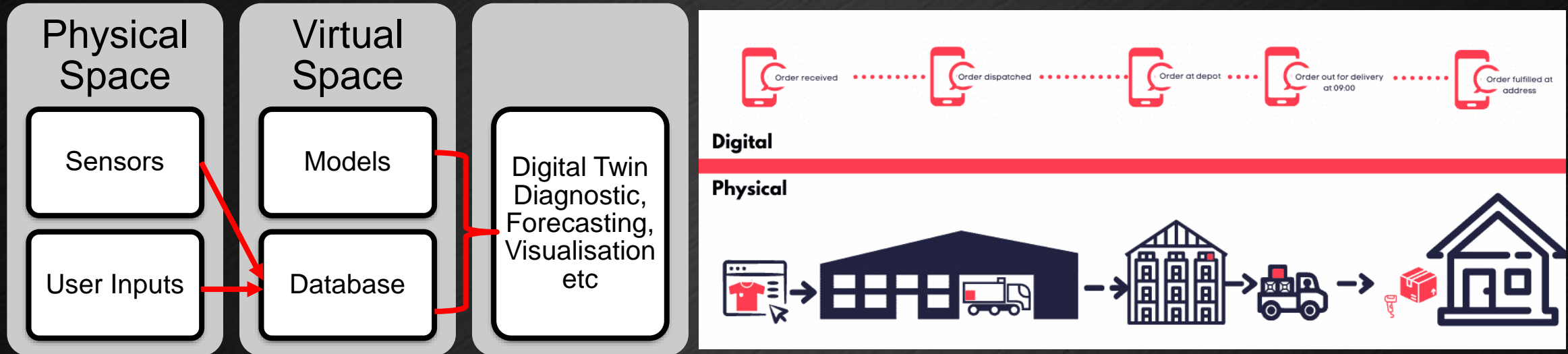
Nowadays, Commercial flights without radar one of the main problems, because we do not know an aircraft position in real time over the ocean<sup>1</sup>.



<sup>1</sup>On how planes are routed over the Atlantic Ocean (aeriana.com)

# Definition of Digital Twin?

Digital twins are commonly used for systems of all sizes—from small-scale IoT deployments to smart cities (large-scale) and even global economies.



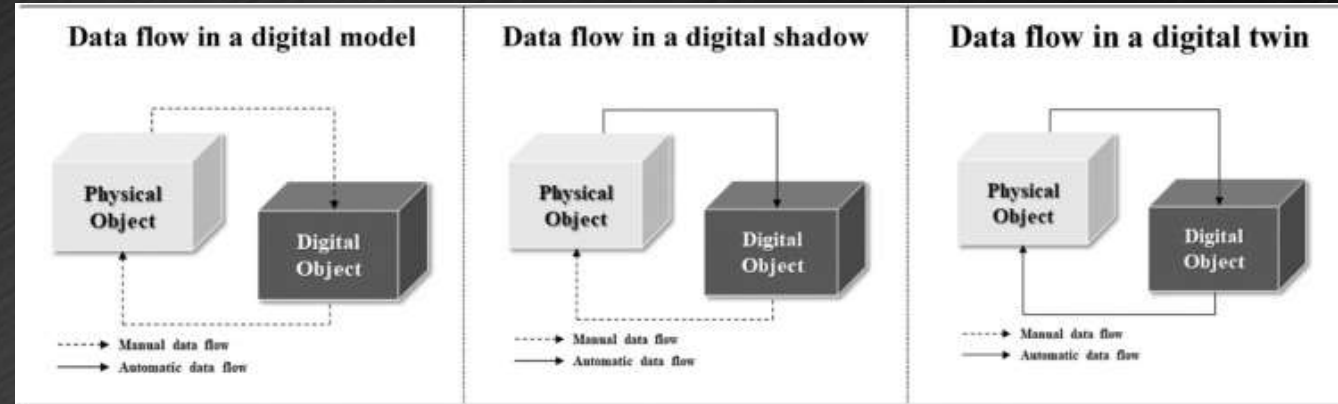
Preparing the digital twin in this way requires the following steps<sup>2</sup>; (1) **Understanding the process that is happening and building a digital representation of it**; (2) **Gathering (and in some cases developing) the automatic, system-generated information about the progress of a product or service**; (3) **Presenting the information in a highly visual and easy-to-interpret digital format**

“A dynamic virtual representation of a physical object or system across its lifecycle, using real-time data to enable understanding, learning and reasoning” Bolton et. al. 2018

# Types of Digital Twin

The concept of digital twins involves creating a virtual replica or representation of a physical object, people, process, or system. It leverages data from various sources, such as sensors, historical records, and databases, to build a dynamic model that mirrors the real-world counterpart. This digital replica can be interacted with, analyzed, and modified to simulate scenarios, monitor performance, and make informed decisions.

Kritzinger et al. (2018) define digital twin data into three types based on the extent of data integration<sup>1</sup>, whereas Zhu et al. (2019) classified data into three types: static property data, real-time data, and measurement data<sup>2</sup>.



Classification	Content
<b>Static property data</b>	Static property data stand for the basic properties of the physical part, such as the information of machine, cutting tools, workpieces, and the physical environment.
<b>Real-time data</b>	Real-time data can represent the status of the operation process from different aspects
<b>Measurement data</b>	Measurement data refers to the measurement results obtained from different measurement devices during the operation. It can used to monitor and optimize the operation process, and will provide useful information to the digital twin to control both the physical and virtual parts.

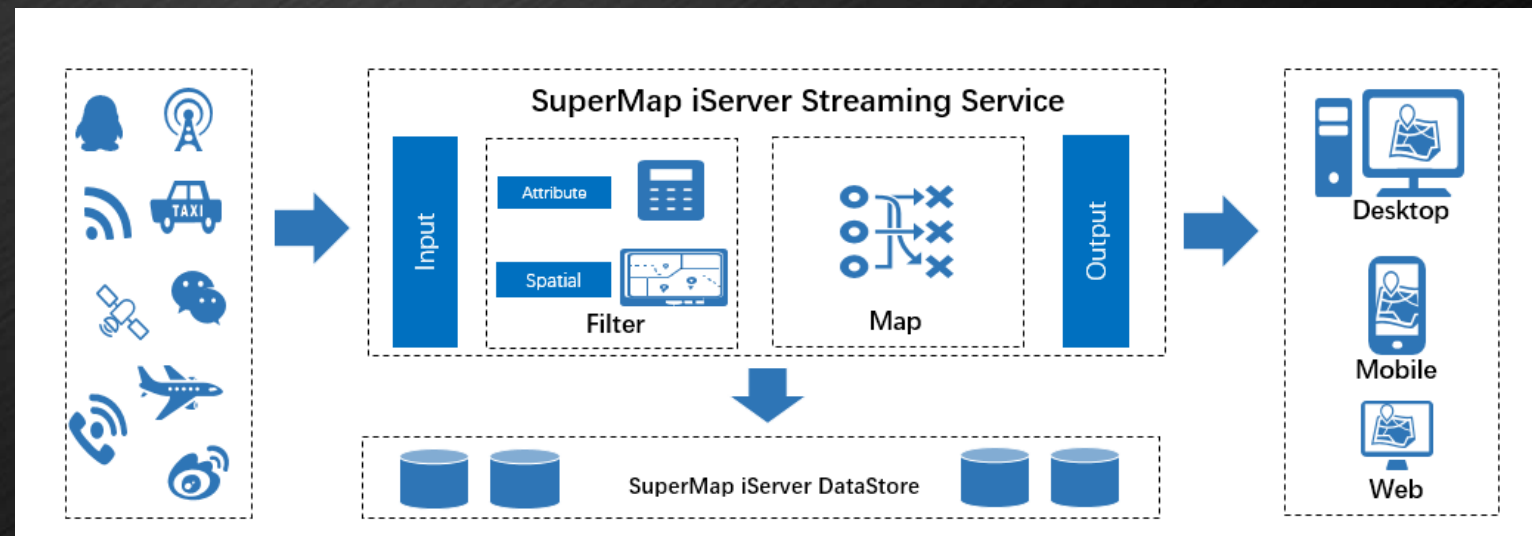
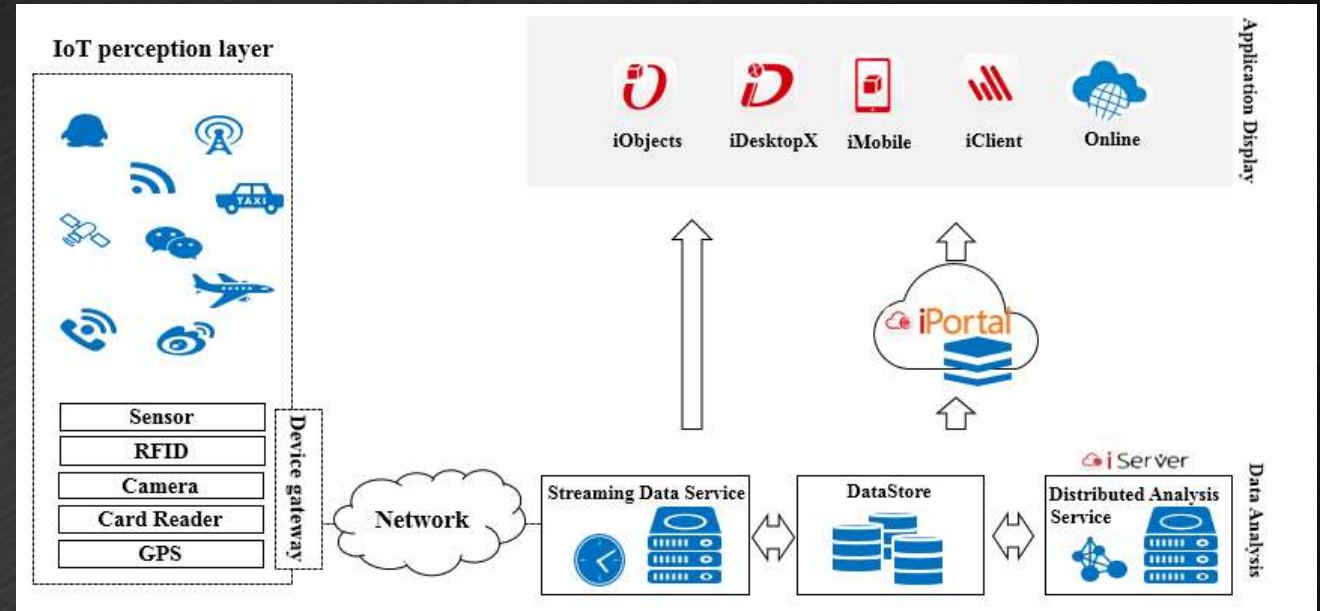
<sup>1</sup>Kritzinger, W., Karner, M., Traar, G., Henjes, J., & Sihm, W. (2018). Digital Twin in manufacturing: A categorical literature review and classification. *Ifac-PapersOnline*, 51(11), 1016-1022.

<sup>2</sup>Zhu, Z., Liu, C., & Xu, X. (2019). Visualisation of the digital twin data in manufacturing by using augmented reality. *Procedia Cirp*, 81, 898-903.

# Streaming Data or IoT Concept in Supermap

SuperMap allows storing streaming data in SuperMap iServer DataStore, as well as analyzing and mining historical data via SuperMap iServer's distributed analysis service. Using the SuperMap iPortal, users may manage streaming data resources and services identically, and finally actualize streaming data visualization on PC, Web, and mobile<sup>3</sup>.

**The potential to unlocking digital twins for cultural heritage tourism and customary land administration.**

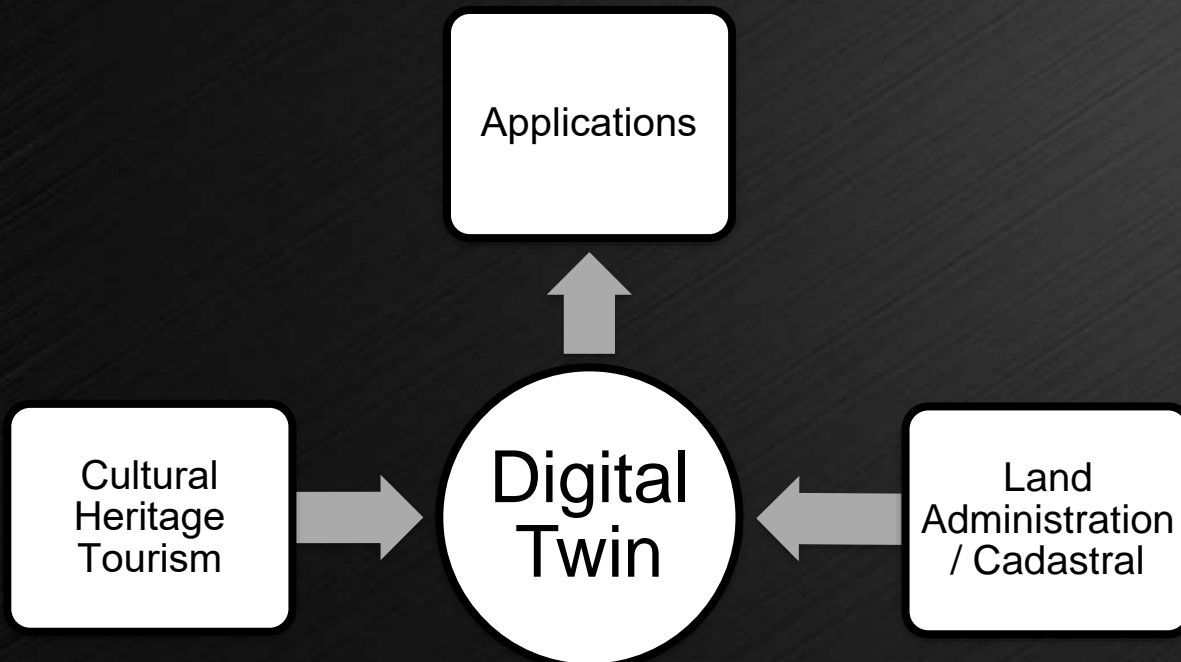


<sup>3</sup>[https://www.supermap.com/en-us/news/?82\\_2606.html](https://www.supermap.com/en-us/news/?82_2606.html)

# Integrating Digital Twin?

Applying the concept of a digital twin to cultural heritage tourism and customary land administration can offer several benefits.

**DIGITAL TWIN = BIM + GIS + IoT + MR + Cultural Semantics + Mathematical Models**



Preservation and Documentation

Virtual Tours

Conservation Planning

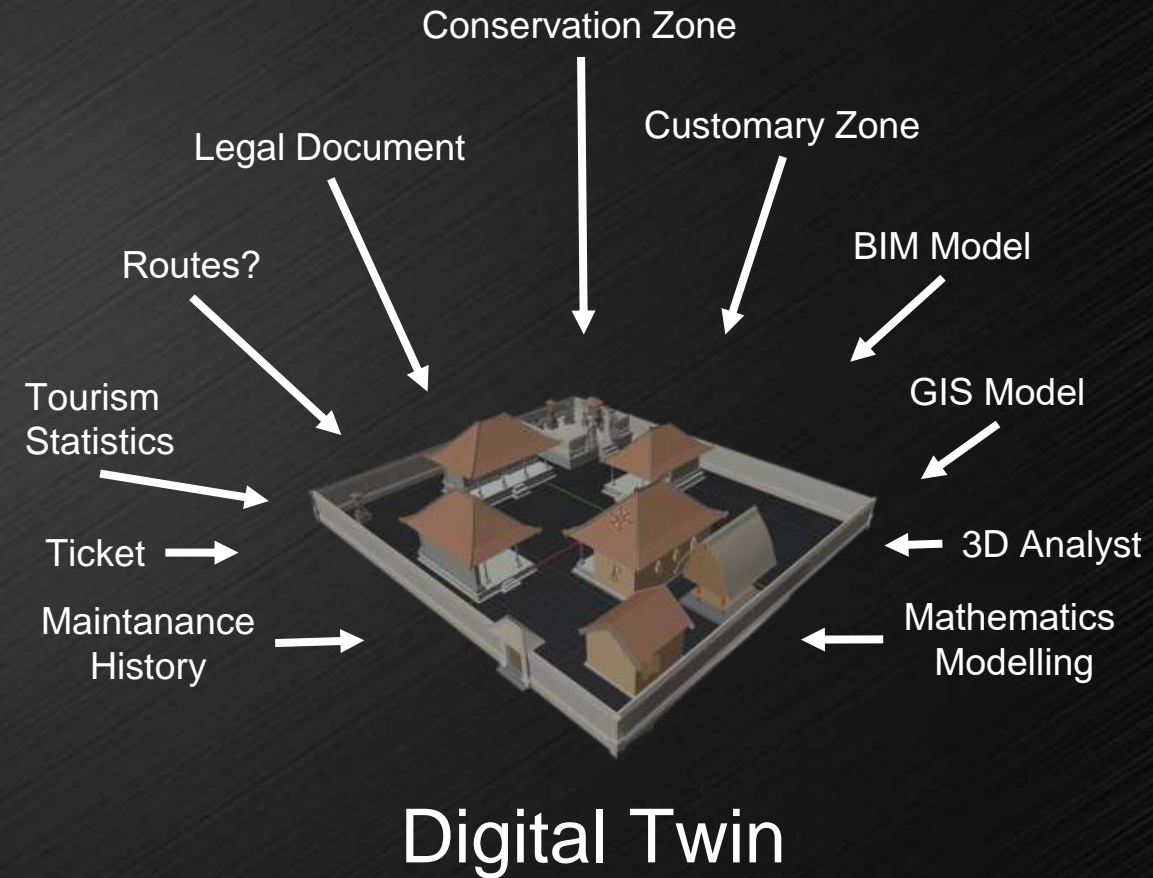
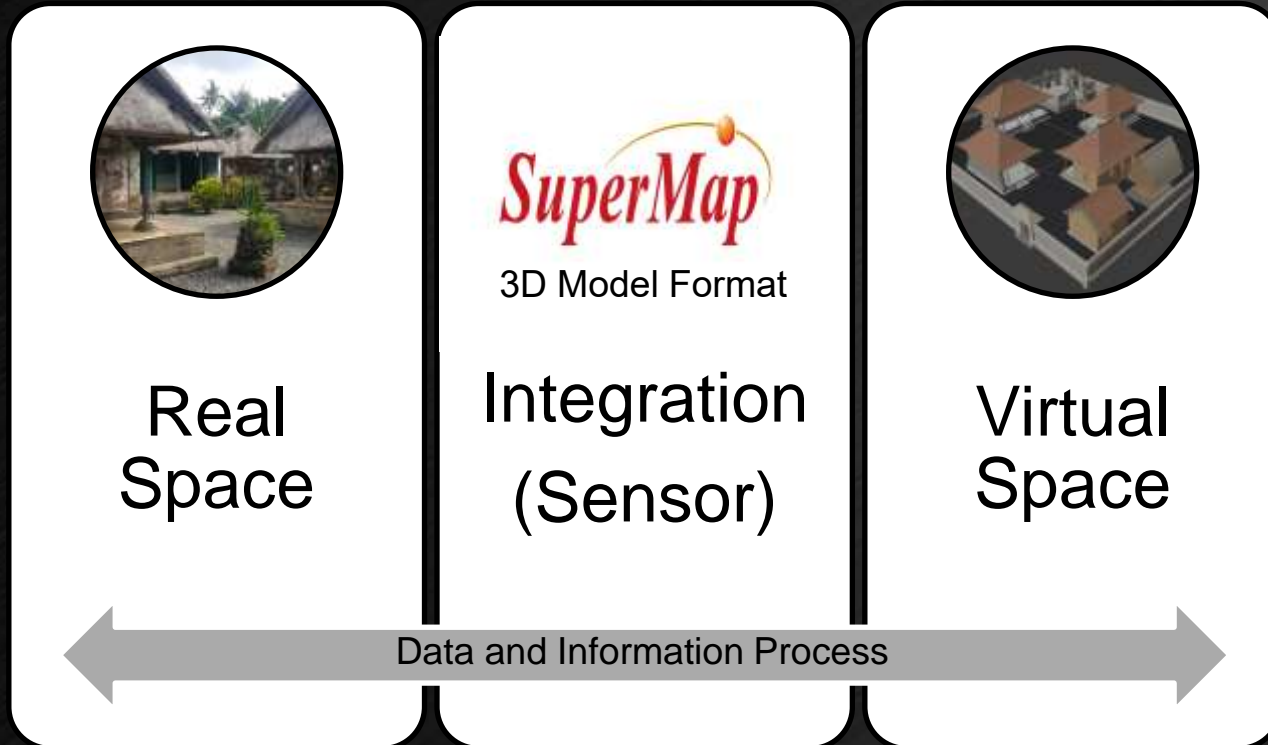
Customary Right registration, Restriction identify, Responsibilities clear (Customary Cadastre)

Resource Planning

Decision Support

# Digital Twin Concepts for Cultural Heritage

## Information Mirroring Model

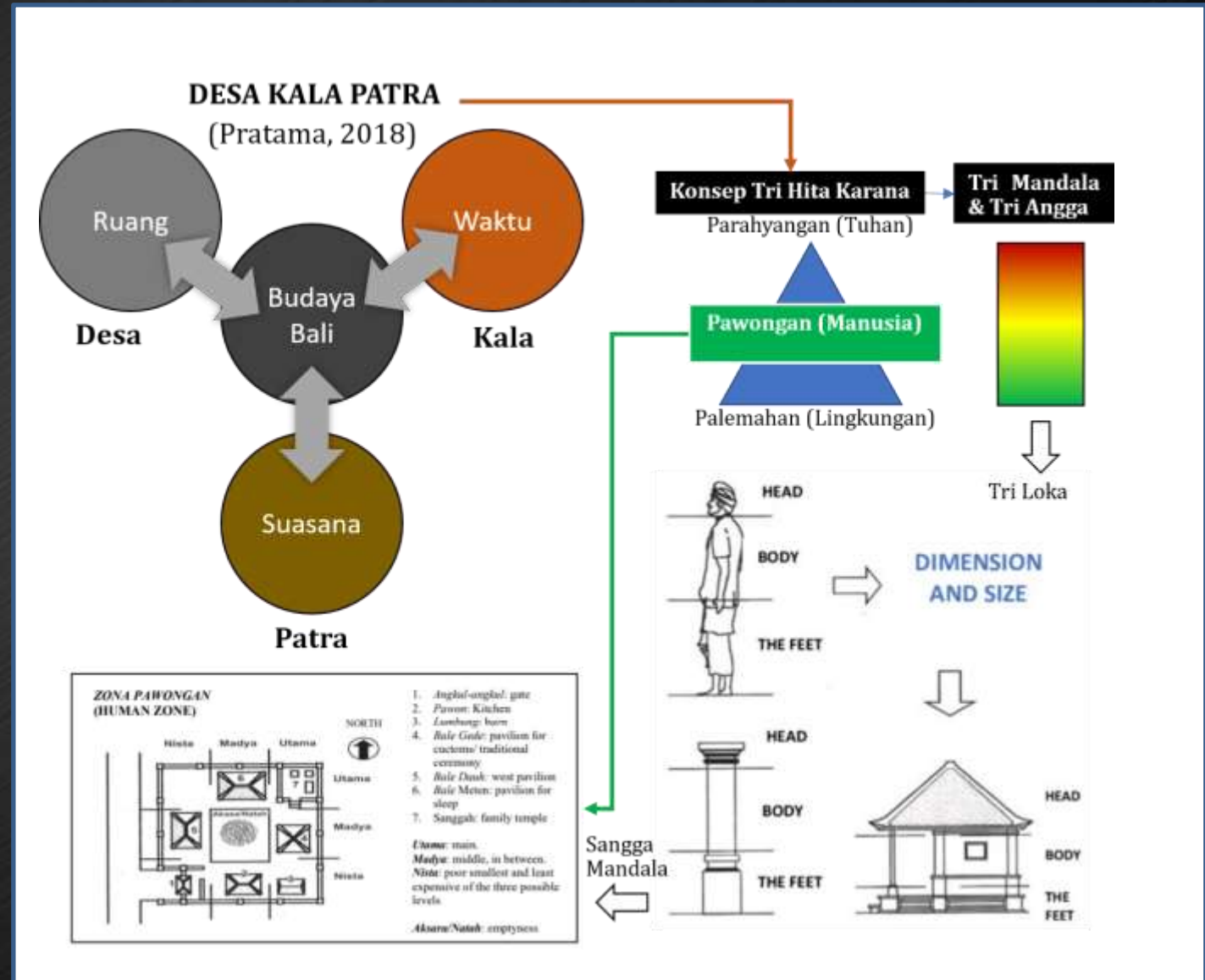




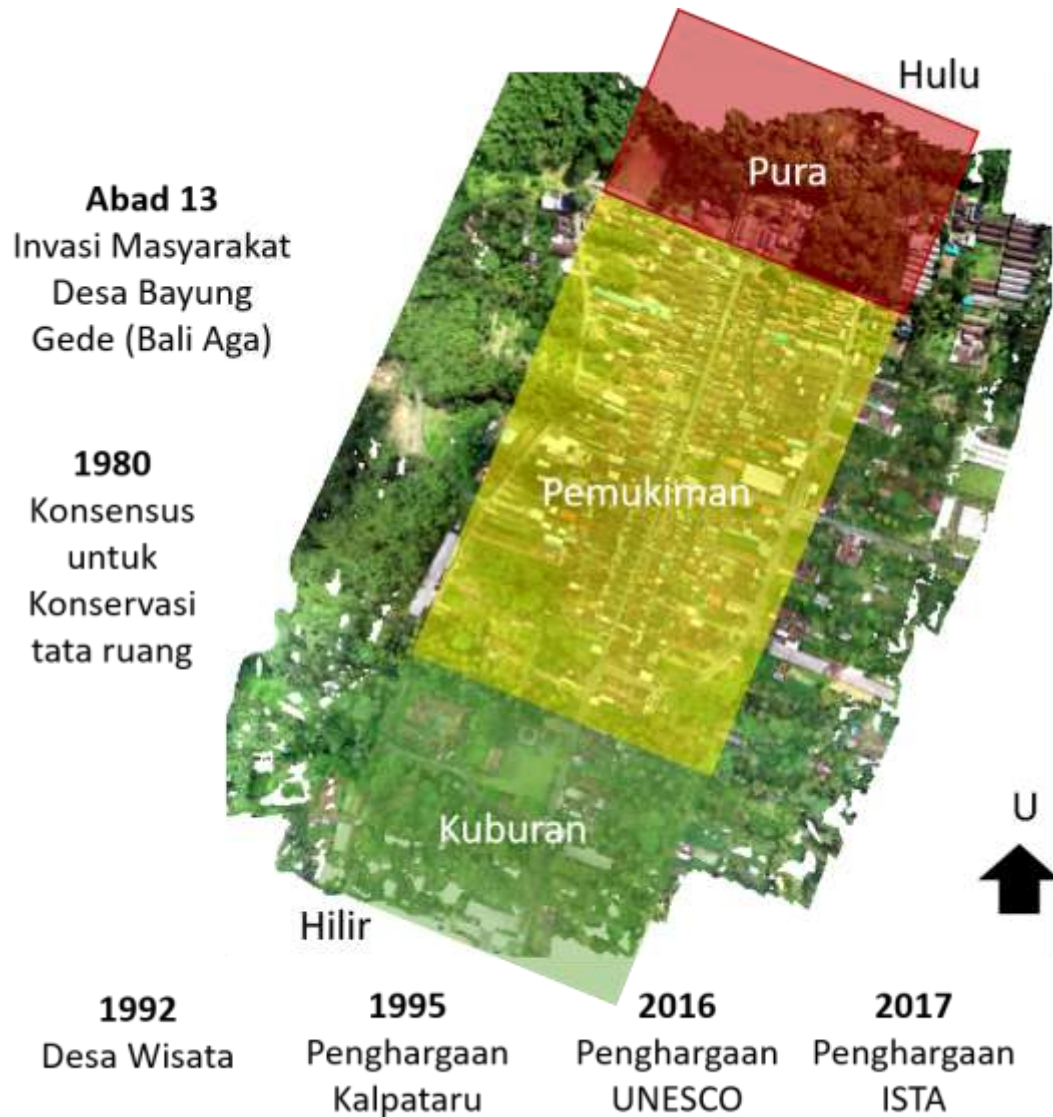
# Balinese philosophy

Support from Local Regulations (PERDA) Prov. Bali No. 3 of 2020, in the Implementation of Cultural Heritage.

"Tri Hita Karana is a philosophy of Balinese people life which contains three elements that build balance and harmony in the relationship between humans and God, humans with humans, and humans with their environment which is a source of welfare, peace, and happiness for human life"



# Penglipuran Traditional Village, Bali, Indonesia



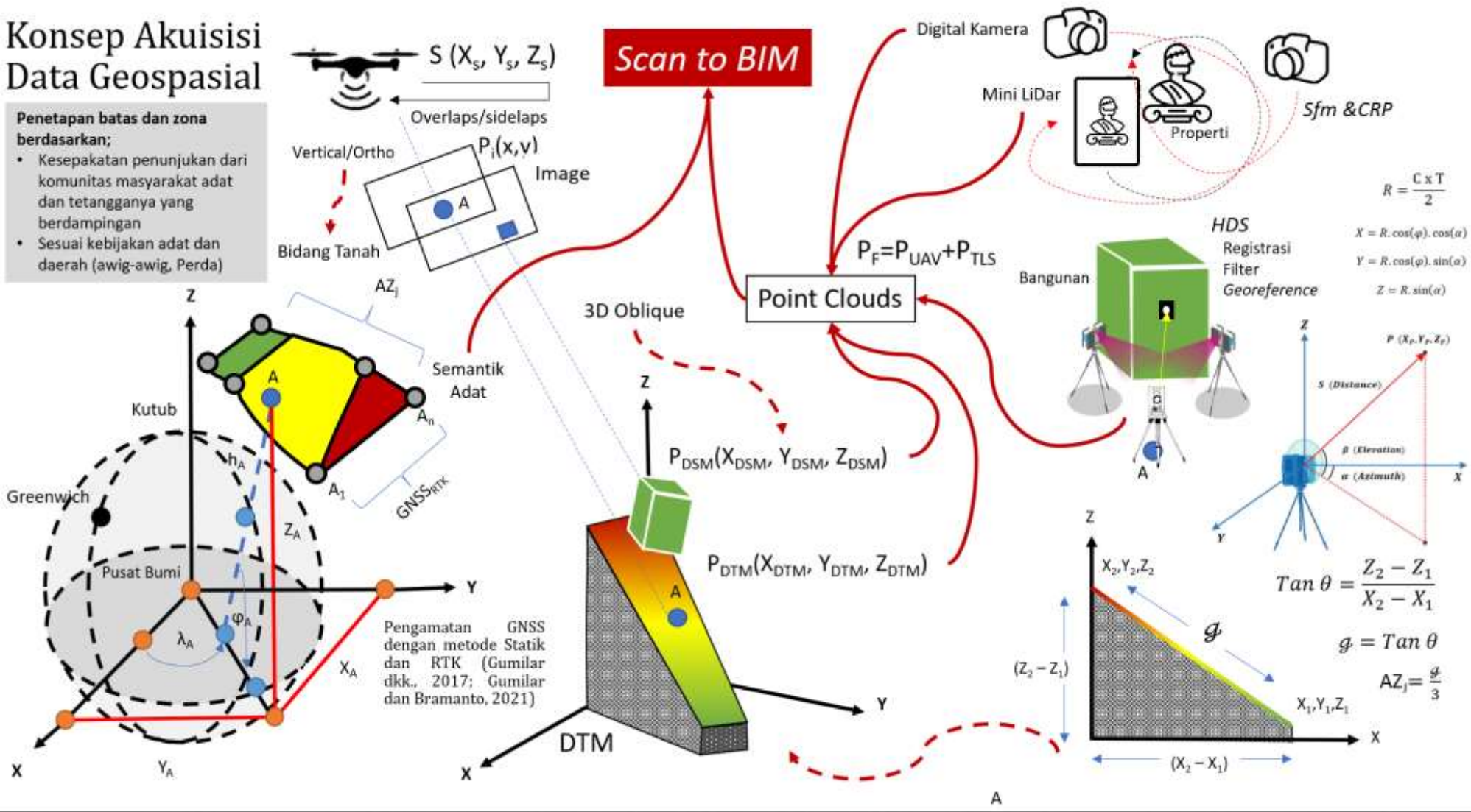
Some architectural characteristics that are still preserved in Penglipuran Traditional Village:

1	Linear settlement arrangement pattern with luan (upstream) and teben (downstream) orientations
2	Utilizing differences in village land topography that shows the highest and lowest areas
3	The residential arrangement also applies luan and teben orientation (Customary Zone) and becomes a conservation zone
4	There is the existence of original Bali Aga buildings (traditional / vernacular buildings)

# How to acquisition?

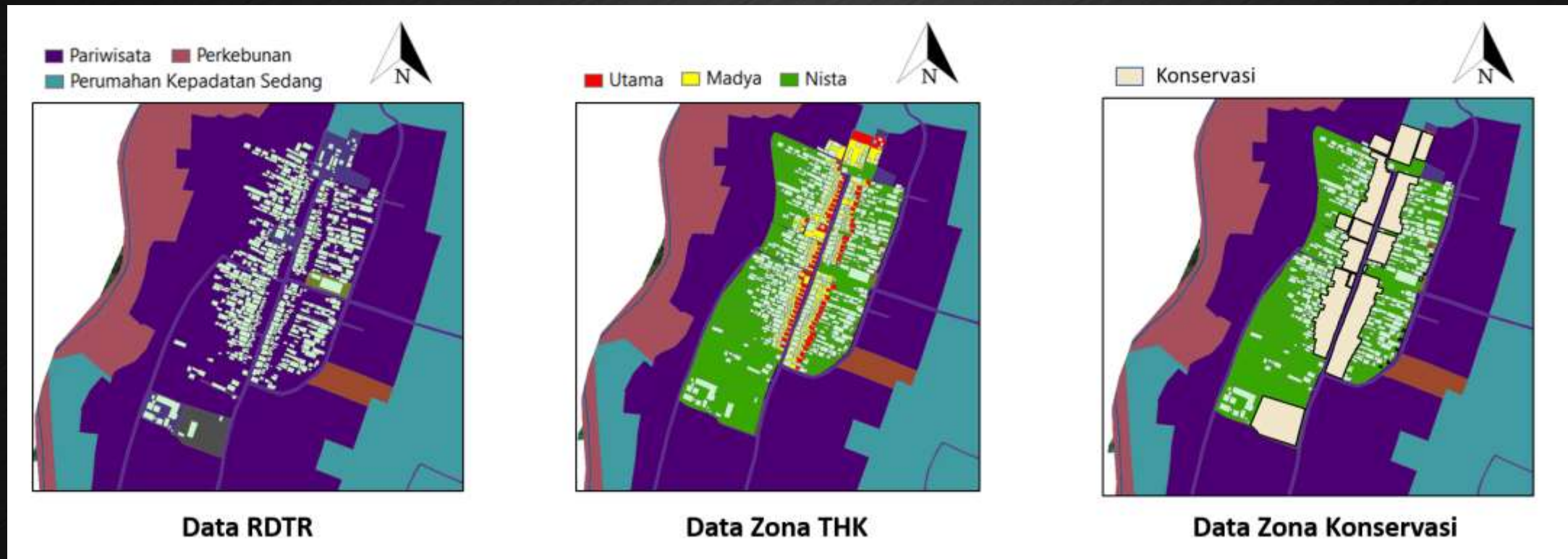
## Konsep Akuisisi Data Geospasial

- Penetapan batas dan zona berdasarkan;
- Kesepakatan penunjukan dari komunitas masyarakat adat dan tetangganya yang berdampingan
  - Sesuai kebijakan adat dan daerah (awig-awig, Perda)



# Why Customary zone is Important?

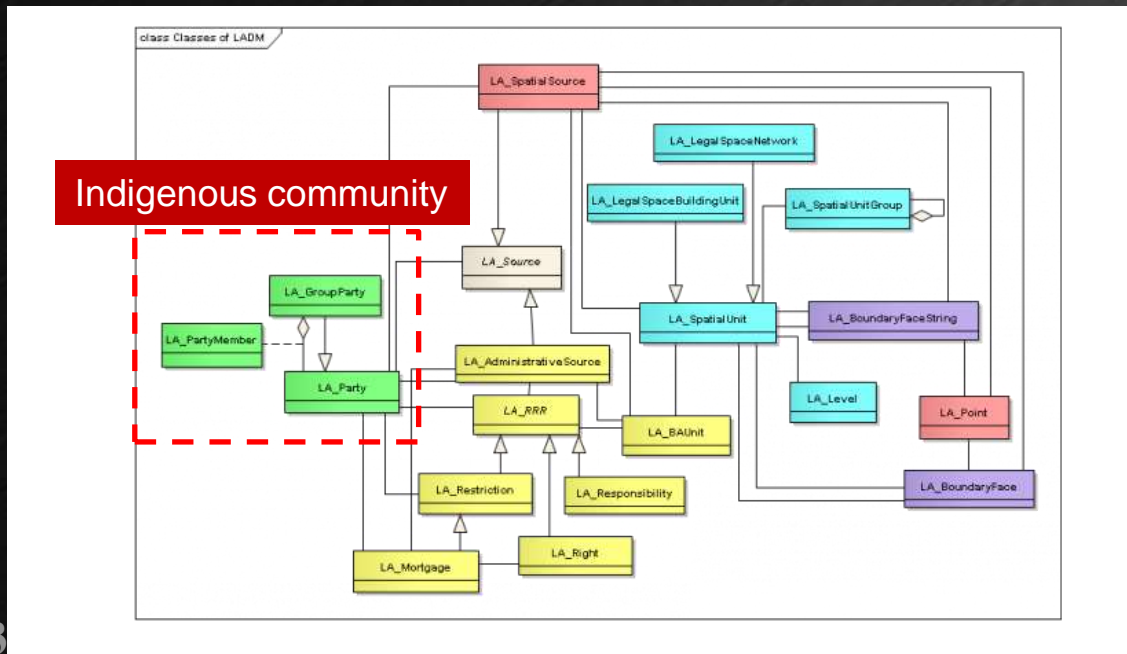
Bali Provincial Regulation Number 5 of 2005 regulates the architectural requirements of buildings and the Bali Provincial Government also stipulates Bali Provincial Regulation Number 16 of 2009 concerning Bali Provincial Spatial Plan 2009-2029 supports the existence of customary zones and this is a gap in the detailed spatial plan that does not include this zone.



The survey data results are integrated with RDTR data from Bangli Regency obtained from the PUPR Agency of Bangli District, Bali Province, Indonesia

# Customary Land Administration

Customary land administration refers to the traditional systems and practices through which indigenous communities govern and manage their lands, territories, and natural resources based on their customary laws, norms, and cultural practices. It involves the collective decision-making, allocation, use, and conservation of land and resources by indigenous communities, often guided by principles of sustainability, intergenerational equity, and cultural values.



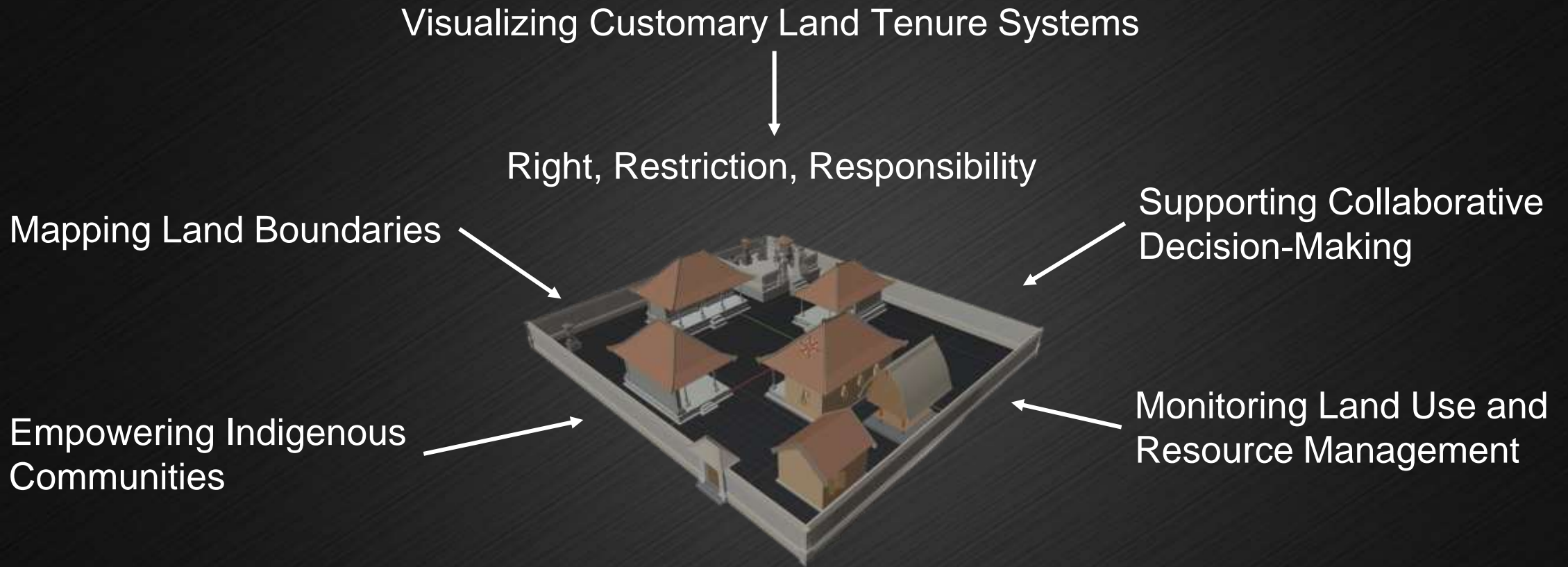
Sustainable Land Management



Preservation of Indigenous Knowledge

Protection of Cultural Practices

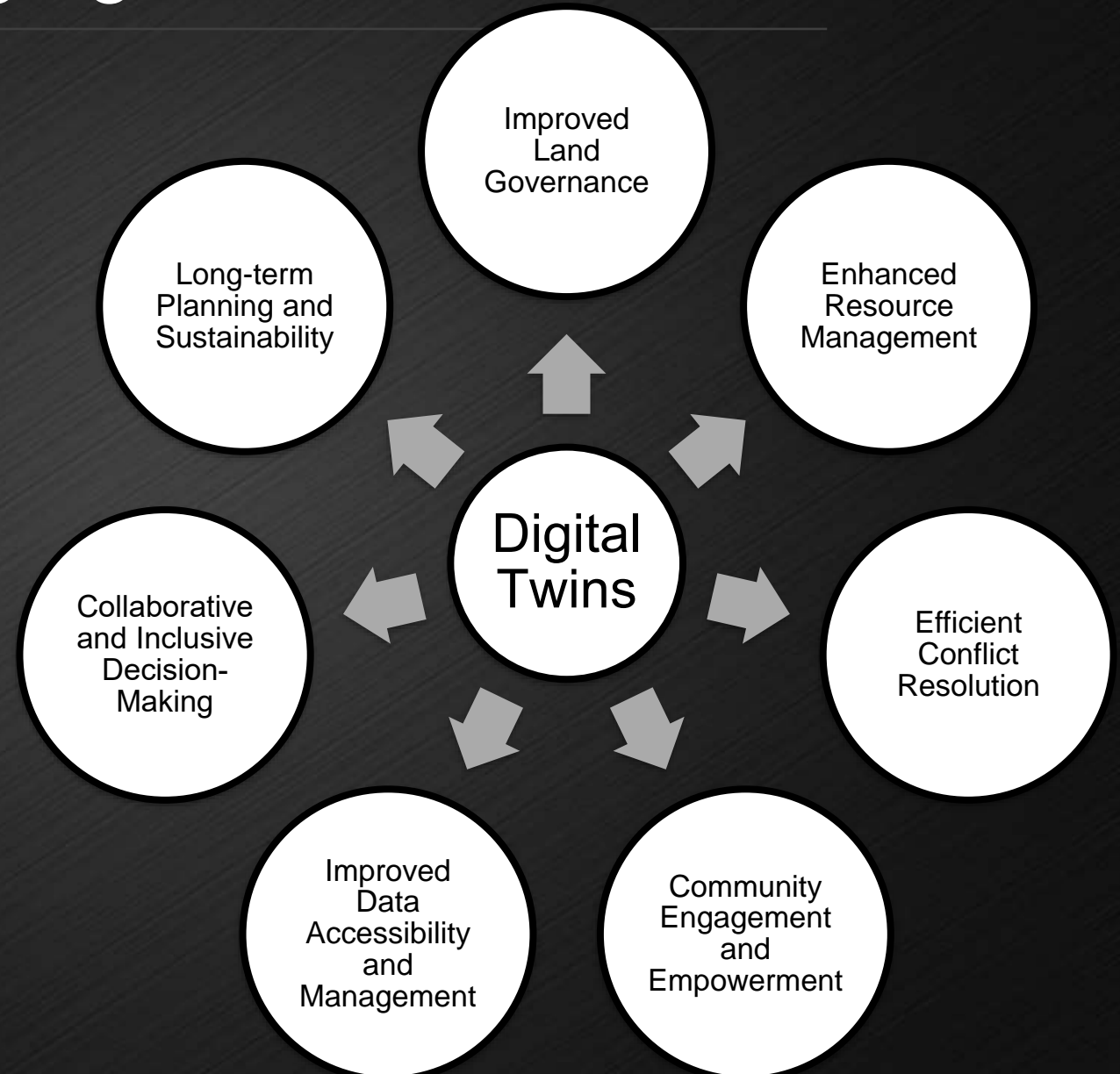
# How digital twins can contribute to Customary LA?



**By leveraging digital twins, customary land administration can benefit from improved land mapping, visual representation of tenure systems, efficient decision-making, and data-driven monitoring. This contributes to the preservation of indigenous knowledge, cultural practices, and sustainable land management, while ensuring the recognition and empowerment of indigenous communities in land governance processes.**

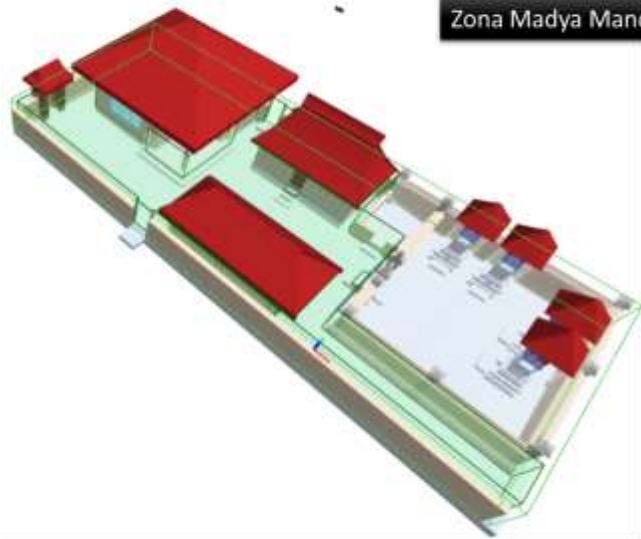
# Discuss the advantages of using digital twins for customary land administration

Digital twins offer numerous advantages for customary land administration, including improved land governance, resource management, conflict resolution, community engagement, data accessibility, and long-term planning. By leveraging digital technologies, customary land administration can benefit from enhanced efficiency, transparency, and sustainability, while preserving indigenous knowledge, cultural practices, and land rights.



# BIM for Customary Cadastres

Zona Madya Mandala

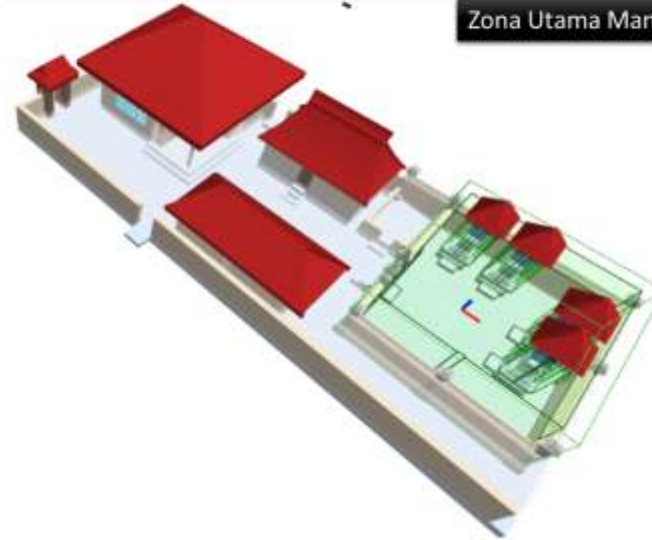


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<input type="checkbox"/>	Space	2	Children's Room
<input type="checkbox"/>	Space	3	Living Room
<input type="checkbox"/>	Space	1	Utama
<input type="checkbox"/>	Space	2	Madya
<input type="checkbox"/>	Space	3	Madya
<input type="checkbox"/>	Space	4	Nata
<input type="checkbox"/>	Space	4	Parent's Room
<input type="checkbox"/>	Space	5	Poon (Kitchen)
<input type="checkbox"/>	Space	9	Ritual Room
<input type="checkbox"/>	Space	10	Sanggah
<input type="checkbox"/>	Space	11	Sanggah
<input type="checkbox"/>	Space	12	Guest's Room
<input checked="" type="checkbox"/>	Space	13	Natah / Local Area
<input type="checkbox"/>	Space	13	Madya

Name	Value	Unit
<b>Element Specific</b>		
<b>Legal Document</b>		
Approved By	Kepala BPN Kab. Bangli	
Luas Bidang	119,917747	m2
Luas Volume	291,303782	m3
NDB	819	
Nilai Pajak	Rp. 0,-	
Pemilik	Desa Pakraman Penglouran	
Register By	Kekur Tommy Suhan, ST	
Status	Approved	
Status Hak	Hak Milik	
Wilayah	Kelurahan Kubu, Kecamatan Bangli, Kabupaten Bangli, Provinsi Bali	
<b>Tri Mandala Zona</b>		
Zona	Madya	

Zona Utama Mandala

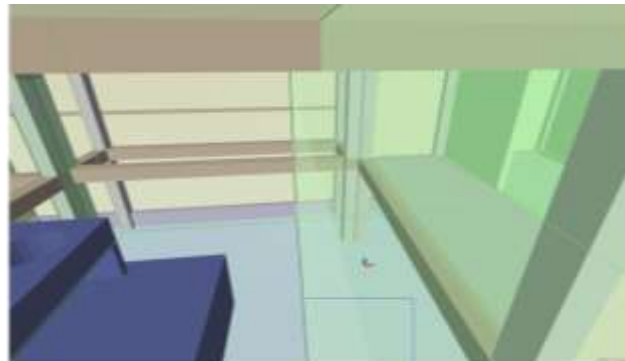
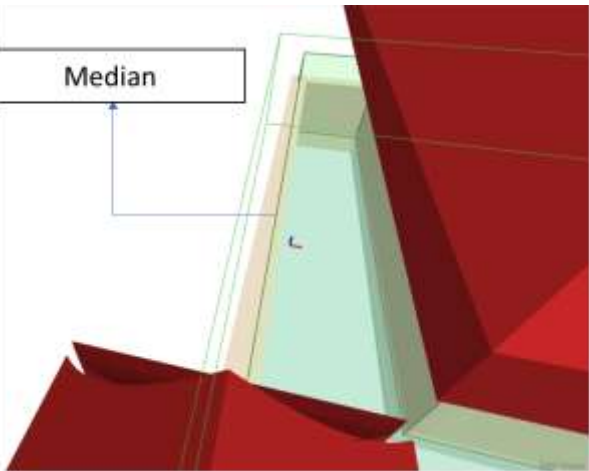


Active	Type	Name	Description
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<input type="checkbox"/>	Space	3	Madya
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<input type="checkbox"/>	Space	13	Madya

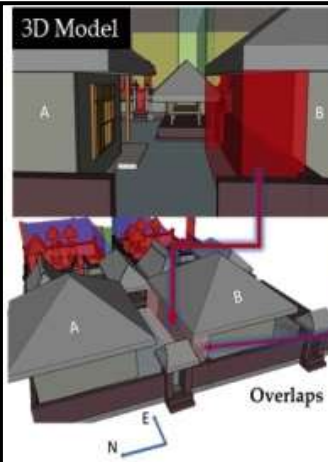
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<b>Legal Document</b>		
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Pemilik	Desa Pakraman Penglouran	
Register By	Kekur Tommy Suhan, ST	
Status	Approved	
Status Hak	Hak Milik	
Wilayah	Kelurahan Kubu, Kecamatan Bangli, Kabupaten Bangli, Provinsi Bali	
<b>Tri Mandala Zona</b>		
Zona	Utama	

Median



Virtual Boundary

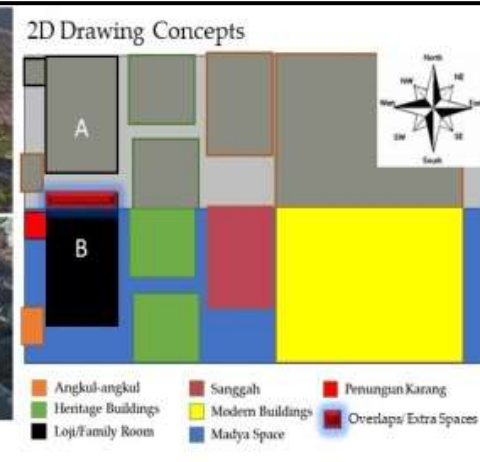
3D Model



Point-cloud



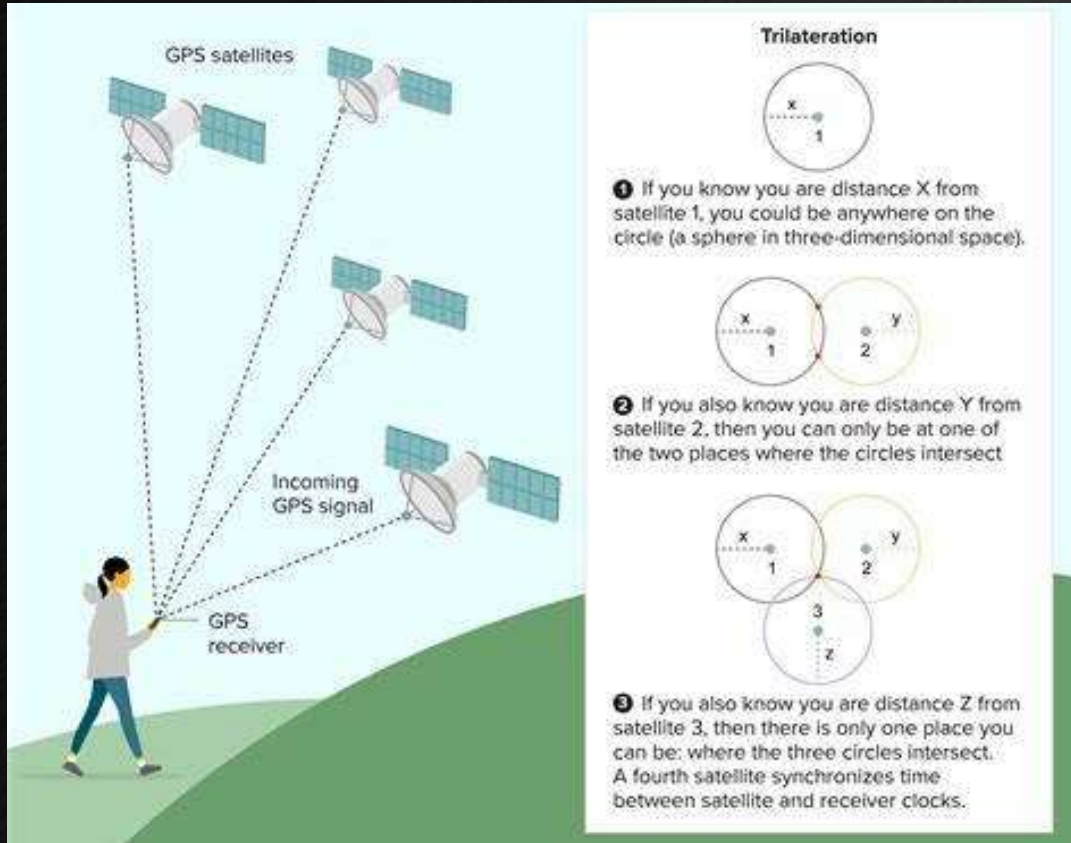
2D Drawing Concepts



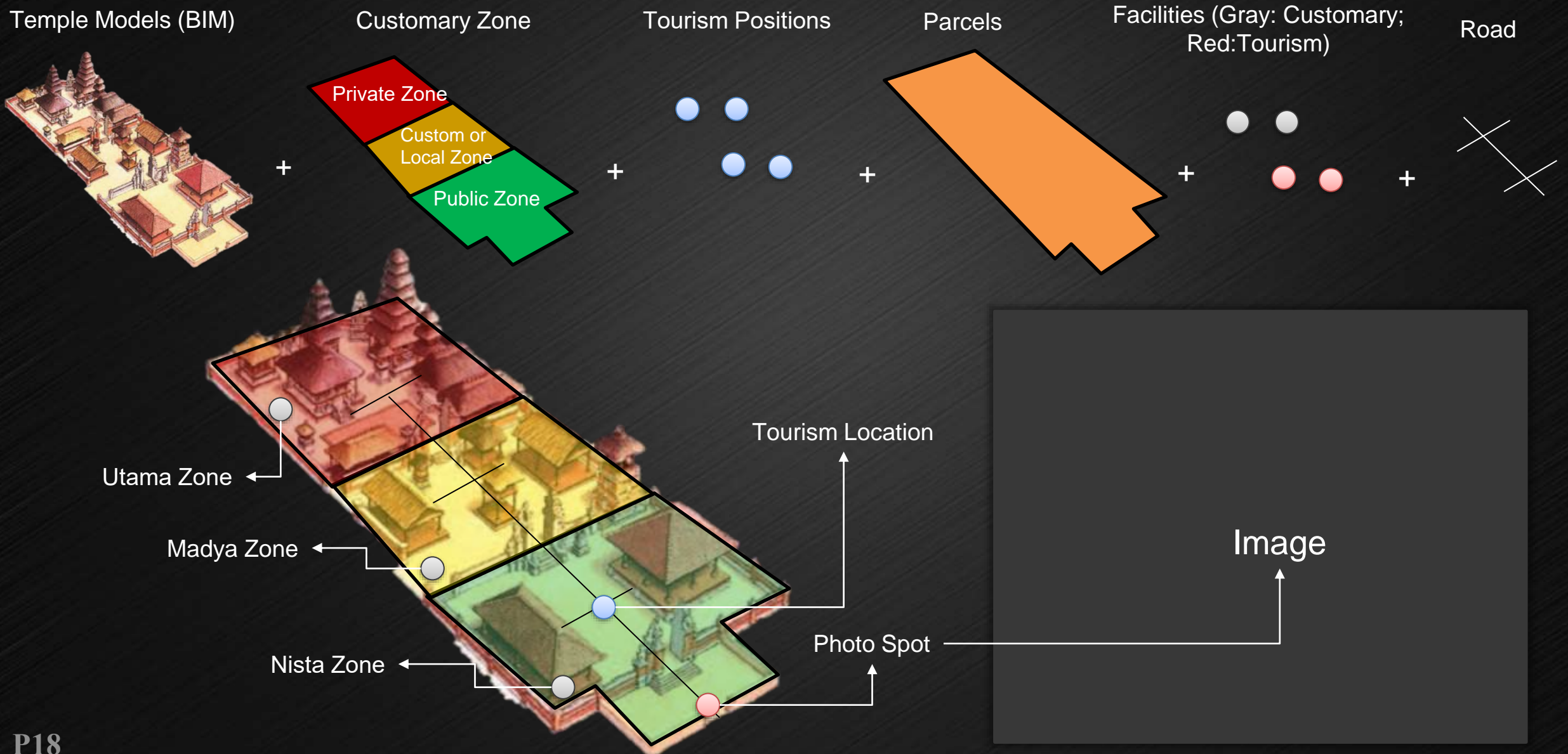


# Navigate Positioning

A GPS receiver, like the one in smartphone, pinpoints its location on Earth Surface by analyzing its distance to three GPS satellites; a fourth satellite synchronizes clocks in the receiver and satellites



# Overlay BIM and GIS concept



# Iportal Cultural Heritage Tourism



## Pura Penataran Agung



Go Live

AR

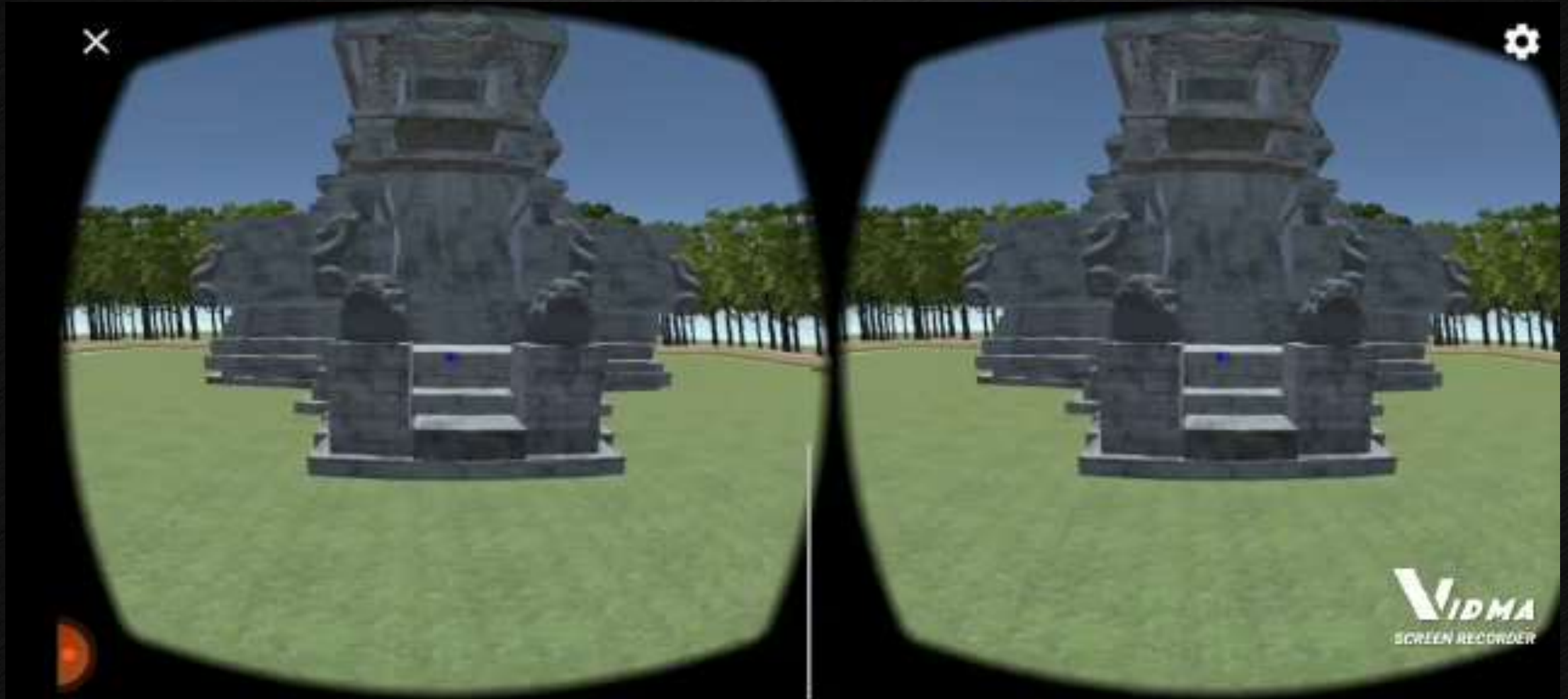
VR

XR

Information

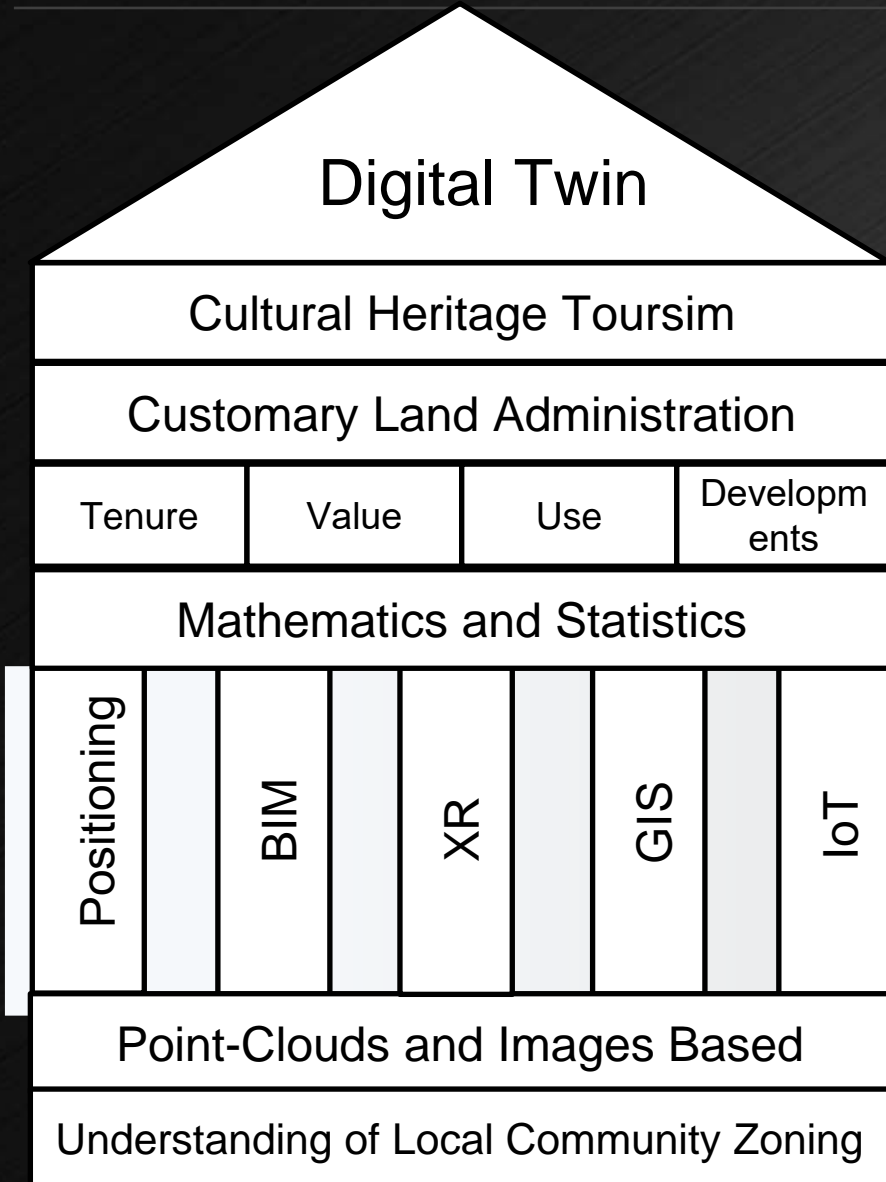
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34	344	Desa A...	407

# VR - Cultural Heritage Tourism

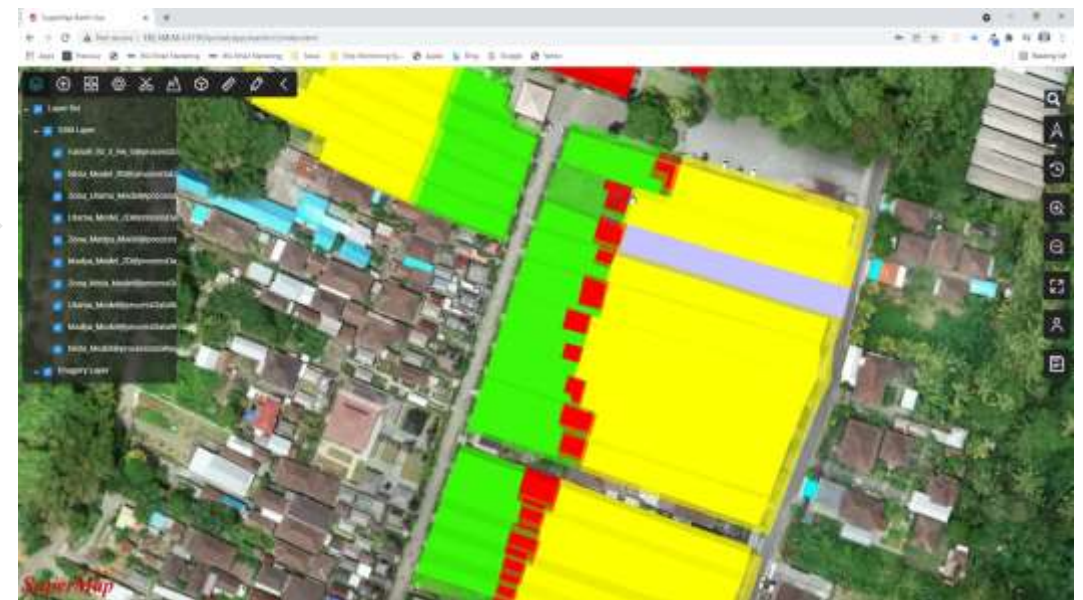
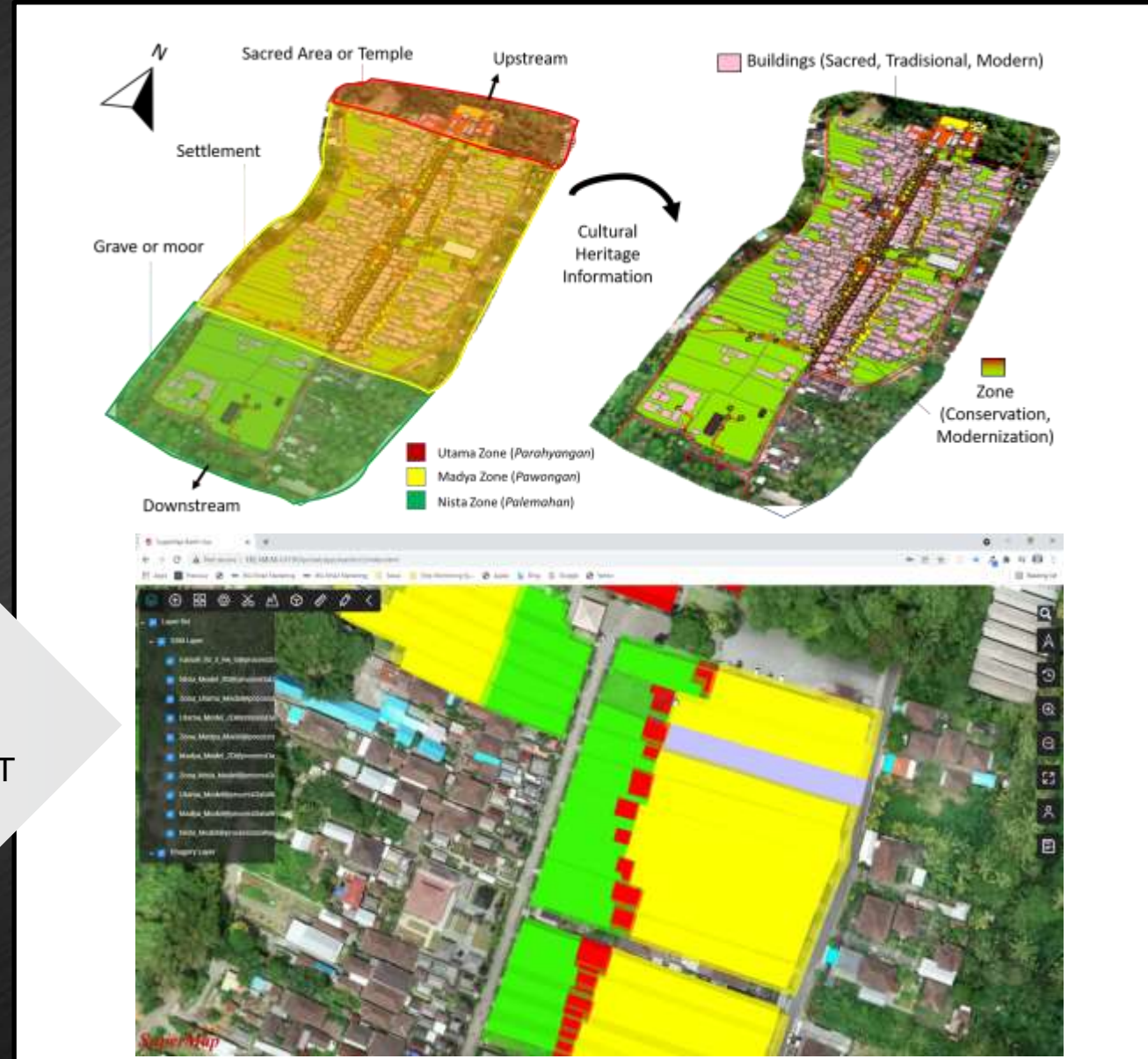




# Digital Twin future concept



Future:  
GeoAI,  
ChatGPT



# The challenge is create a digital twin for this area

Minka, Japan



Turf House, Islandia



Irish Cottage  
Thatched Roof,  
Ireland



Asta Kosala Kosali, Bali,  
Indonesia



Iglo, Canada



Hanok, Korea



Traditional Holland  
House, Belanda



RUEN KHUENG  
PHOOK, Thailand



Izba, Rusia



Trullo, Italia



Siheyuan, China



Vietnamese stilt home,  
Vietnam





# Thank You All!

**GISTC** | 2023地理信息软件技术大会  
空间智能 因融至慧 | 2023 Geospatial Information Software Technology Conference

ဧည့်သည်တော်များအား  
ကျေးဇူးတင်အထူးတော်စွာ  
တောင်းဆိုပါသည်။