

# Digital Twin Hype: Threat or Opportunity for PMAs?

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value of city-level and nationwide Digital Twins?  
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## Forewords

- ▶ This presentation is an opportunity to share thoughts with scientists that have already worked on the topic
- ▶ This presentation is an attempt to structure my ideas... 😊
- ▶ PMA : Public Mapping Agencies
  - National / Region / City (called “City offices” later on)

# Forewords

## ▶ DT from NMCAs perspective

- “a realistic digital representation of physical assets, processes and systems”. (Ellul et al., 2022)

## ▶ DT from Socio-Technical Perspective

- “... CDTs are realistic digital representations of cities (including their assets, processes, and systems) that aid decision-making aimed at delivering city-level outcomes (urban planning, management, and associated services) and provide improved insights for decision-making”. (Nochta et al., 2021)

# Forewords

The practical implementation of the concept

- ▶ (1) 3D city models enriched with semantic information
- ▶ (2) often coupled with historical and sensor data in near or real time (depending on an appropriate rate of synchronization),
- ▶ (3) enabling a connection (e.g., data flow between the real counterpart and the virtual twin and vice versa),
- ▶ (4) allowing updates and analysis through a variety of simulations, predictions and visualization tools (web applications or game engines platforms)
- ▶ (5) offering an integrated view of the multiple datasets, models through its life cycle allowing to understand and adapt city current and future states.

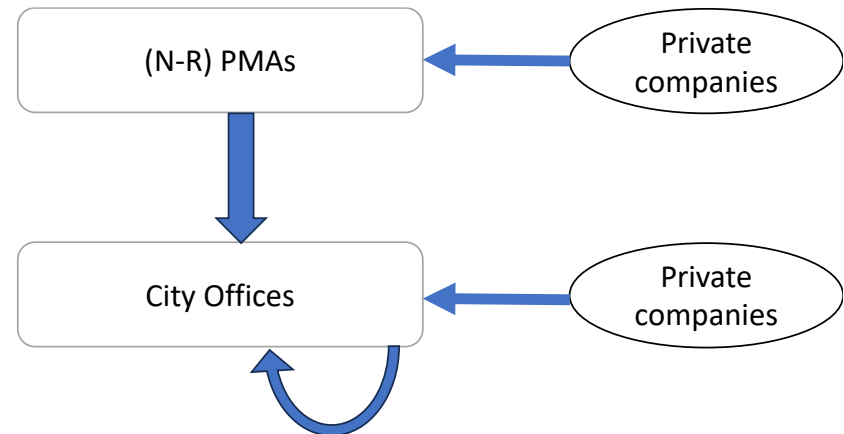
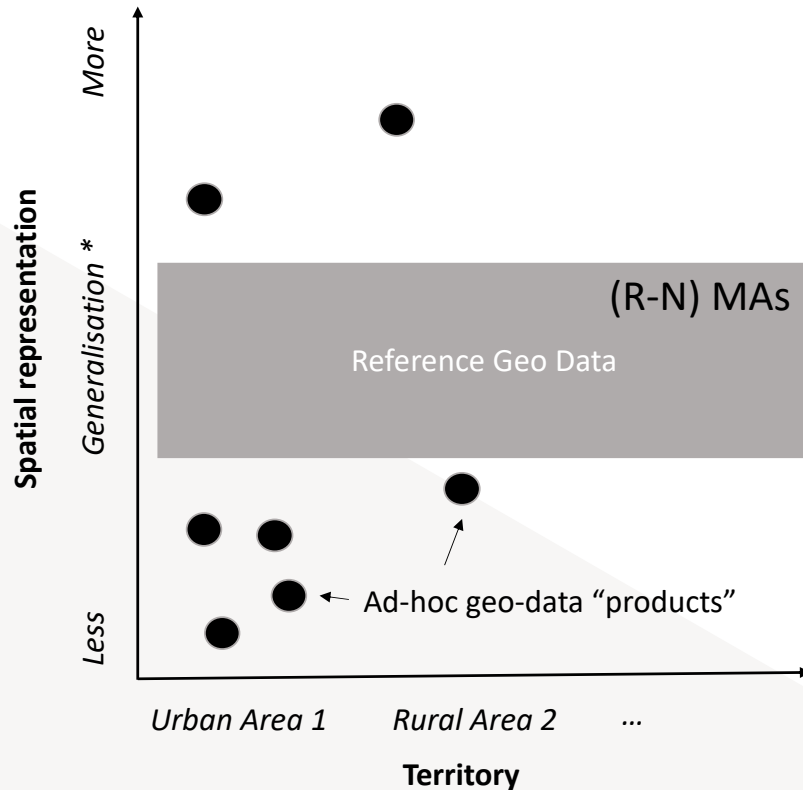
## Forewords

- ▶ In this presentation, I would like to consider impacts (positive or negative) that development of very ambitious DTs could have on public organisations that produce, control or distribute geographic information.
- ▶ Part 1: Position the problem and identify trends
- ▶ Part 2: Analyse a case study

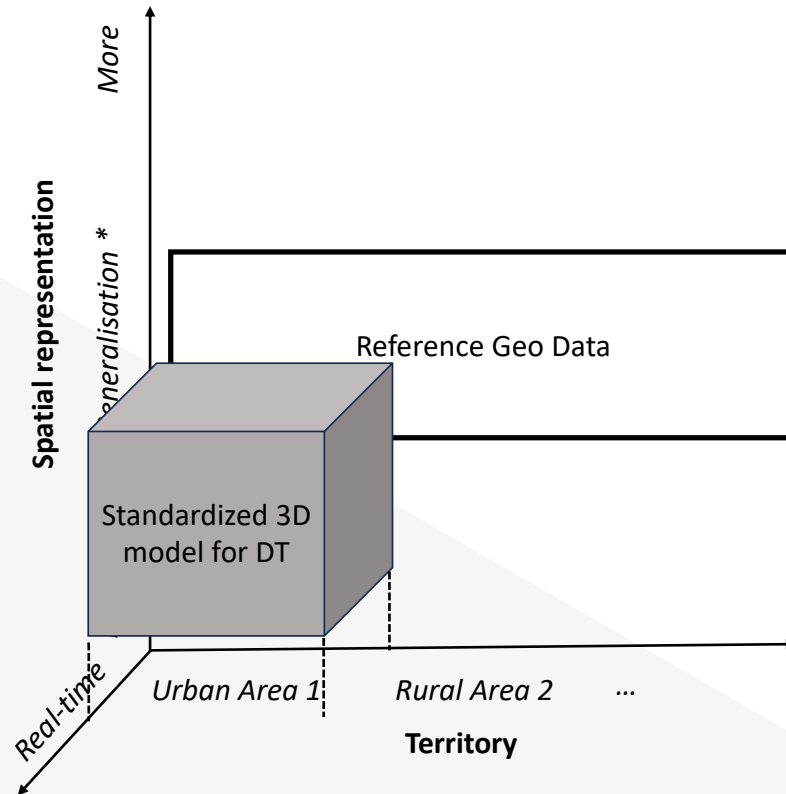


## **Part 1:** Position the problem and identify trends

# PMAs and Geo Data “production” up-to-now



# DT core 3D model's requirements



(N-R) PMAs

?

Private companies

City Offices



# Data is only of the challenges

## Technical challenges

- Data
- Integration
- Interoperability
- Software
- Technical competency
- Standard
- Update
- Data creation
- Data complexity
- Architecture
- Data maintenance
- Hardware
- Reconstruction
- Visualisation



## Non-technical challenges

- Understanding
- Practical value
- Collaboration
- Capacity building
- Management
- Data sensitivity
- Ownership
- Trustworthiness
- Participation

*The combined list of challenges identified from the literature review and the Delphi survey (after Lei et al., 2023).*

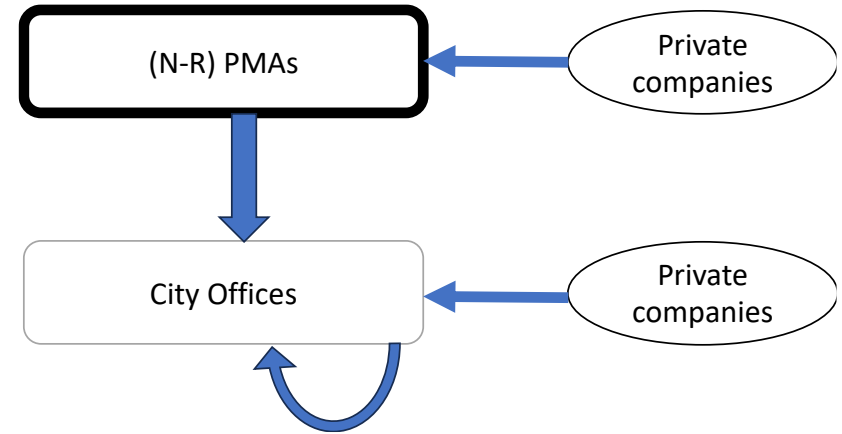
# Three main trends

## 1. “Keep it as usual”

► (N-R) PMAs adapt their “production” to fulfil DT requirements

► **Threat :**

- Are they not too far from the applications?
- Being just one of data and “solutions” providers → not solving the whole DT issue

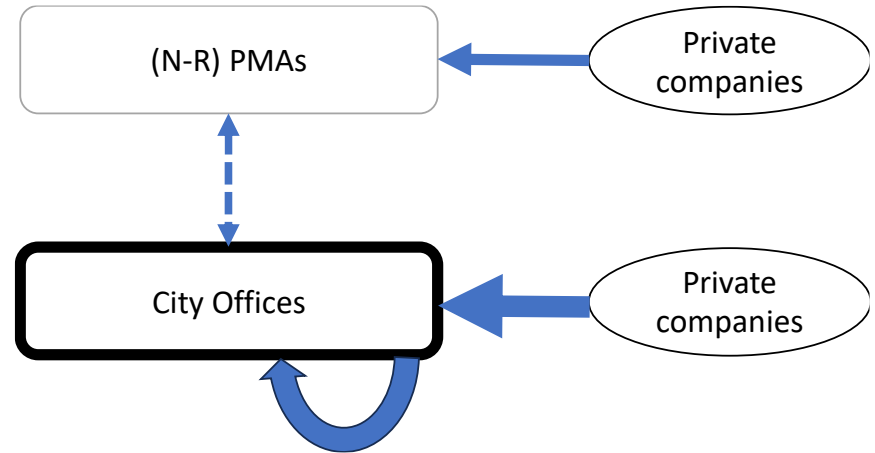


- *3D digital landscape model – Swisstopo?*
- *National Land Survey of Finland (NLS)?*
- *Bundesamt für Kartographie und Geodäsie (BKG) – Germany?*
- ...

# Three main strategies

## 2. “Promoting City level”

- ▶ “City DT should be handled at the City level – closer to the applications and usage”



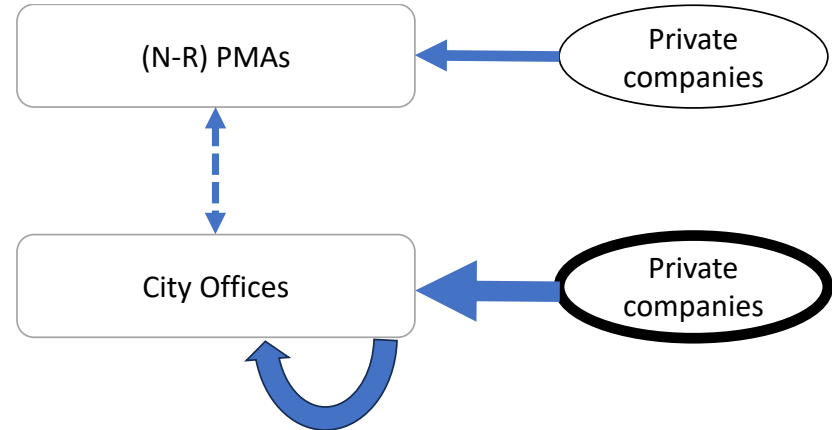
- *Helsinki 3D?*
- *Digital Twin Munich?*
- *Rennes 3D?*
- *Zurich 3-4D?*
- ...

# Three main strategies

## 2. “Promoting City level”

### ► Threat :

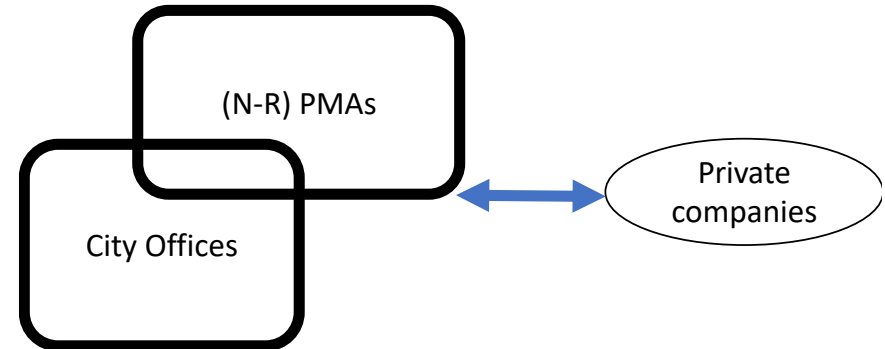
- Are there enough resources and competencies?
- Need for excessive externalisation?
- Lost of public sovereignty/mastery on sensible data and processes



# Three main strategies

## 3. “Reshaping PMAs’ roles”

- ▶ Considering City and “territory” DTs requirements, reshape the current division of works within public agencies
- ▶ Such a evolution is not a merely technical challenge ... but a **socio-technical challenge** - Articulation of sets of technologies and ways of governing (politics, economy, human resources, values and interests, ...)

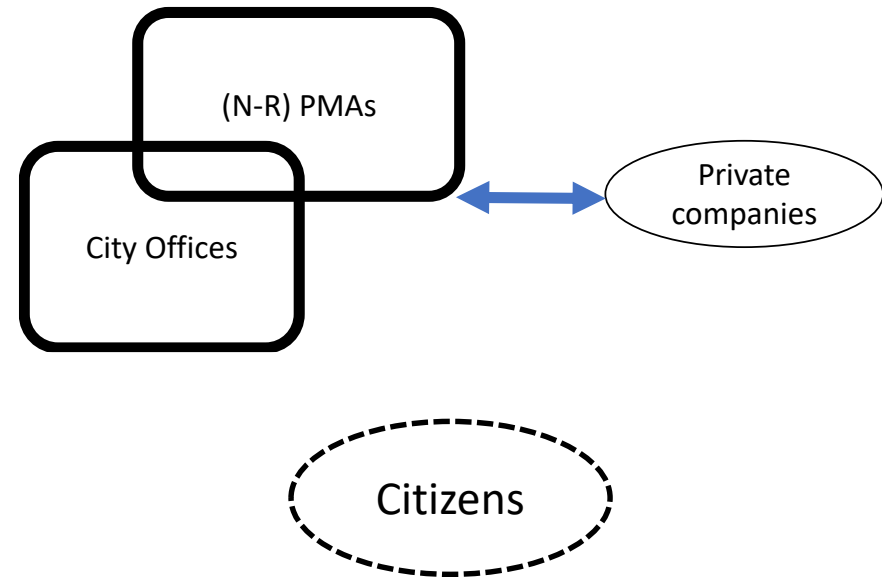


- *Rotterdam 3D?*
- *Digital Twin Australia?*
- ...

# Three main strategies

## 3. “Reshaping PMAs’ roles”

- ▶ **Opportunity:** Keep a good balance with private partners (e.g. act as a platform) and ensure the public sovereignty/mastery on data and processes.
- ▶ **Threat:** Public operators' resistance to change, and the political and governance issues involved
- ▶ The best schema to include Citizens in the whole process?





## **Part 2:** A case study – Liege DT initiative

# The early stages

- ▶ In 2021, the Liège Economic Redeployment Group (GRE - Liège) carried out a market study and brought together a number of players interested in setting up a digital twin in Liège.
- ▶ A smaller group launches in early 2022 to take the project forward through a number of initiatives and developments : GRE-Liège, SPI, City of Liège, ULiège

## LIEGE DIGITAL TWIN

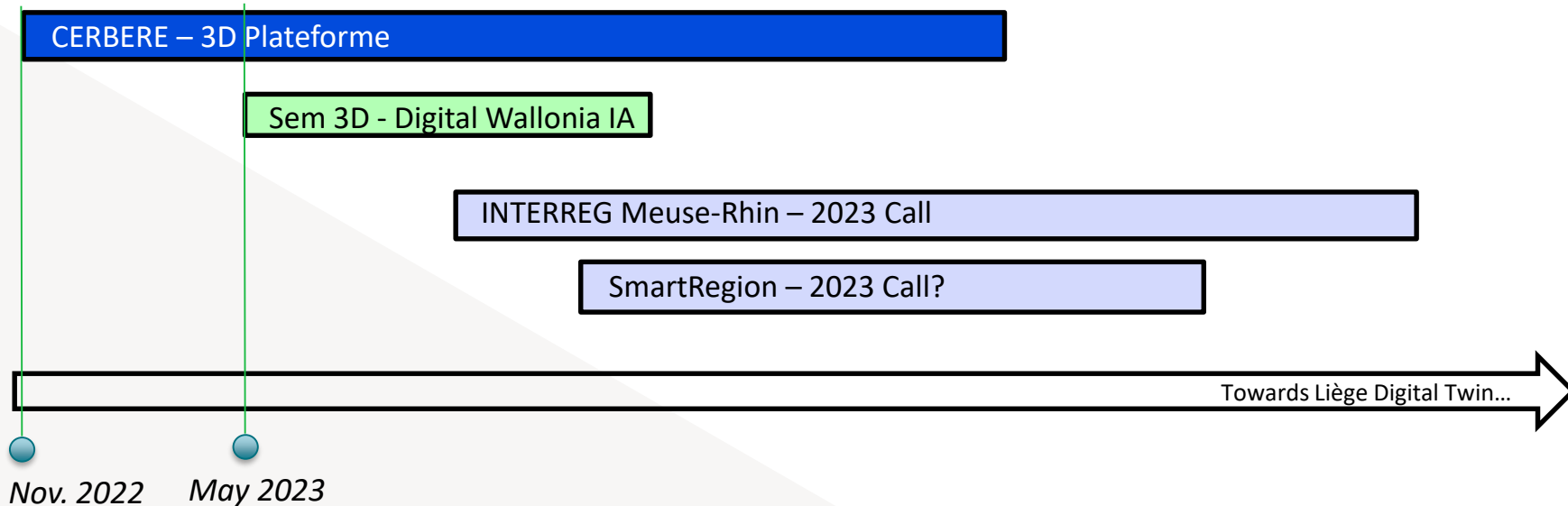
Rencontre Doctorant.e.s ULiège &  
SPI pour façonner ensemble la  
métropole de demain





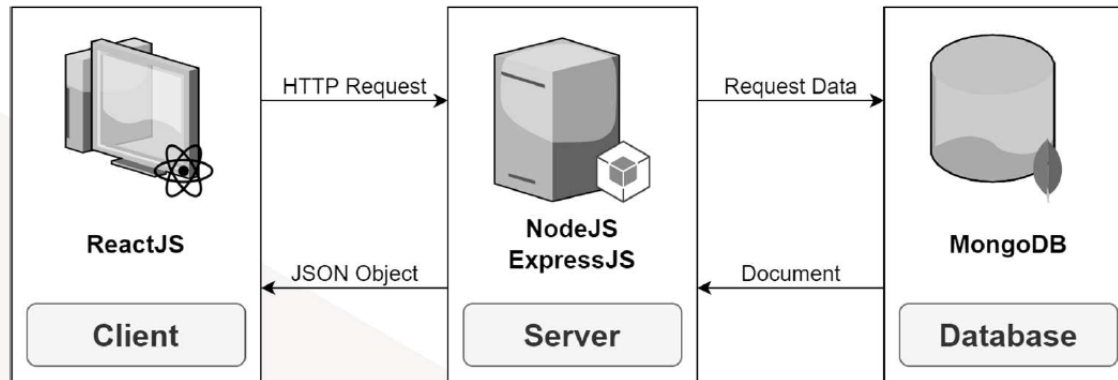
# So far ... ULiège and City of Liege partnership

- ▶ Several DT research projects at the Geomatics Unit
- ▶ Specific strategy for Liege DT :



# CERBERE - CityJSON-based IT architecture for City DTs

- ▶ A MERN application (MongoDB, ReactJS, ExpressJS and NodeJS) to manage CityJSON files
- ▶ Guarantee of the logic and quality of the model passed from the database to the middleware



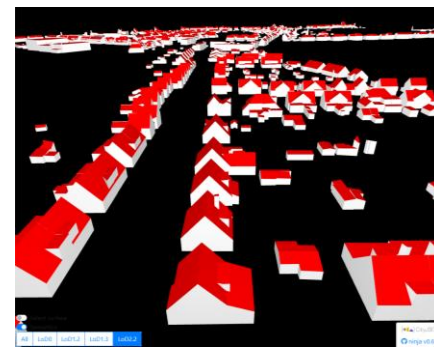
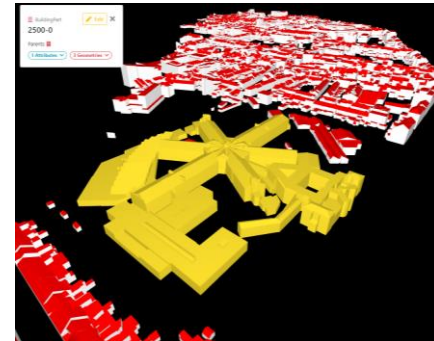
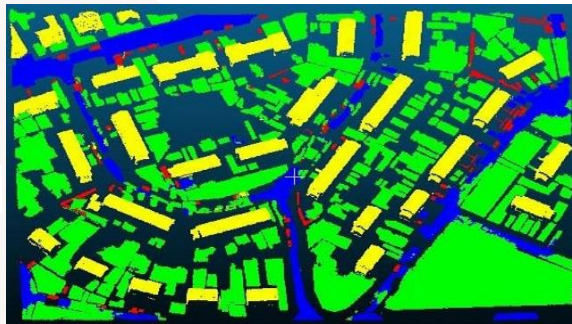
Nys, G.-A., & Billen, R. (2022). From consistency to flexibility: Handling spatial information schema thanks to a middleware in a 3D city modeling context. Transactions in GIS. doi:10.1111/tgis.13014 <https://hdl.handle.net/2268/299037>

## SEM3D - Obtaining 3D semantic objects for urban applications

### ► Object extraction and automatic conversion to CityJSON

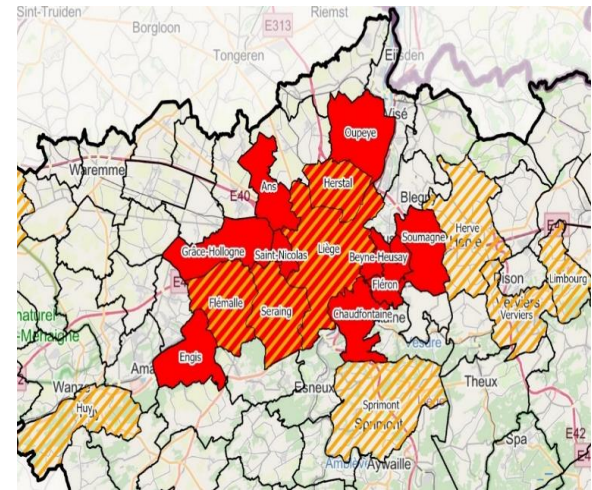


- Buildings
- Vegetation
- Impervious surfaces
- Cars



# Current strategy

- ▶ Progressive development through technical and application building blocks
- ▶ "Proof of concept" to raise awareness among the various stakeholders
- ▶ Define the geographical framework of the DT and activate the various public partners



# Analysing the case study

## ► Weaknesses

- A misunderstanding of City DT issues at the early stages
- The rigid structure of the various public organisations

## ► Strengths

- The diversity of stakeholders involved (university / public bodies) and their links with the private sector
- Ongoing research at the University and openness to research communities

# Analysing the case study

## ► Threats

- Lack of clear support and action from political decision-makers
- The willingness and opportunity for change within public bodies

## ► Opportunities

- A stimulating field of research
- The willingness to develop innovative solutions to technical and non-technical problems

Wanted to be a trend 3 **“Reshaping PMAs’ roles”** ... so far ... more an early stage of trend 2 : **“Promoting City level”**

## General conclusions

- ▶ The development of ambitious DTs raises socio-technical challenges for public agencies
- ▶ DTs are intended to be closer to reality (in space and time), so isn't it logical that public structures should evolve along these lines?
- ▶ Threat: if they are not able to handle DT complexity, there is a risk that these missions will be abandoned to the private sector, resulting in a loss of public sovereignty and mastery.
- ▶ Opportunity: Adapting the roles and missions of public agencies to the challenges posed by DTs to ensure public values in city DTs

# Thanks for your attention



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An exploratory survey for Digital  
Twin (DT) concepts and initiatives  
for cities.

