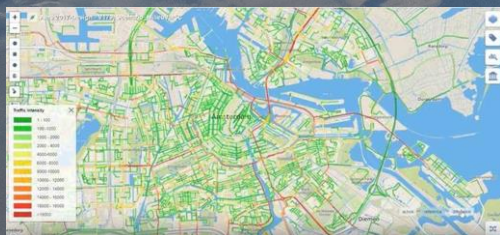
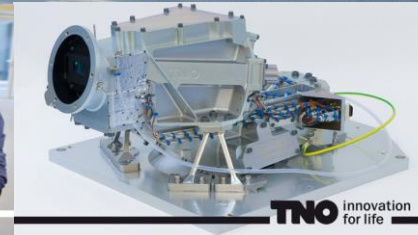


EXAMPLES OF VARIOUS TWINS AT TNO

BUILT ENVIRONMENT



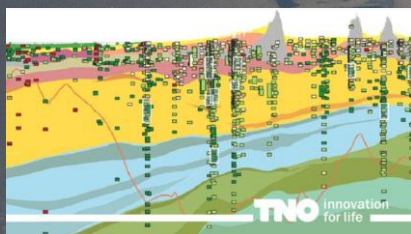
SMART INDUSTRY & SPACE



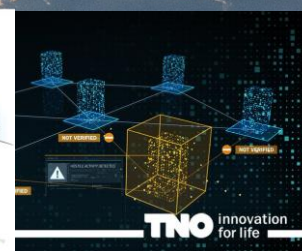
SELF DRIVING



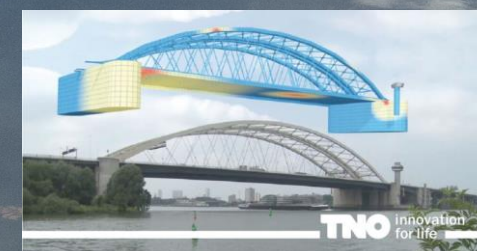
SUBSURFACE



IT & AUTOMATION



INFRASTRUCTURE



MY WORK:

TRANSFORM SINGLE MODEL TO INTERACTIVE TWIN

Creating models & knowledge

YOUR STRATEGY IN SEVEN STEPS



Acquiring & storing
data & information

Data
Experts

Twinning
Experts

Business
Consultants

Adjusting processes &
creating feedback loops

Twinning Methodology and
Increased capability

IT Experts

Integrating digital twin

**TOWARDS MULTI-PURPOSE
MULTI-USE TWINNING
INFRASTRUCTURE**

› WHY DO YOU USE A TWIN?

good enough
to **take action**
for a **specific purpose**

“A digital twin is a **virtual representation** of **real-world entities and processes**, **synchronized** at a specified **frequency** and **fidelity**”

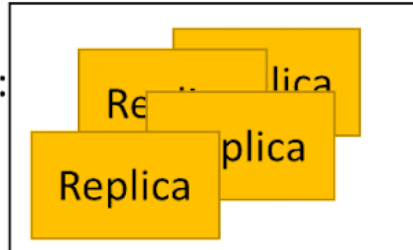
Source: OMG Digital Twin Consortium

› TWIN BREAKDOWN BASED ON ISO 23247

Digital Twin
application (software)

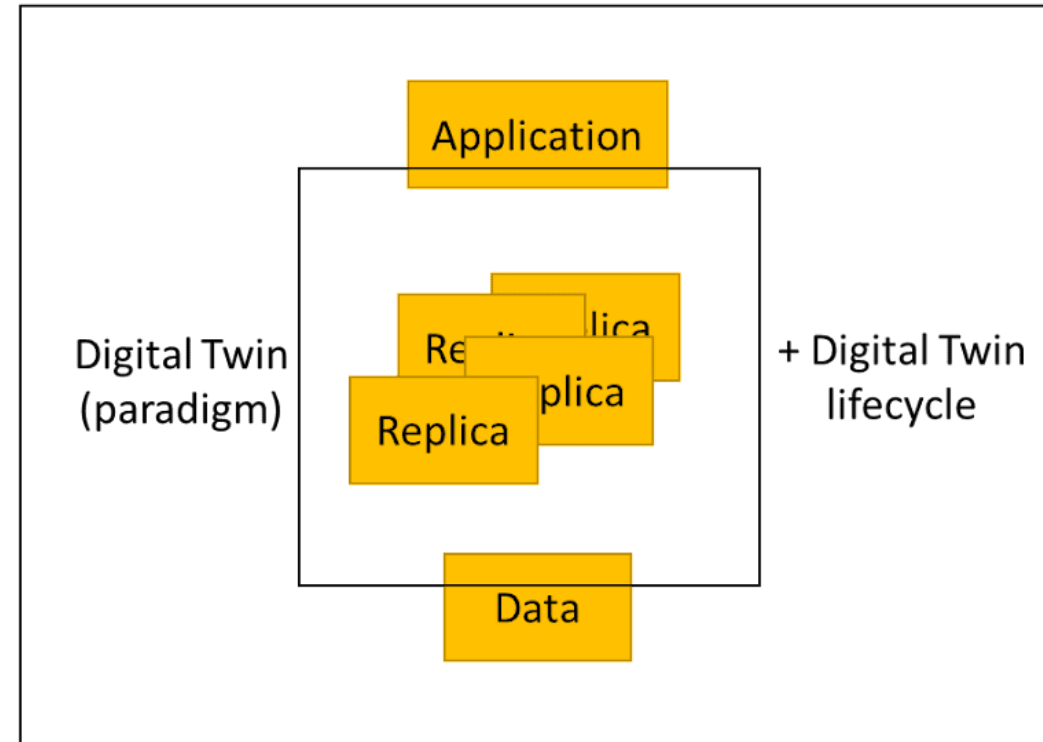
Application

Digital Twin (noun):
One or more
replicas (model)

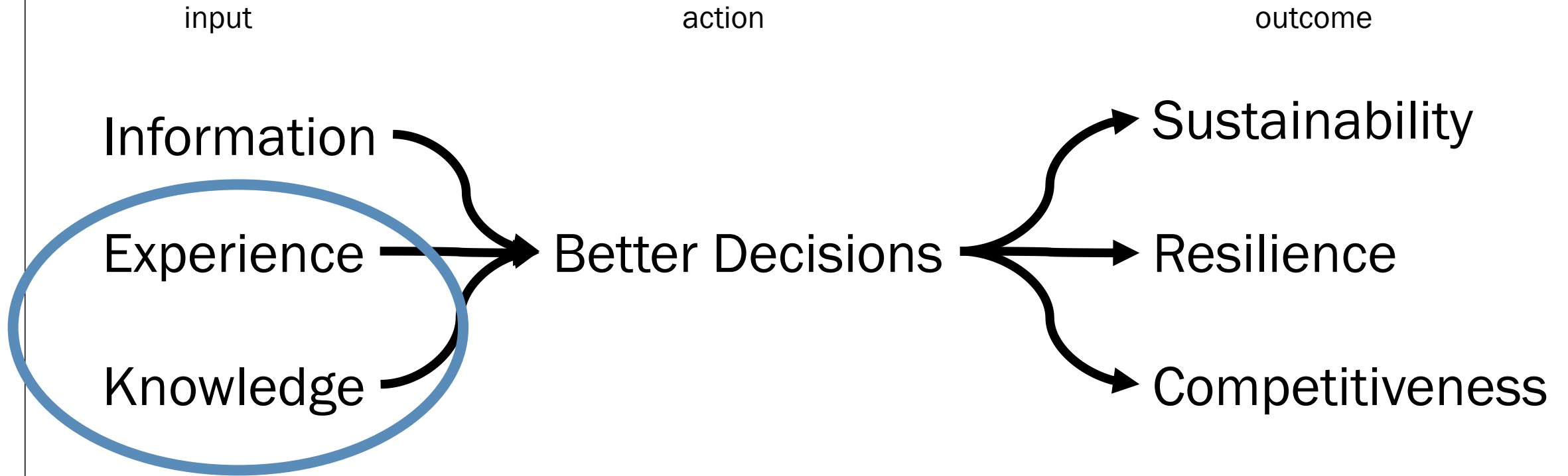


Data

Digital Twinning



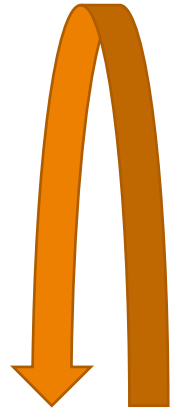
› DIGITAL TWINS - CONTEXT



Twin => digital replica of experience & knowledge!

› 7 STEP APPROACH FOR DIGITAL TWINS

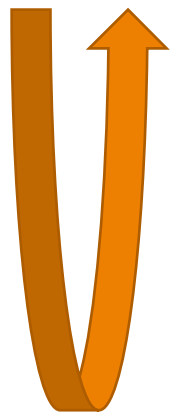
LINKING BUSINESS, CULTURE, ORGANISATION AND TECHNOLOGY (LAST)



1. What is your purpose?
2. What is your scope?
3. What do you already have?
4. ***Make the replica!***

} **WHY** **good enough**
to **take action**
for a **specific purpose**

} **WHAT**



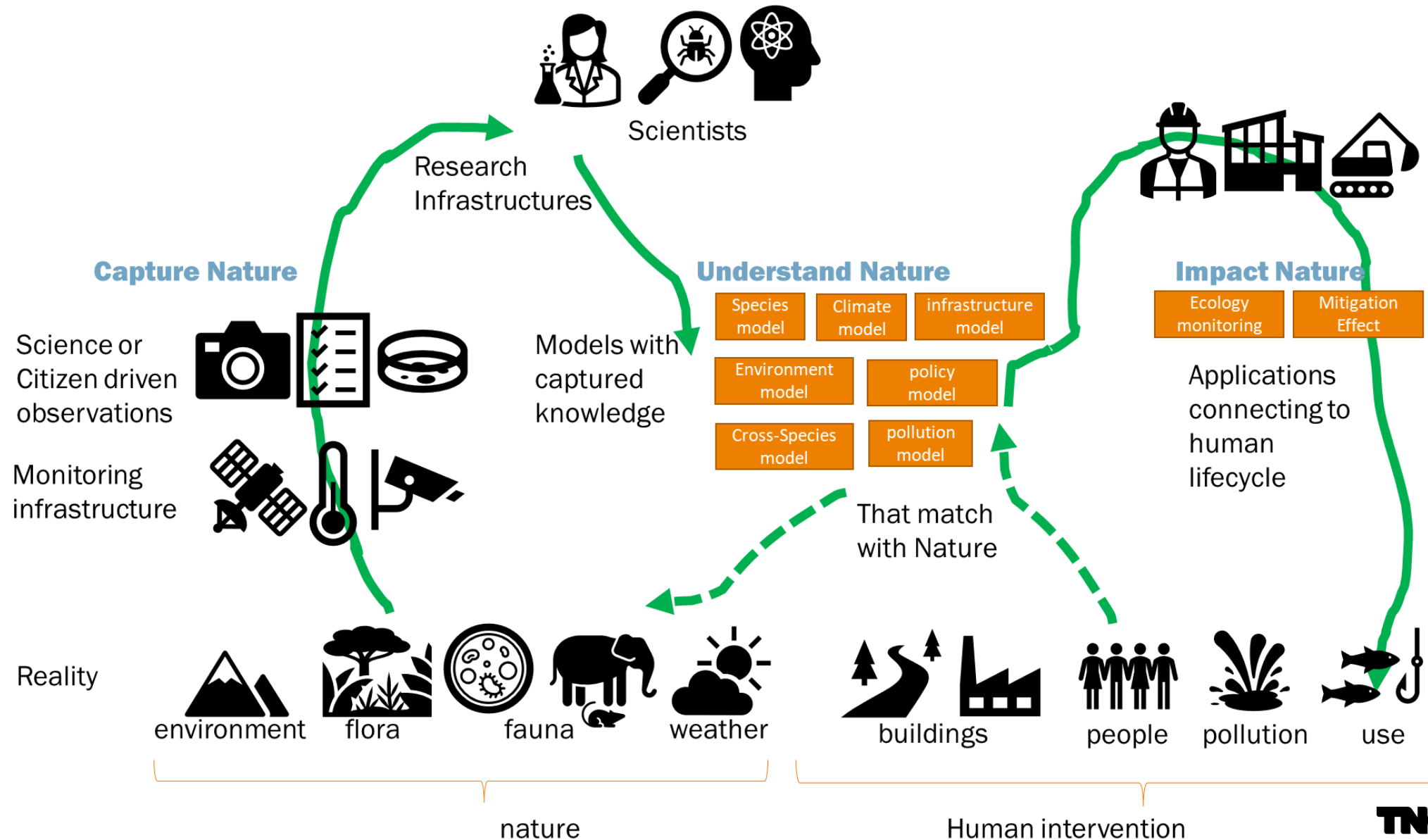
5. How do I get the twin operational?
6. How do I apply the twin in my business?
7. How do I evaluate, update and improve my twin?

} **HOW**

EXAMPLE: URBAN STRATEGY



EXAMPLE: BIODIVERSITY



› BABY STEPS TO TRANSFORM SINGLE MODEL TO INTERACTIVE TWIN

Scientific model / Twin Pilot/ One person Twin	Self contained Twin (Running Pilot)	Operational Twin	Scenario Twin	Interactive Twin
Model that mainly lives on the PC of the researcher	Shareable model that can run independently	Model on infrastructure for various applications and is able to get the right data/configuration	Twin application that is able to run multiple scenarios and optimize according to user parameters	Twin application that can respond interactively to user changes and deliver value for business

How do we get there?
Who does what?



Business

Domain



IT

Data

Big leap Big leap 

Role	Category	Scientific model	Self contained Twin.	Operational Twin	Scenario Twin	Interactive Twin
Business	Description	Owners mind	7 step template	User storyline	Scenario storyline	Interaction flow
IT	Automation	Self-Run executable	Modular / Scriptable + APIs	Scaleable		
IT	Deployment / Transferability	Not deployable	Self contained folder	Scriptable / Containerized	As-a-Service + API	
Data	Data	Manual / Hand crafted	Separated into input / configuration / output	Based on (External) APIs	Outputs of twins are stored & re-used	Live data streaming
Data	Fairness	Findable Data Model Application	Accessible Data Model Application	Interoperable Data Model Application	Reusable Data Model Application	
Domain	Test / Validation	Non-validated or Single-case validated	Cross-validation / Parameter sweep	Generalized		
Domain	Generalisability	Location / Habitat / Ecotype Time / Historical / Future		Taxonomy / Species / Subspecies Cross-species / Ecosystem		
All	Lifecycle	Non-versioned	Versioned model, data, application	Design choices are made explicit DevOps tools are in place	Versioned scenarios	

› CONSIDERATIONS

TWINNING IS A CHOICE, NOT A PRODUCT

- Twinning involves more than just creating the twin itself, it covers:
 - Organizational aspects & company culture
 - **New way of working, thinking & business processes**
 - Heavy use of digitalization & data driven working
 - Applying the results of the twin in your operation
 - And more

› **CONTACT ME:**



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