THE L-CDE PROJECT FOR A DATA DRIVEN INFRASTRUCTURE

MAKING CONSTRUCTION INDUSTRY OPEN AND CONNECTED

SIX FUNDAMENTAL CHANGES UNDERPIN THE NEW APPROACH

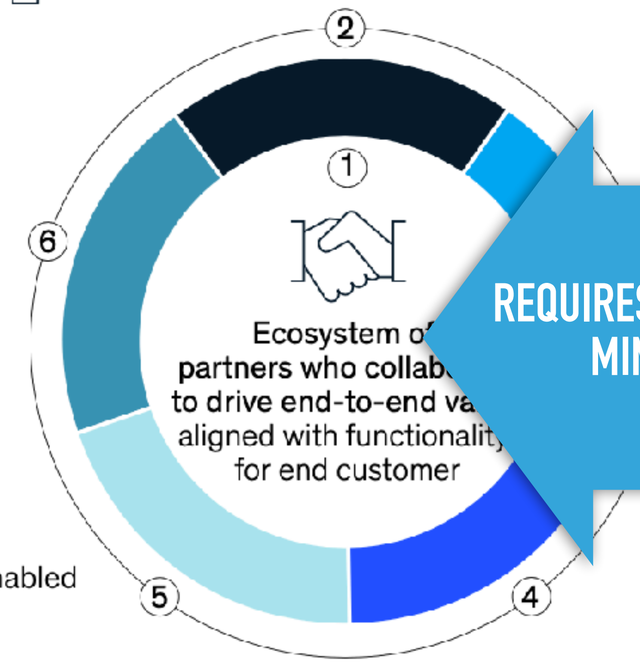
REQUIRES REAL INDUSTRY STANDARDS

REQUIRES OPEN, CAPABLE, ROBUST SYSTEMS

Industrialization (standardization, reuse, and modularization) for **repeatability and innovation**

Future-proofing of projects by ensuring **sustainability** and planning for potential opportunities, constraints, and risks

Data-driven operating model enabled by digital technologies



, and resilience,
ibility in project
onding to change

Sustained capability building and **redesigned talent pipelines** foste
collaboration across the project

REQUIRES CONTROL OF SUPPLY CHAIN

REQUIRES AGILE MANAGEMENT

REQUIRES THE RIGHT MINDSET

REQUIRES THE RIGHT PEOPLE

Shift in mind-sets to adopt disruptive ideas and ways of working to **unleash value from Projects 5.0**

McKinsey: Capital Projects 5.0: Reimagining capital- project delivery

THE GEMINI PRINCIPLES BY CDBB

Purpose: Must have clear purpose	**Public good** Must be used to deliver genuine public benefit in perpetuity	**Value creation** Must enable value creation and performance improvement	**Insight** Must provide determinable insight into the built environment
Trust: Must be trustworthy	**Security** Must enable security and be secure itself	**Openness** Must be as open as possible	**Quality** Must be built on data of appropriate quality
Function: Must function effectively	**Federation** Must be based on a standard connected environment	**Curation** Must have clear ownership, governance and regulation	**Evolution** Must be able to adapt as technology and society evolve

IPA TIP ROADMAP 2030

Stadt Zürich

Strategie BIM Stadt Zürich 2026

BIM®StZH

Strategie zur Koordination der Einführung von Building Information Modelling (BIM) in der Stadtverwaltung

Zweck der Strategie

rategie BIM Stadt Zürich 2026» (BIM®StZH) ziert Themen in Zusammenhang mit BIM, dtweit einheitlich adressiert und geklärt wer- ssen. Im Fokus stehen Grundlagen, Stan- und übergeordnete Rahmenbedingungen, trategisch, taktisch und operativ gute Vo- zungen für die Einführung von und die Arbeit in den Dienstabteilungen geschaffen wer- nnen. BIM®StZH strukturiert die Themen, e in einen Zusammenhang und definiert auf cher Ebene Ziele für die weitere Konkreti- in den Dienstabteilungen und städtischen gruppen.

ZH schafft Klarheit hinsichtlich der relevan- emen, gibt im Sinne einer Orientierung die richtung vor und schafft mit dem Umset- zungsplan die erforderlichen Strukturen für die wei- tere Bearbeitung. BIM®StZH bildet gleichzeitig die Grundlage für das sich entwickelnde gleichnamige Programm zur Umsetzung der Strategie.

2.3 Abgrenzung

BIM®StZH ist kein fertiges Handbuch zur Einfüh- rung der Methode BIM in der Stadt Zürich. Die dafür erforderlichen Grundlagen und übergeordneten Rahmenbedingungen existieren auf städtischer Ebene noch nicht. BIM®StZH zeigt vielmehr den Weg auf, wie diese erarbeitet werden können.

BIM®StZH definiert auf Projektebene keine Vorga- ben hinsichtlich Zielen oder Anwendungen für Planung, Bau und Betrieb der Bauwerke oder weite- ren BIM-Nutzungen. Dies verbleibt in der Hoheit der jeweiligen Dienstabteilungen. Sie formulieren unter Berücksichtigung von BIM®StZH ihre eige- ne, auf ihre Aufgaben gemäss Stadtratsbeschluss über die Departementsgliederung und -aufgaben (STRB DGA) optimal zugeschnittene BIM-Strategie.

BIM®StZH ersetzt nicht die bisherigen und künfti- gen Bemühungen von «GIS Stadt Zürich» gemäss der städtischen GIS-Strategie, sondern baut darauf auf und ergänzt diese hinsichtlich vernetzter Geo- informationen. Insbesondere für den digitalen Zwilling der Stadt Zürich ergeben sich Synergien: Sowohl BIM- wie auch GIS-Daten fliessen in den gesamtstädtischen Zwilling.

BIM®StZH baut auf den bestehenden Angeboten von OIZ und GeoZ auf und eruiert, ob und in wel- cher Form diese um zusätzliche Anforderungen hin- sichtlich BIM erweitert und ergänzt werden müssen. Bestehende Systeme in den einzelnen Dienstabteil- ungen werden integriert und verfügbar gemacht.

Im Rahmen von BIM®StZH geht die Stadt Zürich davon aus, dass mit der Anwendung von BIM neue, wertvolle Daten generiert werden und mit der Methode ein Datenlieferant entsteht, der sich ge- samthaft in die städtischen Systeme integriert. Die BIM-Programmleitung etabliert sich hierfür als Ansprechpartnerin und Vertreterin der Interessen, die sich aus der Nutzung von BIM ergeben und bringt entsprechende Inputs ein.

2.4 Integration

BIM®StZH folgt übergeordneten Strategien bzw. in- tegriert sich in die darin enthaltenen Ziele und Vor- gaben. Hinsichtlich der «Strategie Digitale Schweiz» des Bundes ist insbesondere das Aktionsfeld «In- frastruktur» von Interesse. Aber auch «Bildung, Forschung und Innovation» sowie «Umweltschutz, natürliche Ressourcen und Energie» enthalten wich- tige Punkte, die in BIM®StZH adressiert werden.

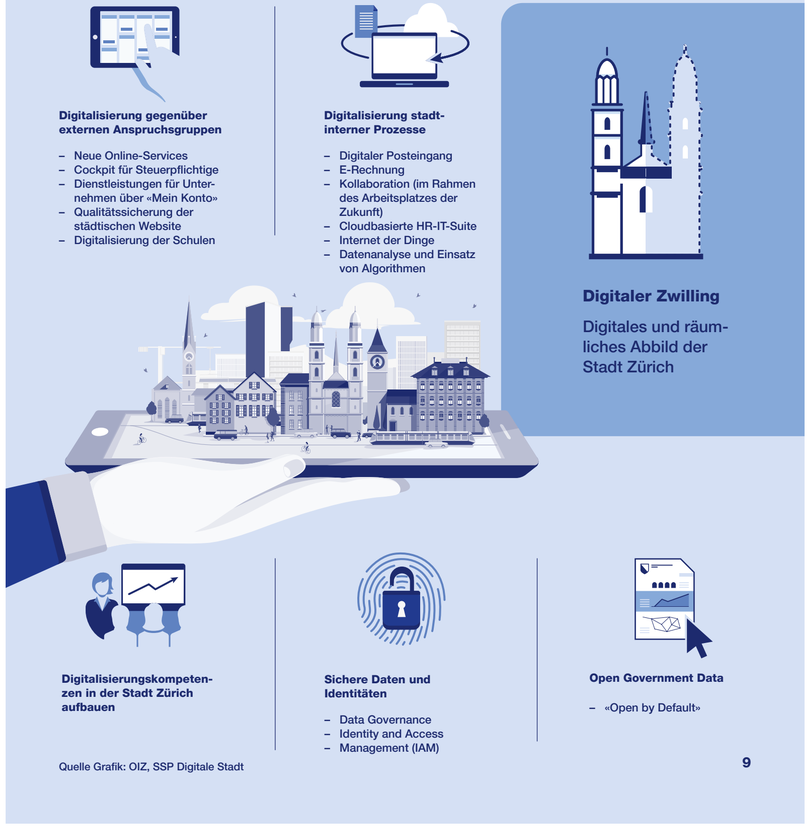
Die städtische Publikation «Strategien Zürich 2035» beinhaltet das Handlungsfeld «Digitale Stadt» und den strategischen Schwerpunkt (SSP) «Digitale Stadt». Mit dem Fokus auf digitale Zwillinge der Bauwerke gliedert sich BIM®StZH nahtlos in das Thema «Digitaler Zwilling» ein. BIM®StZH leistet aber auch wichtige Beiträge zu anderen Themen wie «Digitalisierung stadtinterner Prozesse», «Digitalisierung gegenüber externen Ansprech- gruppen» oder «Digitalisierungskompetenzen in der Stadt Zürich aufbauen».

BIM unterstützt zudem die Bemühungen der Dienst- abteilungen im Rahmen des Digitalpakts, den der Stadtrat initiiert hat.

Inhalt

Strategie-Schwerpunkt «Digitale Stadt»

Gestützt durch den Stadtratsentscheid zur Umsetzung der «Strategien Zürich 2035» im November 2018, soll die Digitalisierung in der Stadt- verwaltung zum Nutzen der Bevölkerung und den Unternehmen deutlich vorangetrieben werden. Dazu gehören unter anderem der Strategie- Schwerpunkt (SSP) «Digitale Stadt» und die Optimierung verwaltungs- interner Prozesse durch eine konsequent digitale Gestaltung.



Digitalisierung gegenüber externen Anspruchsgruppen

- Neue Online-Services
- Cockpit für Steuerpflichtige
- Dienstleistungen für Unter- nehmen über «Mein Konto»
- Qualitätssicherung der städtischen Website
- Digitalisierung der Schulen

Digitalisierung stadt- interner Prozesse

- Digitaler Posteingang
- E-Rechnung
- Kollaboration (im Rahmen des Arbeitsplatzes der Zukunft)
- Cloudbasierte HR-IT-Suite
- Internet der Dinge
- Datenanalyse und Einsatz von Algorithmen

Digitaler Zwilling

Digitales und räum- liches Abbild der Stadt Zürich

Digitalisierungskompeten- zen in der Stadt Zürich aufbauen

Sichere Daten und Identitäten

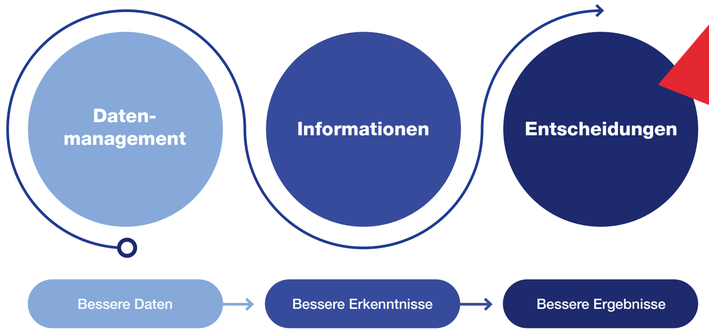
- Data Governance
- Identity and Access
- Management (IAM)

Open Government Data

- «Open by Default»

Quelle Grafik: OIZ, SSP Digitale Stadt

3 Vision



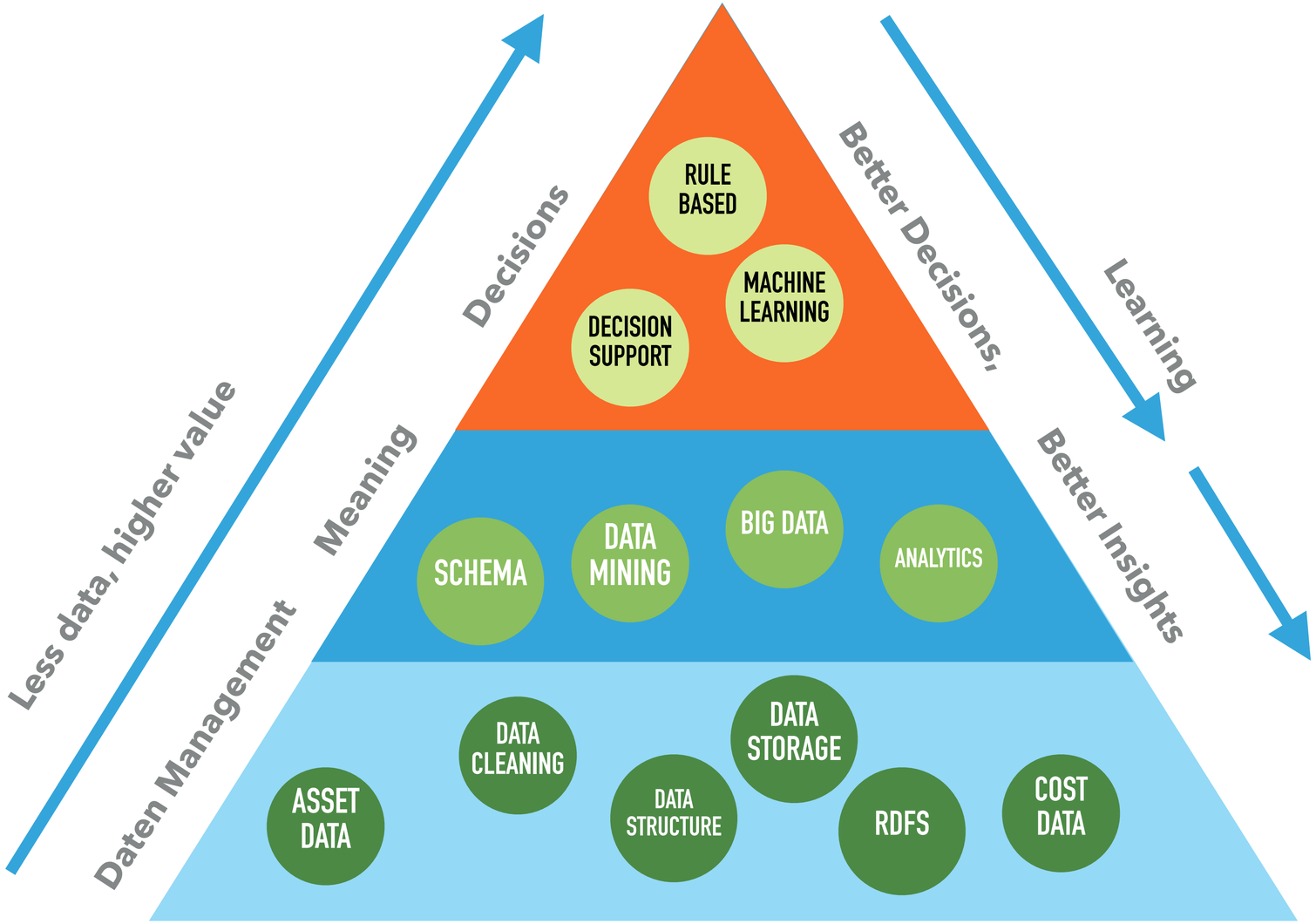
WE USE BIM FOR END-TO-END DATA AND INFORMATION MANAGEMENT ACROSS THE ENTIRE LIFE CYCLE OF STRUCTURES TO GAIN BETTER INSIGHTS FROM DATA TO MAKE BETTER DECISIONS THAT LEAD TO BETTER RESULTS IN THE LONG RUN.

4 Strategie

Inhalt

Um die Leitsätze und strategischen Ziele erreichen zu können, werden für die Umsetzung der Strategie BIM@StZH erste dienstabteilungsübergreifende Massnahmen erarbeitet. Diese sind den vier Handlungsfeldern Mensch, Prozesse, Standards und Technik zugeordnet. Sie werden im Umsetzungsplan dargestellt, der im Zuge der Entwicklungen konkretisiert sowie fortgeschrieben wird.

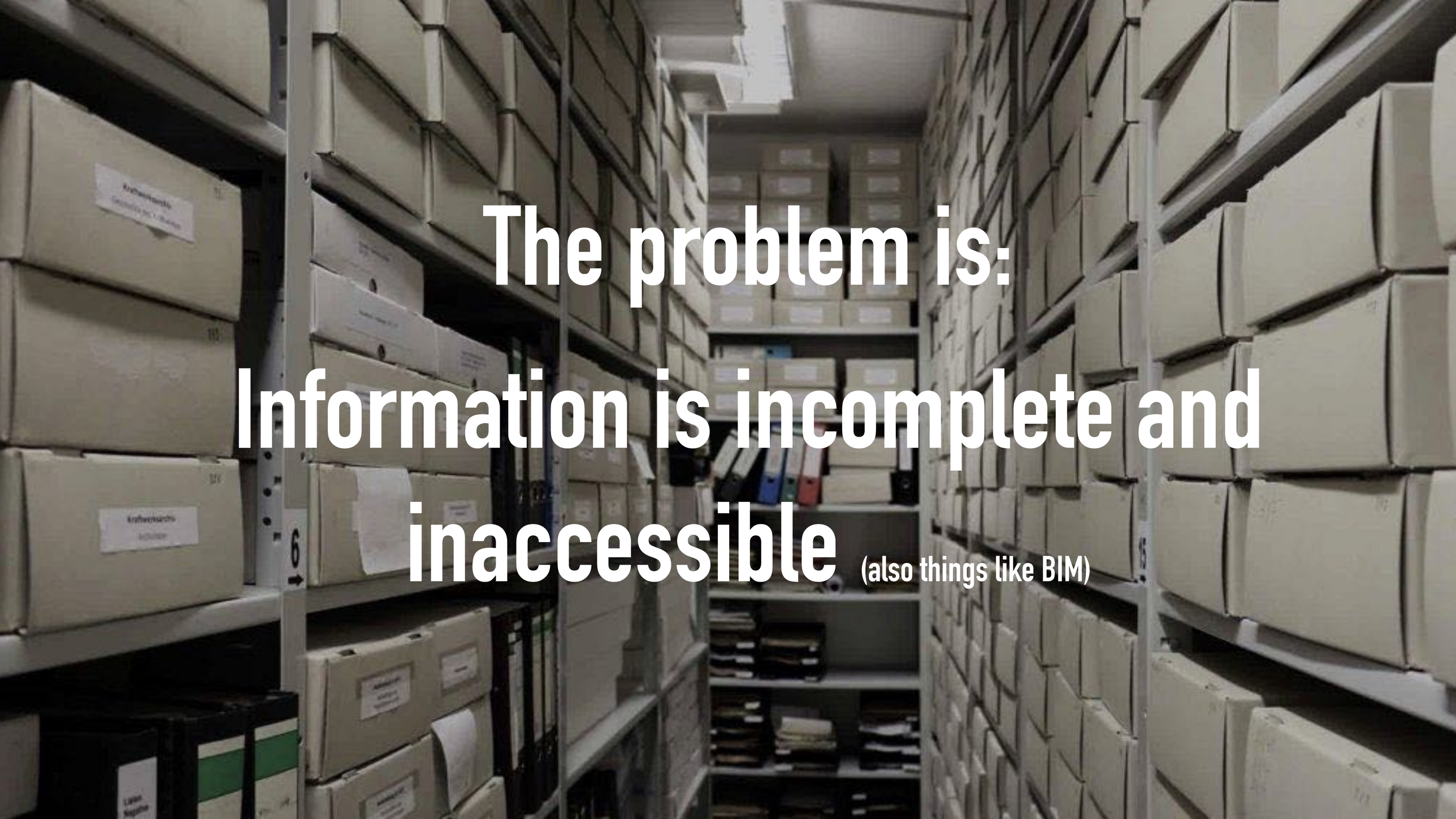
. . .FOR ONE REASON ONLY: TO EMPOWER BETTER DECISIONS



SCADA, GPS, SOCIAL MEDIA, DRONE, LASER, SATELLITE, GIS, BIM

AHB Vision einer CDE für die Stadt Zürich

Projektplattform / Gemeinsame Datenumgebung



The problem is:

Information is incomplete and inaccessible (also things like BIM)

THE PROBLEM WAS ALWAYS THERE (AND ALWAYS WILL BE)

PROBLEM:
Rewinding/forwarding

SOLUTION:
Instant access to tracks

PROBLEM:
Have to buy entire album

SOLUTION:
Buy only the songs you want

PROBLEM:
1,000 songs not enough

SOLUTION:
Get access to 40M songs

PROBLEM:
???

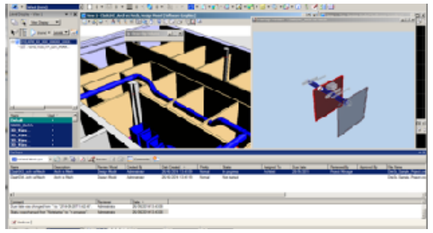
THE PROBLEM WAS ALWAYS THERE (AND ALWAYS WILL BE): COOPERATION

PROBLEM:
Remote access to docs

SOLUTION:
Put things to the cloud

PROBLEM:
Incomplete and inaccessible

SOLUTION:
Link to gain context



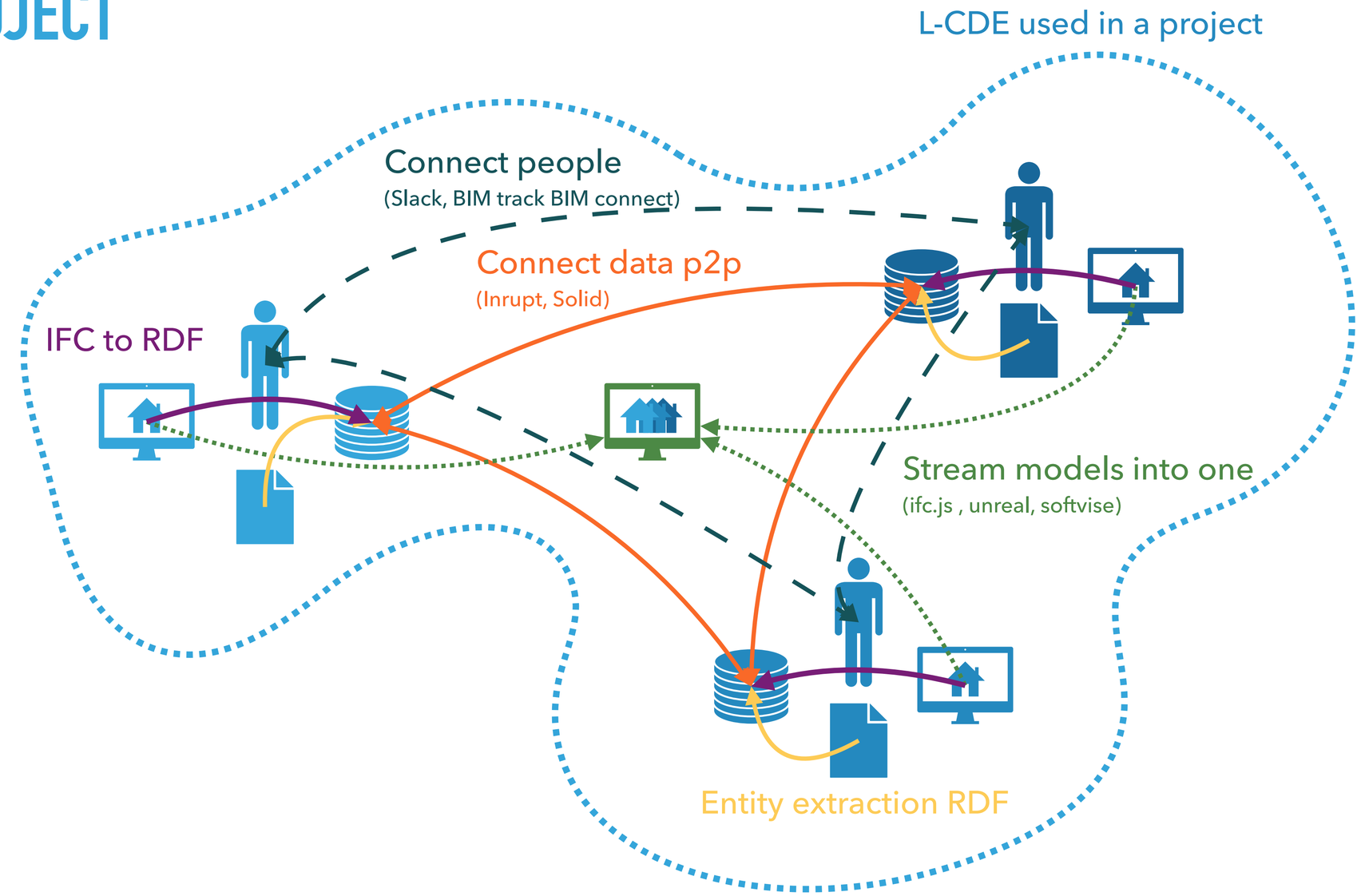
PROBLEM:
Organize work online

SOLUTION:
Ticketsystem and BCF

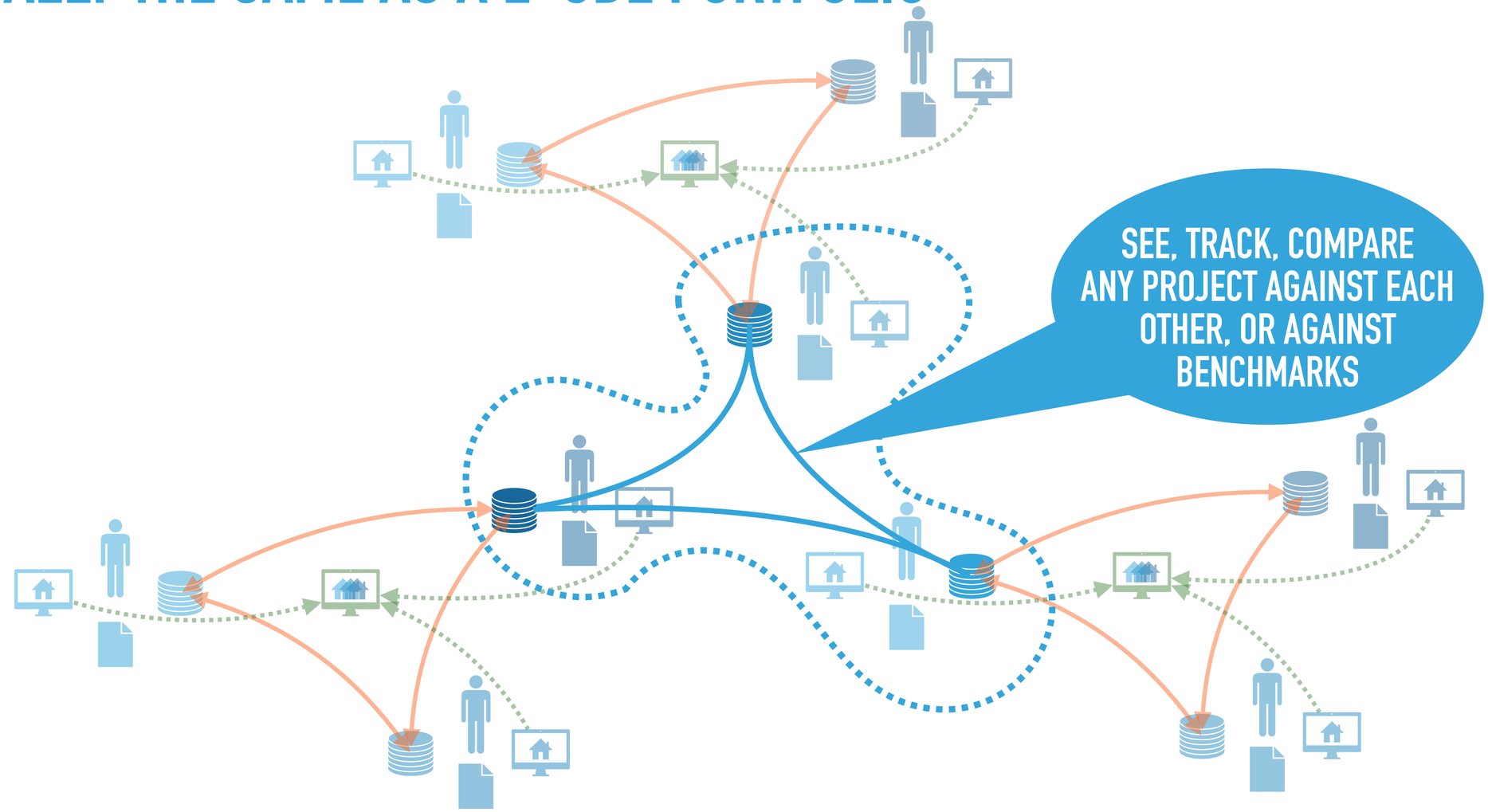
PROBLEM:
Bring back trust

SOLUTION:
?

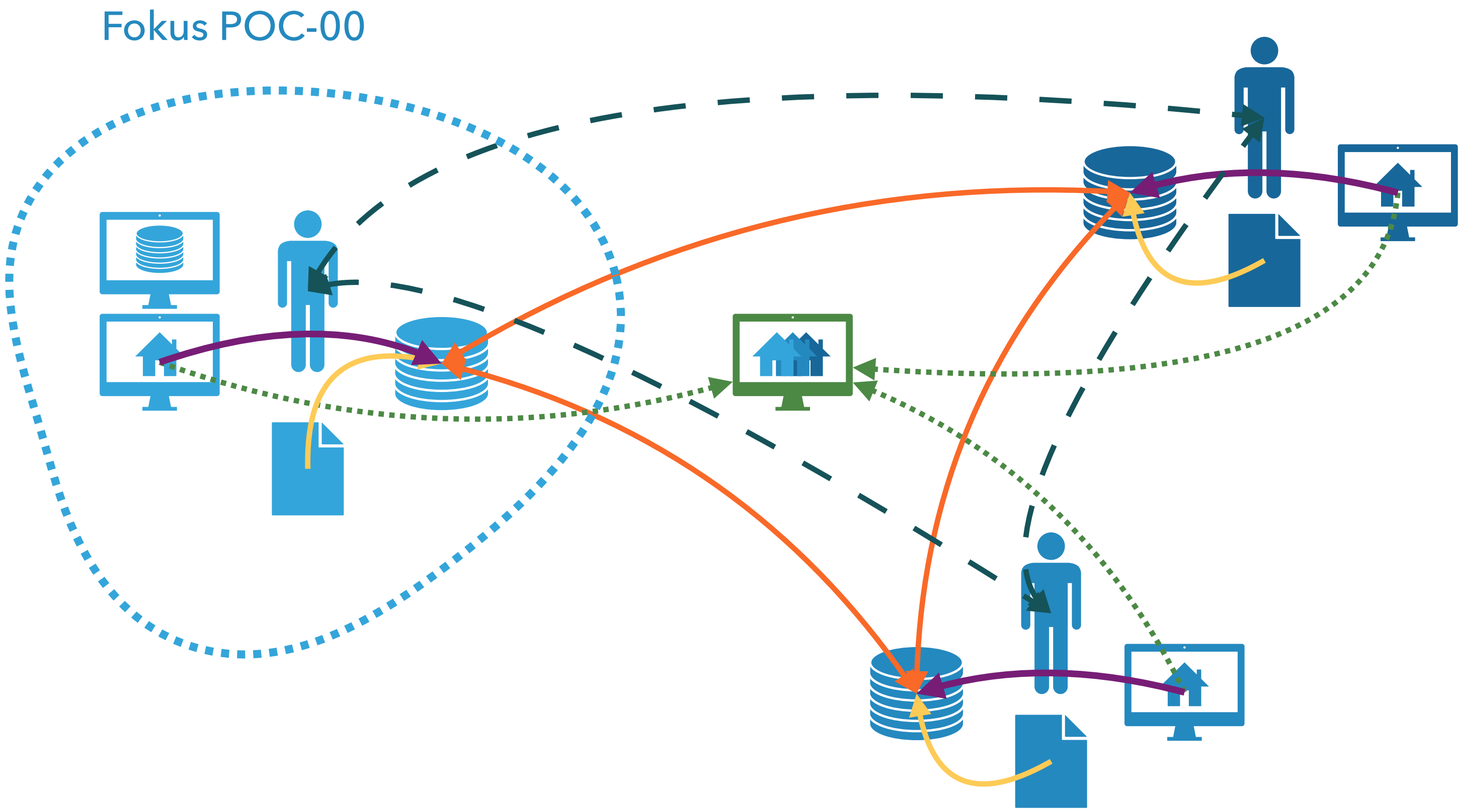
THE L-CDE PROJECT



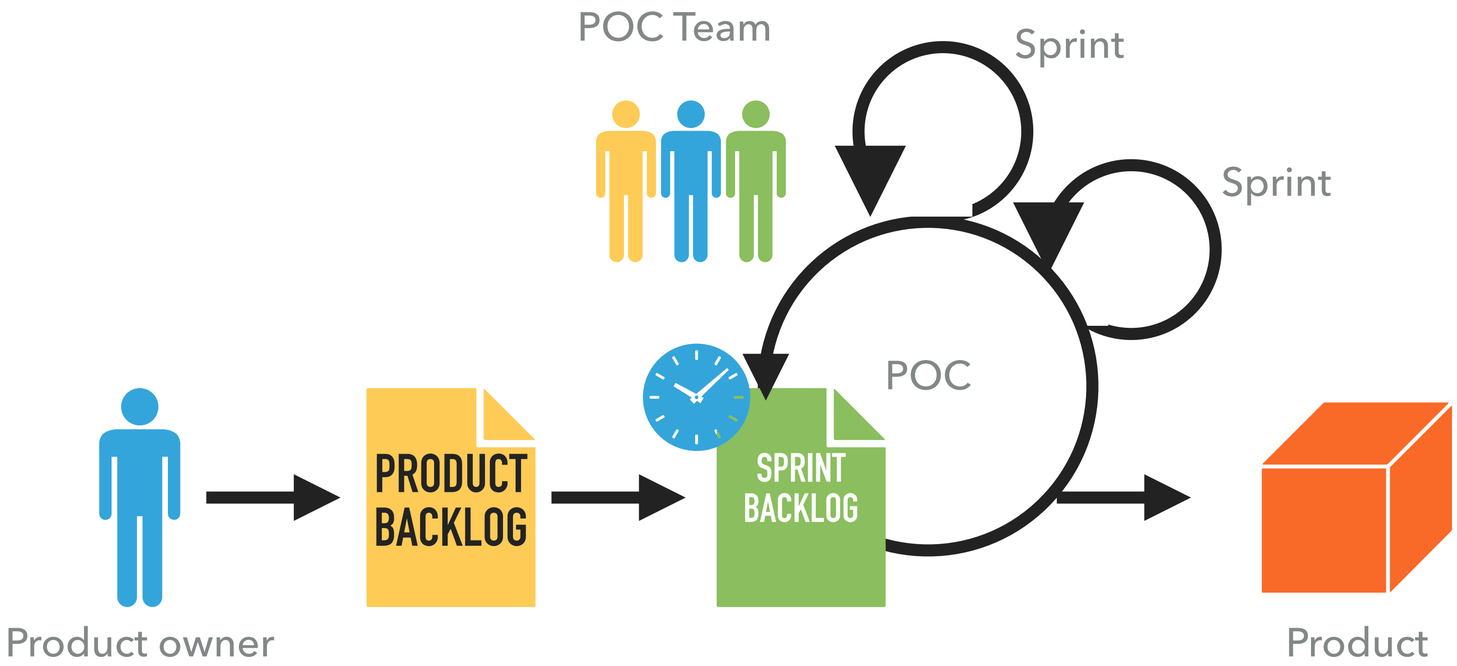
IS ACTUALLY THE SAME AS A L-CDE PORTFOLIO



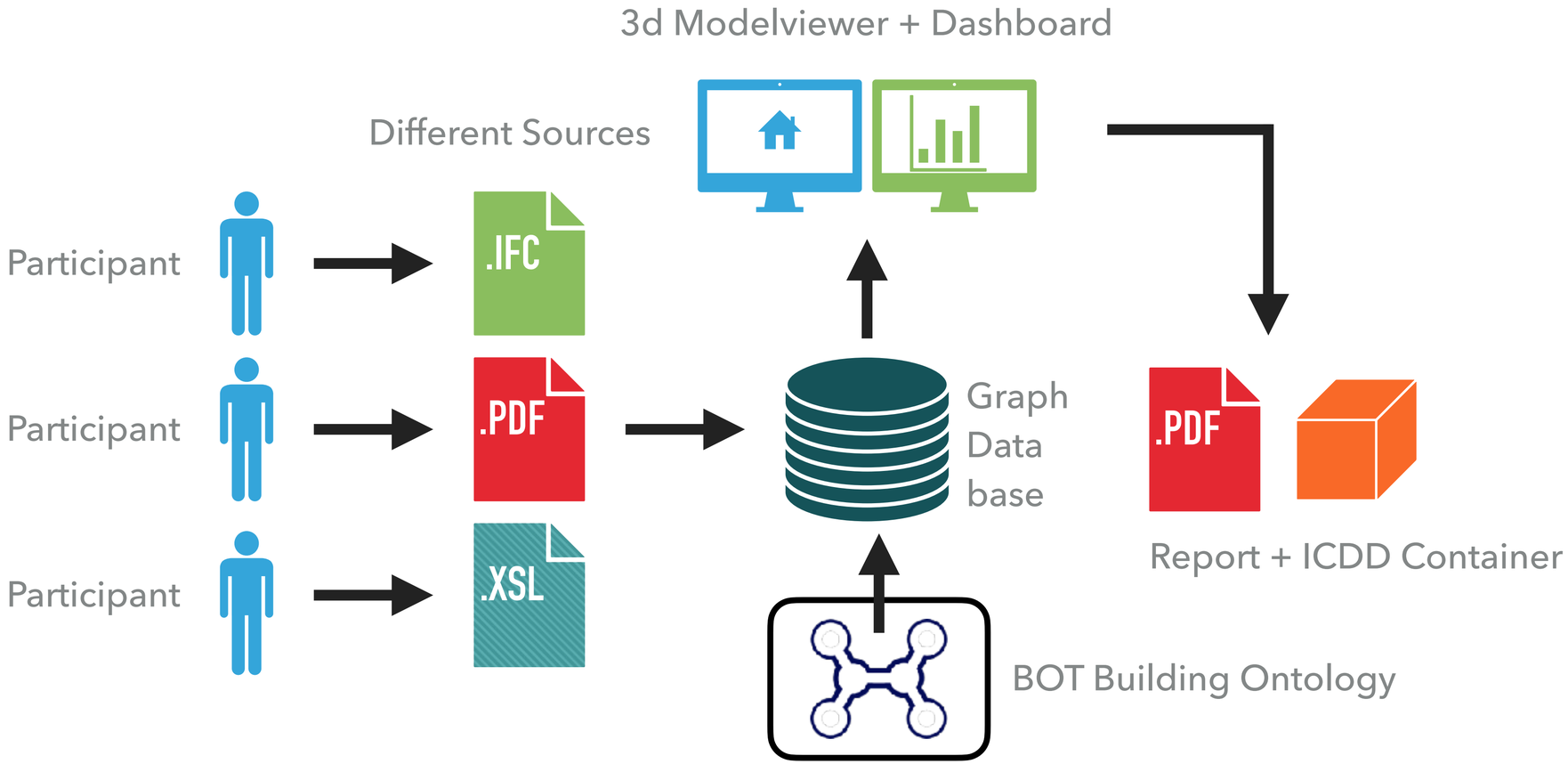
THE L-CDE PROJECT



STEP BY STEP

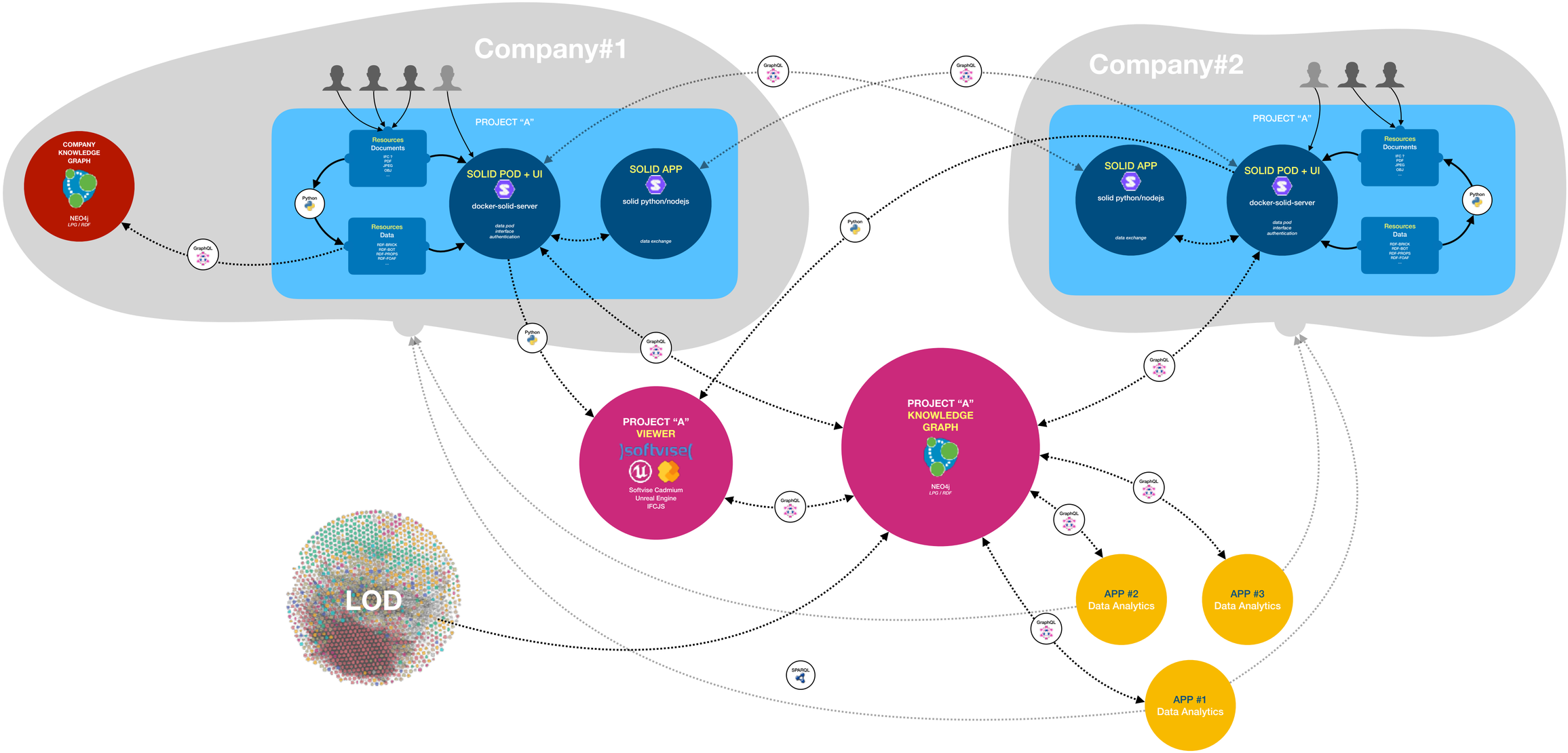

POC Team
Sprint
Sprint
POC
PRODUCT BACKLOG
SPRINT BACKLOG
Product owner
Product

POC 00


3d Modelviewer + Dashboard
Different Sources
Participant
Participant
Participant
.IFC
.PDF
.XSL
Graph
Data
base
.PDF
Report + ICDD Container
BOT Building Ontology


We like data
We like people
We like grafics

TECHNICAL APPROACH & CHALLENGES

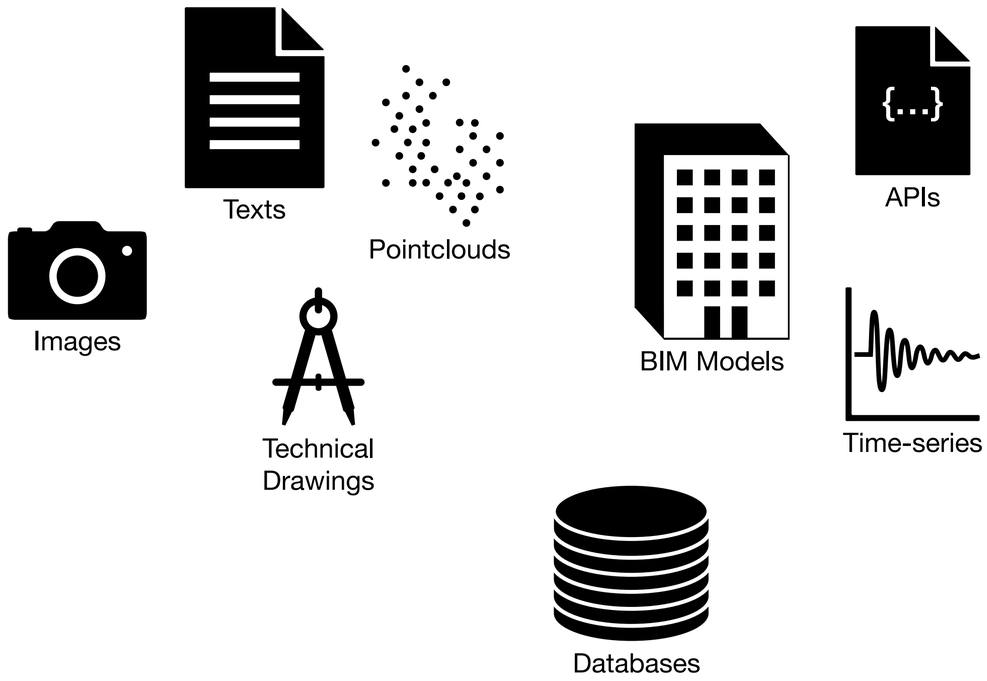


TECHNICAL APPROACH & CHALLENGES

- INFORMATION EXTRACTION
- CONNECTING DATA
- VISUALISING MODELS AND DATA
- ADDITIONAL WORKING PACKAGES

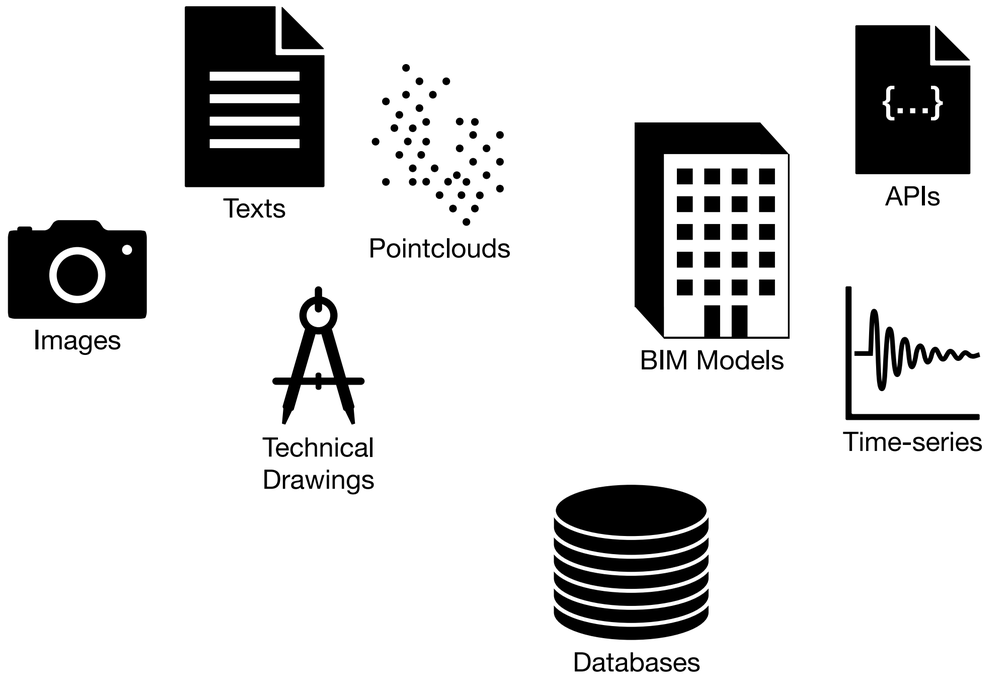
TECHNICAL APPROACH & CHALLENGES

- INFORMATION EXTRACTION



TECHNICAL APPROACH & CHALLENGES

• INFORMATION EXTRACTION

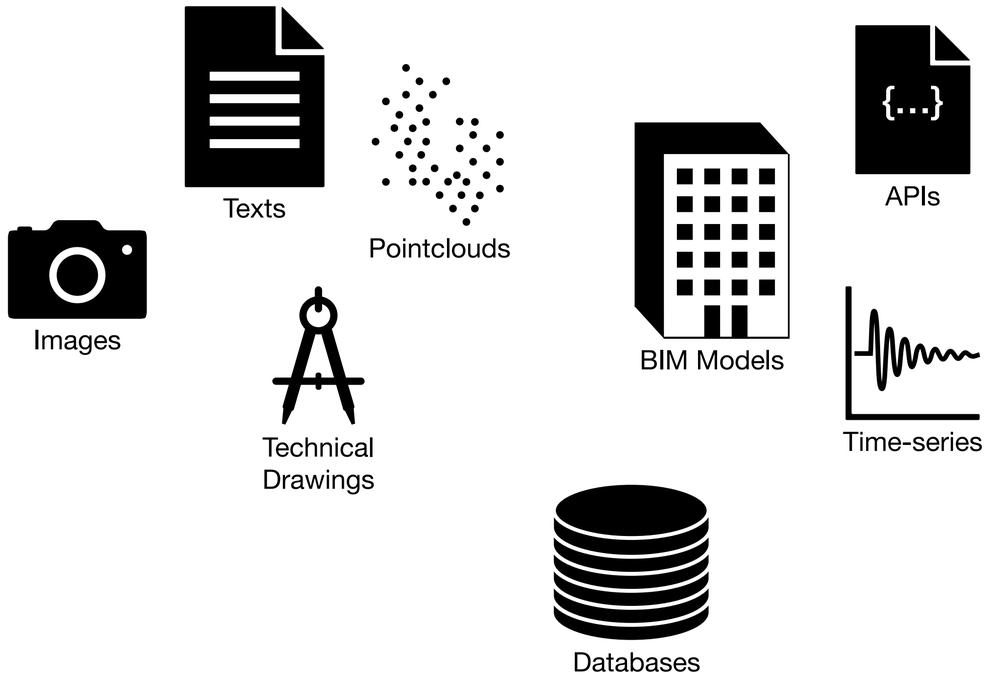


1. **UNSTRUCTURED / RAW SOURCES** (GENERAL)

   - Biggest but less utilised source of information
   - **PDFs** are a very common format that contain multiple types of raw data
   - Training different **Deep Learning models** depending on problem definition (Entity extraction - text, Object Recognition - image etc.).
   - Heavy use of **transfer learning** and pre-trained models

TECHNICAL APPROACH & CHALLENGES

• INFORMATION EXTRACTION

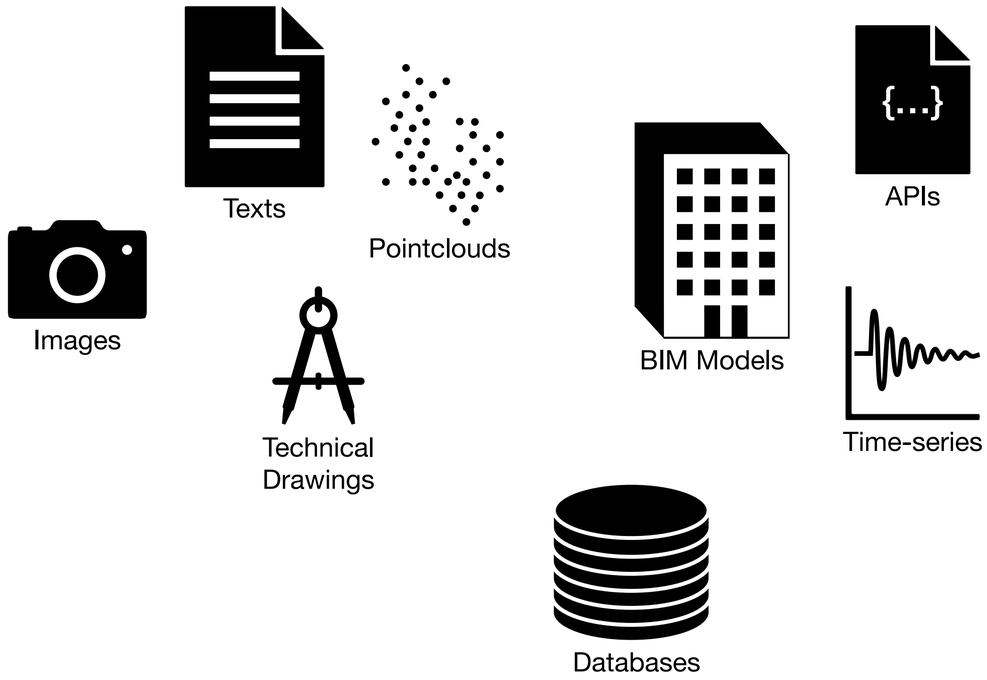


2. POINTCLOUDS

- **Increasingly used** in projects.
- **No streamlined processes** for information extraction.
- Not enough publicly available **labeled data** sets, especially for buildings.
- Actively developing a **data labelling tool** for railway infrastructure.
- Also looking into **unsupervised learning** methods.

TECHNICAL APPROACH & CHALLENGES

• INFORMATION EXTRACTION

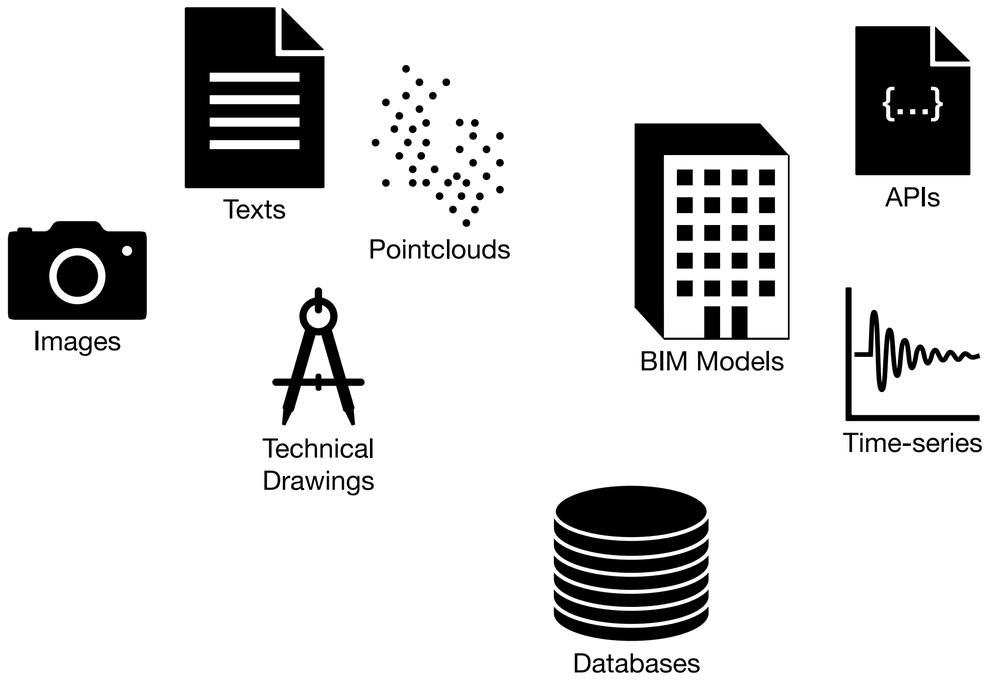


3. BIM MODELS

- Core part of information exchange.
- **IFC** is quite **complicated**.
- Some important information is many times **missing** (eg IfcSpace) and other is **incorrect** (misclassification of elements)
- Actively developing **IFC analysis tools.**
- Combination of **IFC to graph** representation and **Graph Neural Networks** to fill / correct information.
- **Graph transformations** to project IFC to BOT, BRICK etc.

TECHNICAL APPROACH & CHALLENGES

• INFORMATION EXTRACTION

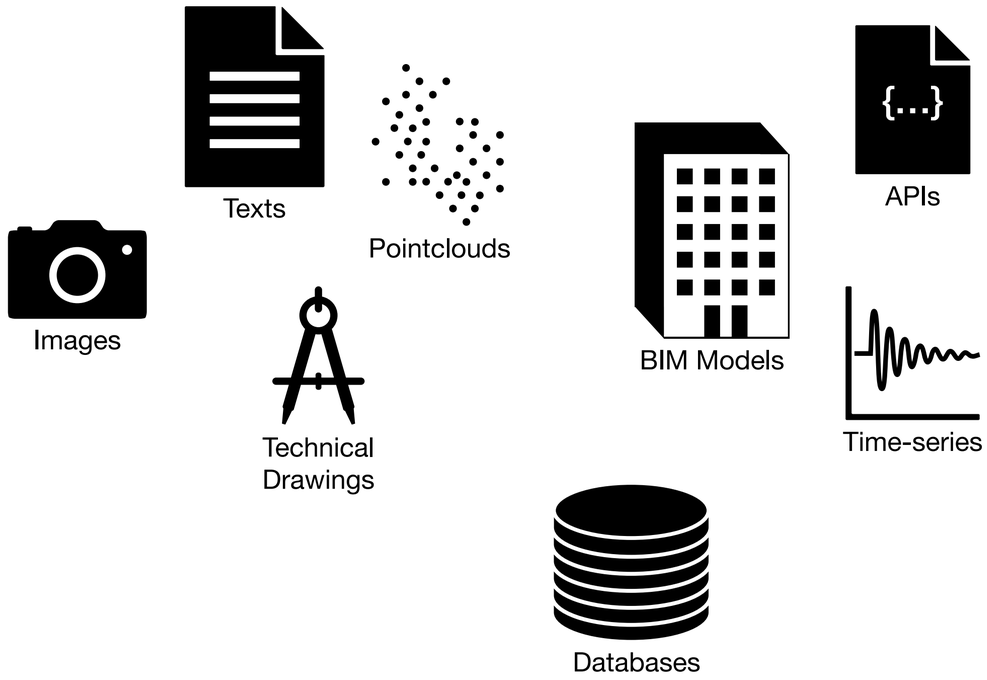


4. **SEMI-STRUCTURED** (XLS, JSON etc)

- Common way to exchange project data in a more formal way.
- They are actually **not standardised.** Not only semantic-wise but also structurally.
- They are **very project-specific.** And many times project-period-specific or stakeholder-specific etc.
- We eventually treat them similarly to unstructured text, using **NLP** techniques.

TECHNICAL APPROACH & CHALLENGES

• INFORMATION EXTRACTION

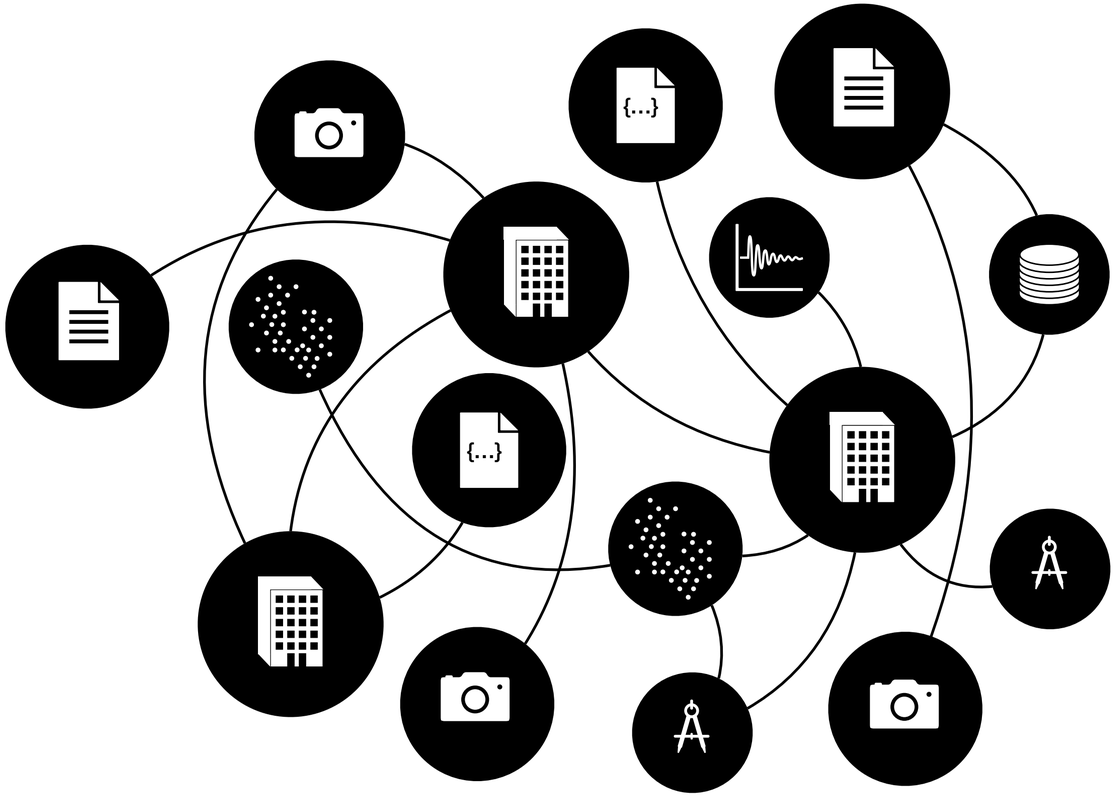


5. DATABASES

- More rare. Usually present in public infrastructure projects.
- Normally easy to access information.

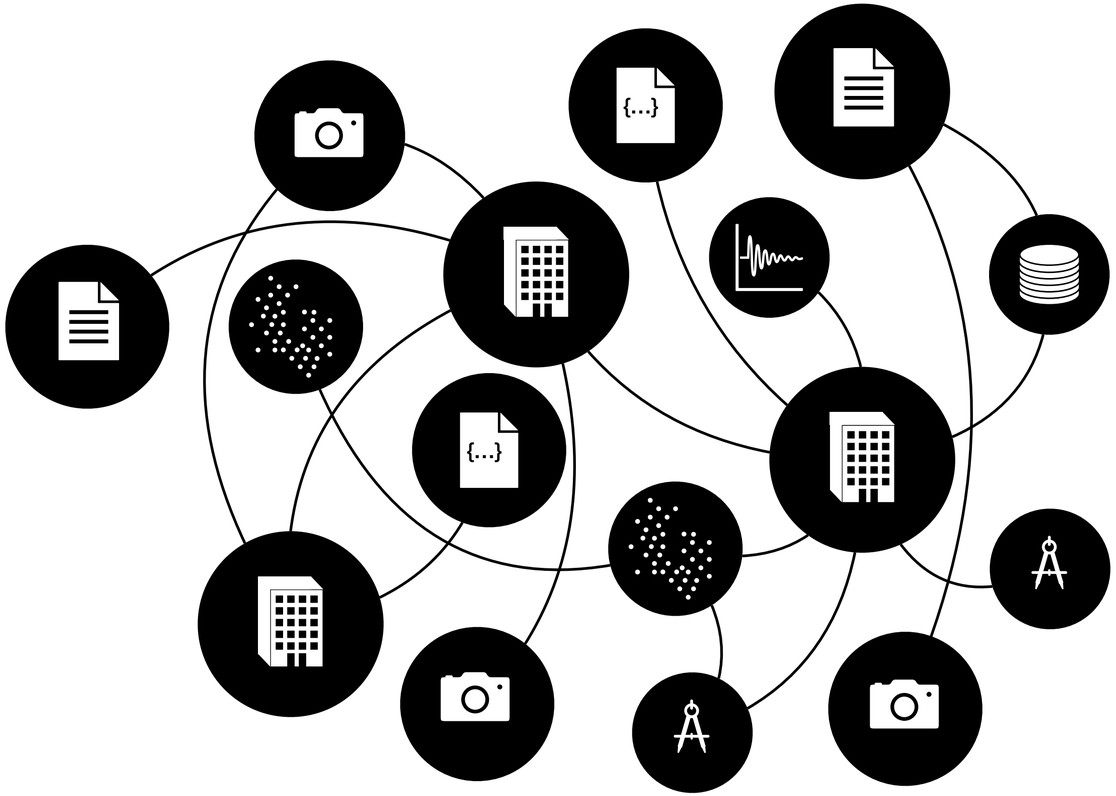
TECHNICAL APPROACH & CHALLENGES

- CONNECTING DATA



TECHNICAL APPROACH & CHALLENGES

• CONNECTING DATA

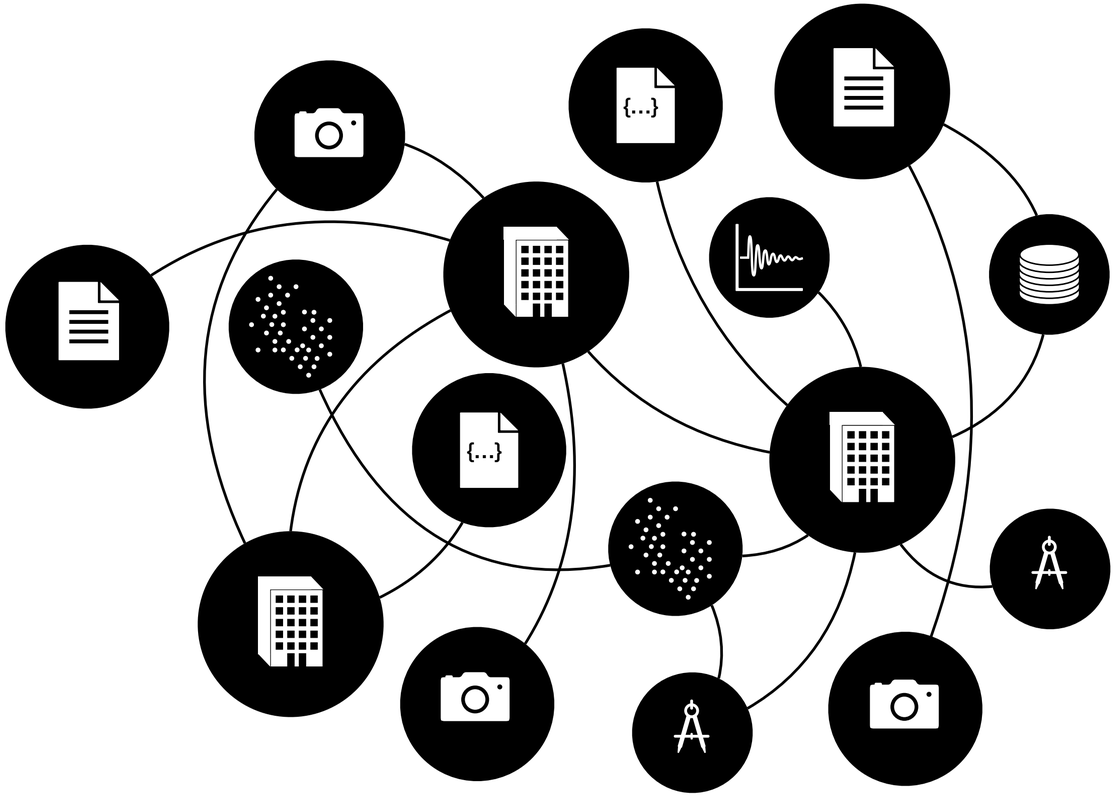


1. FROM A SINGLE SOURCE

- Complexity depends on the **type** of the source.
- BIM models are (more or less) trivial to handle.
- Excel, CSV and json files can also be transformed into graphs in a relatively straightforward way.
- Raw data require more advanced techniques, like **link extraction** for texts or other combinations of methods for technical drawings and images.

TECHNICAL APPROACH & CHALLENGES

• CONNECTING DATA



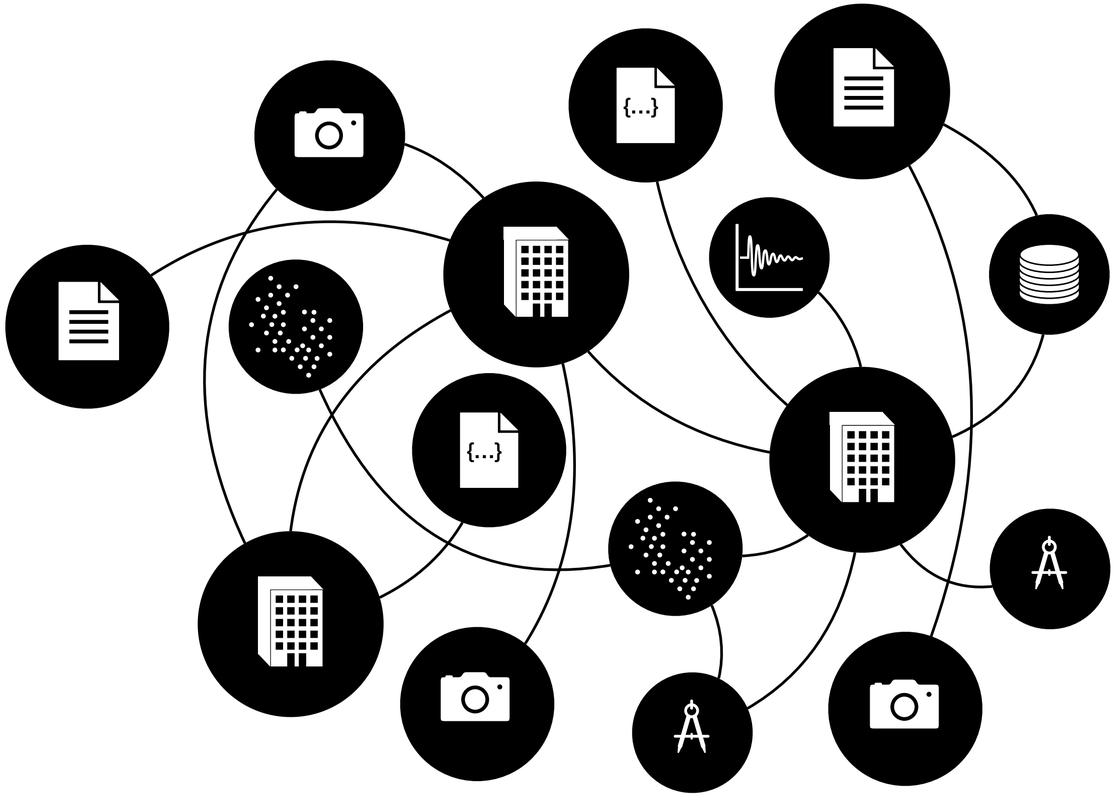
2. FROM MULTIPLE SOURCES THAT AGGREGATE TO ONE

- This mainly refers to **federated IFC models** that are usually partitioned and maintained by discipline.
- Integrating IFC models for viewing purposes is trivial, but this is not true when the objective is to connect **different IFCs into a single valid IFC file**.
- Using **GUIDs** as the anchor point is **not always an option** and is fragile to uncoordinated changes of BIM objects.
- **Graph matching** could be a promising direction here, but we haven't worked on it yet.*

** https://www.researchgate.net/publication/343234138_A_Graph-Based_Method_for_IFC_Data_Merging*

TECHNICAL APPROACH & CHALLENGES

• CONNECTING DATA

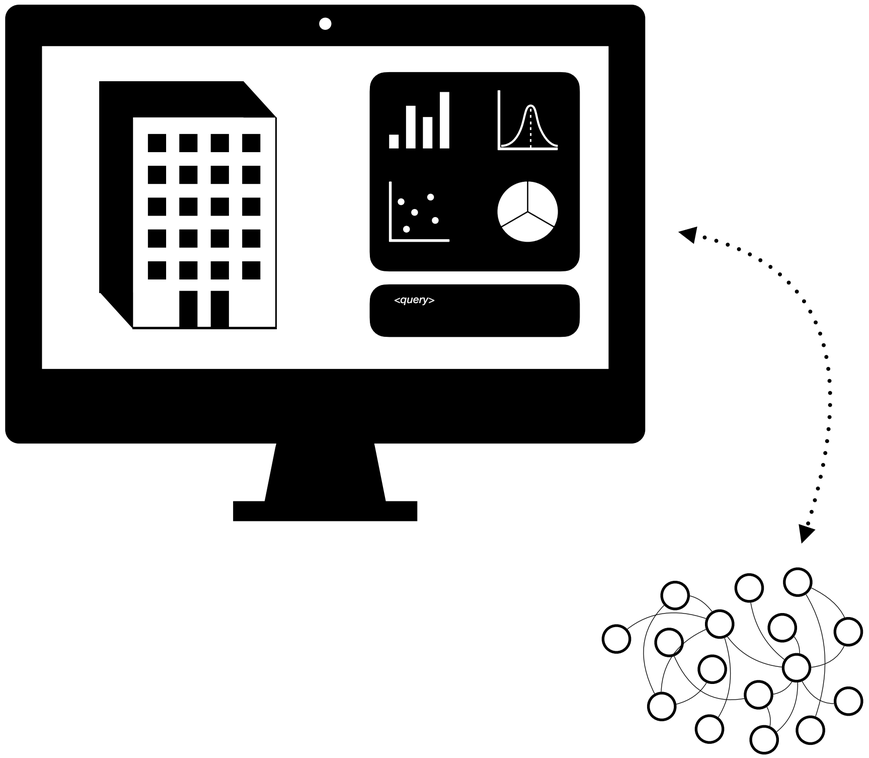


3. FROM MULTIPLE, DIFFERENT SOURCES

- Connecting entities that refer to the **same thing but from different sources** is more challenging.
- One level is to identify **abstract representations** (eg an ontology) that can work as a common reference of objects from different sources. Eg: this entity in the BIM model is of type *Wall* and this object in the image is of type *Wall* too.
- Next step would be to disambiguate connections on the level of the **instance**. Eg: this specific identified *wall* in BIM is this specific identified *wall* in the image.
- **Instance disambiguation** is quite challenging and requires enough context.

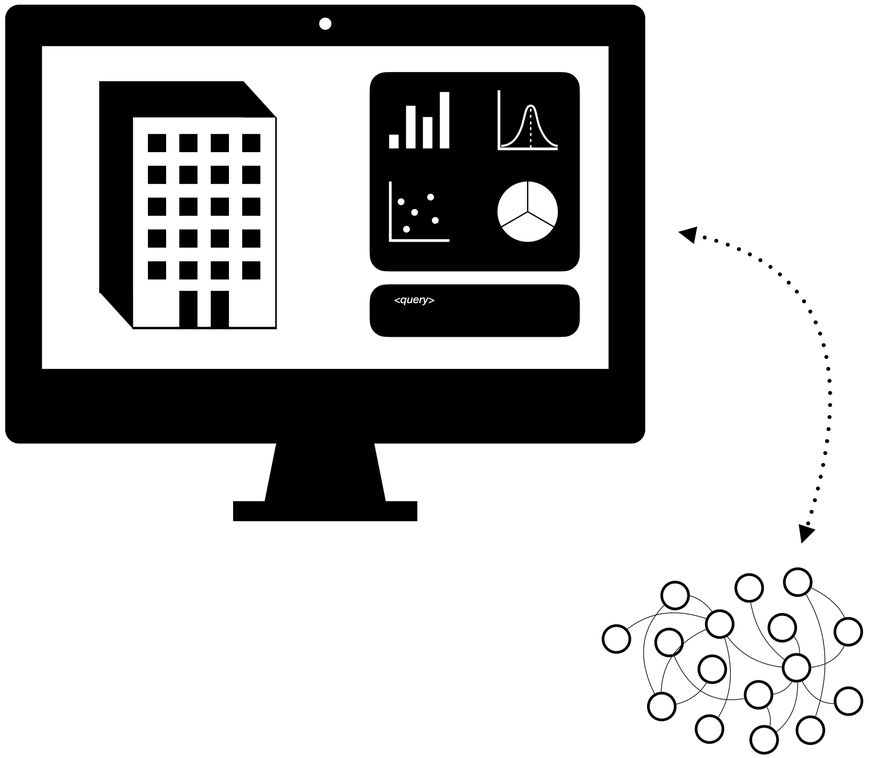
TECHNICAL APPROACH & CHALLENGES

- VISUALISING MODELS AND DATA



TECHNICAL APPROACH & CHALLENGES

• VISUALISING MODELS AND DATA

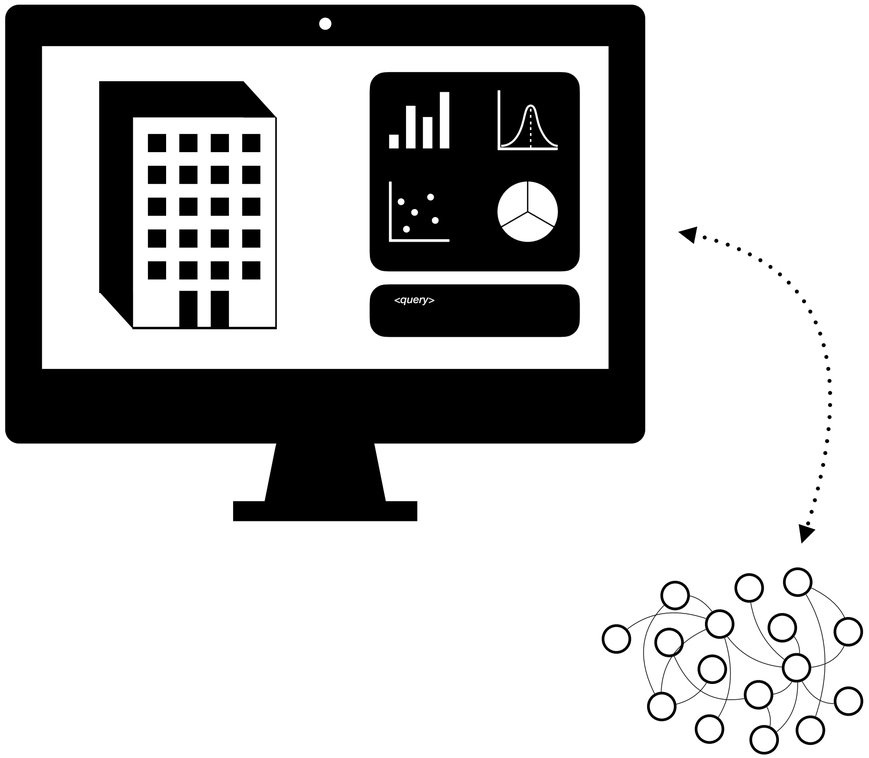


1. VISUALISATION

- Visualising models as IFC with **IFCjs**, **Unreal Engine** or **Softvise Cadmium**.
- Creating **custom dashboards** for data (and graph) visualisation depending on the project.
- Allowing pre-scripted or custom **queries**.

TECHNICAL APPROACH & CHALLENGES

• VISUALISING MODELS AND DATA

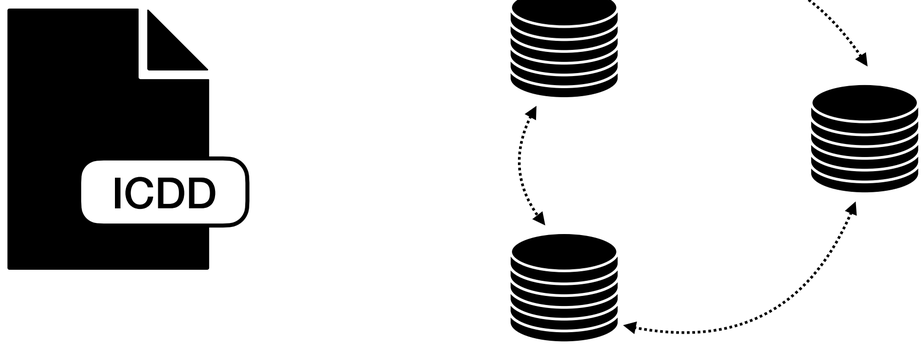


2. INTEGRATION

- **POC** of instant querying of BIM model served in Unreal Engine and stored in Neo4j as an IFC-graph.
- How to **instantly propagate model changes** from the database to the viewer and vice versa?
- Allowing certain **read & write** processes from UI to DB.

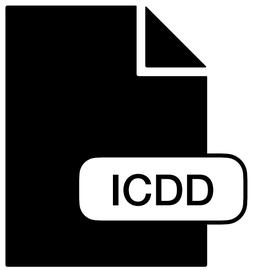
TECHNICAL APPROACH & CHALLENGES

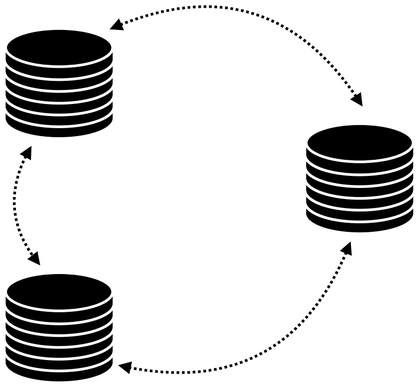
- ADDITIONAL WORKING PACKAGES



TECHNICAL APPROACH & CHALLENGES

- ADDITIONAL WORKING PACKAGES



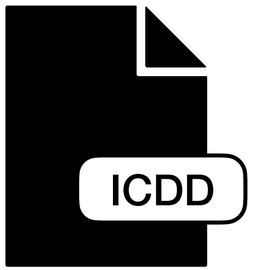


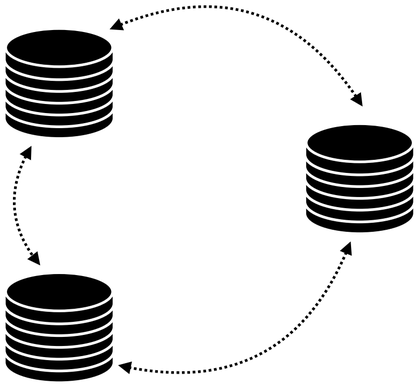
1. **CONTAINERISING (ICDD)**

   - Using ICDD to archive and deliver project information
   - Building user interface and tools to streamline the process.

TECHNICAL APPROACH & CHALLENGES

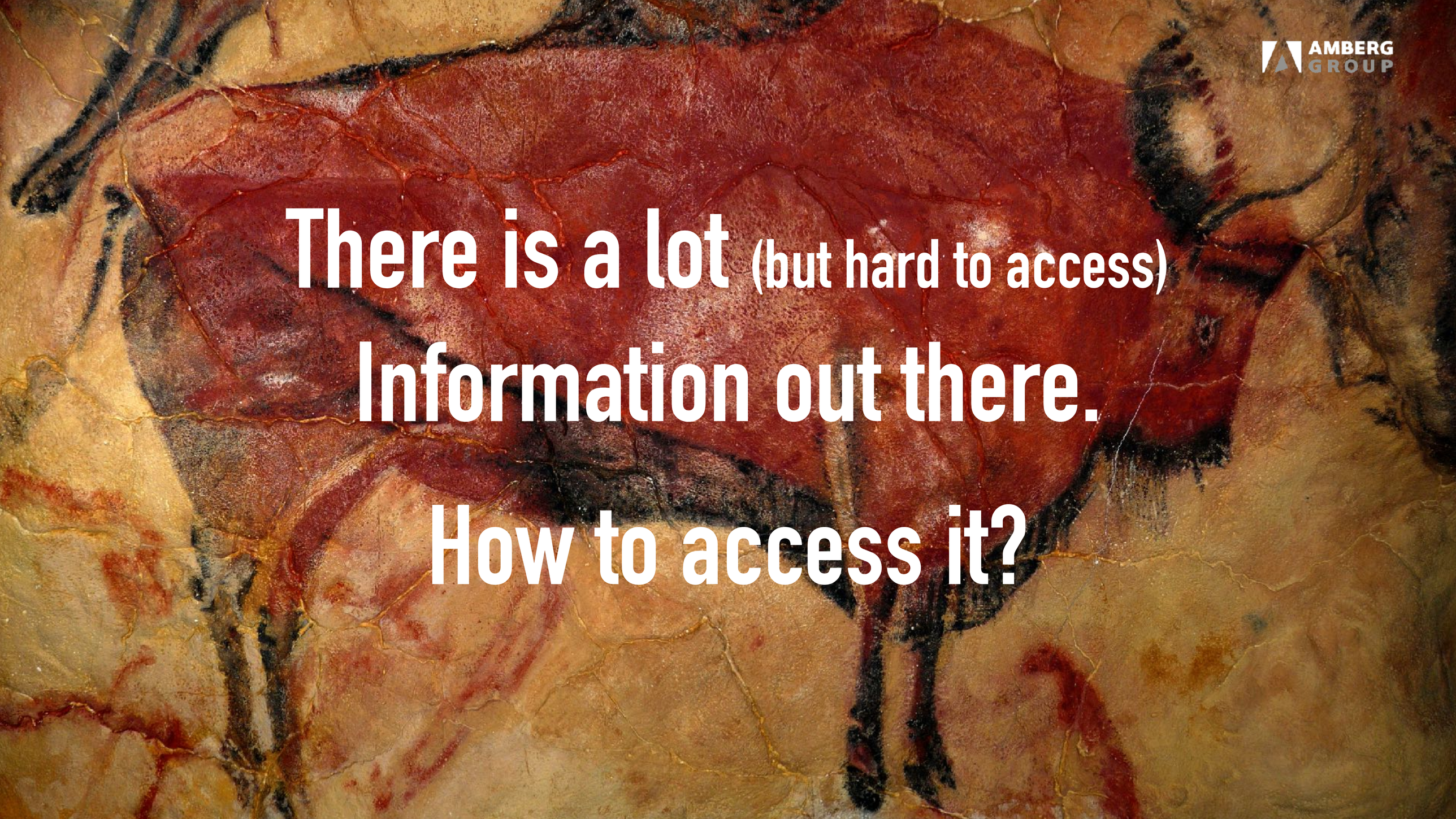
- ADDITIONAL WORKING PACKAGES





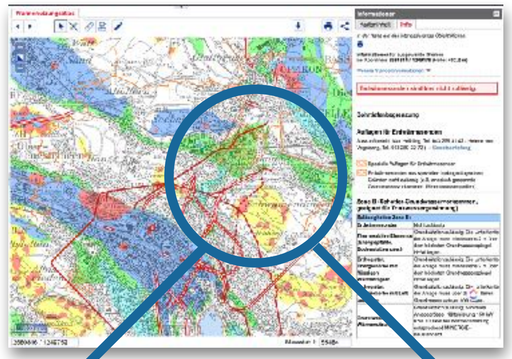
2. FEDERATING

- Looking into Solid. Haven’t built something yet.
- How to integrate Blockchain to validate data transactions?

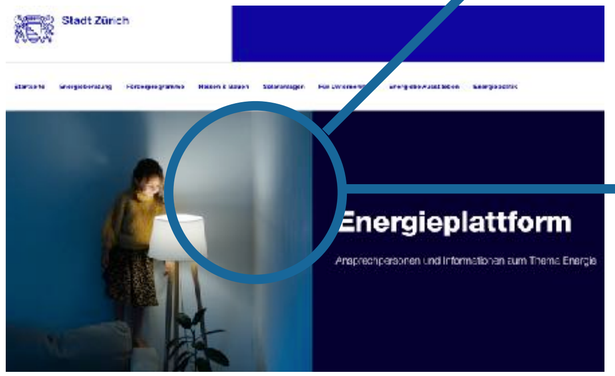

There is a lot (but hard to access)
Information out there.
How to access it?

MAKING ZURICH ~~GREAT AGAIN~~ a big Sandbox and invite everyone in

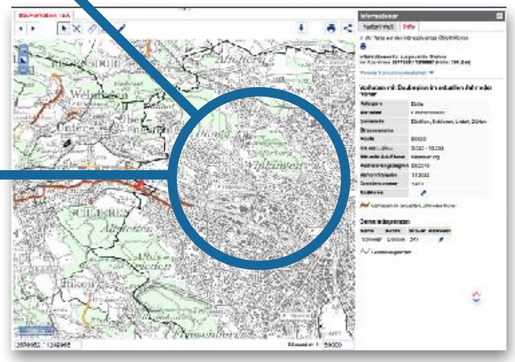
STEP 1. CONNECT THE UNCONNECTED



GIS Wärmeatlas
=Restriktionen



Energieplattform
=Kommunikation



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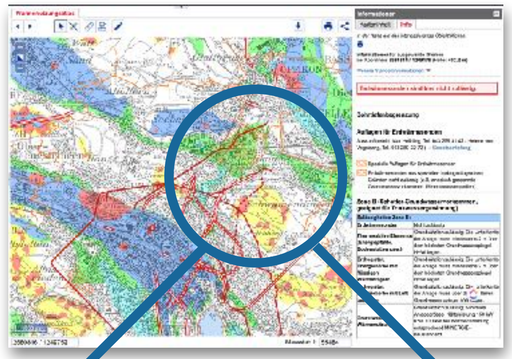
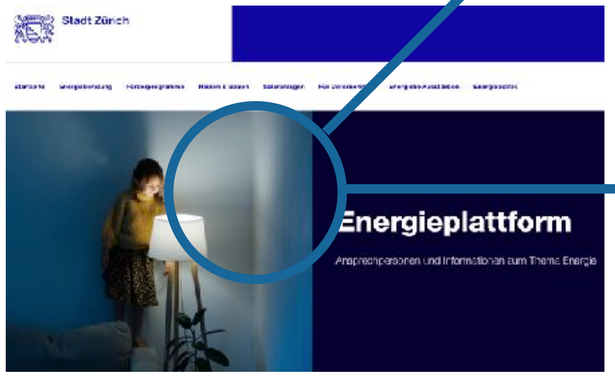
STEP 2. ADD MEANINGFUL INFORMATION



GIS Wärmeatlas
=Restriktionen

Energiekarte
=Potenzial



Energieplattform
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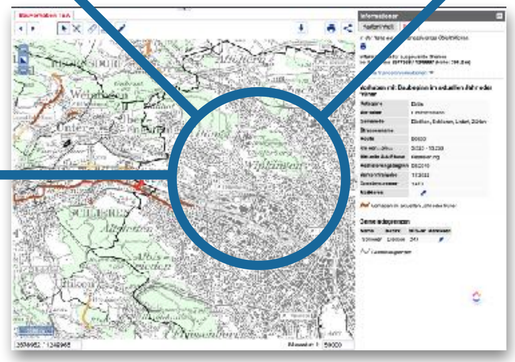

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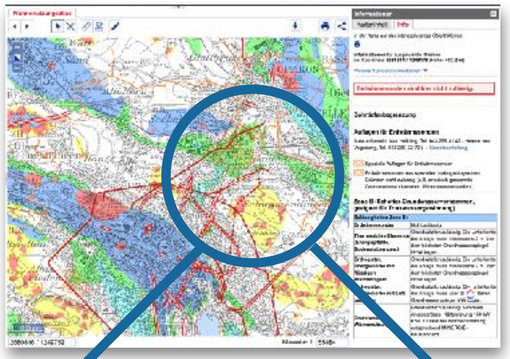
STEP 3. PROVIDE TRUSTFUL INFORMATION (OPEN)

https://



GIS Wärmeatlas
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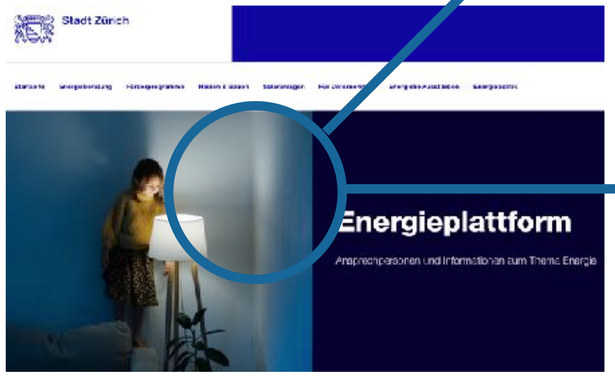
Energiekarte
=Potenzial

http://



Energieplattform
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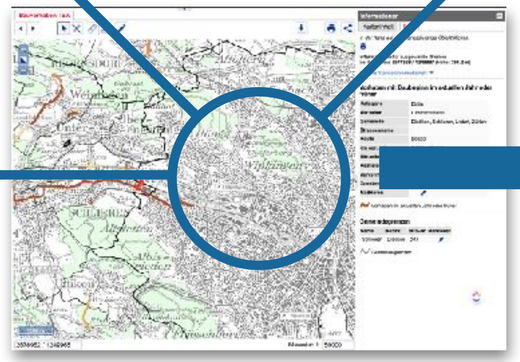

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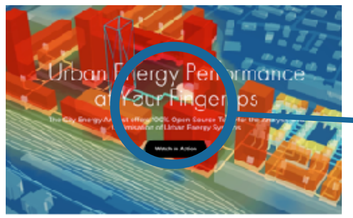
SPARQL

STEP 4. INVOLVE GREAT APPLICATIONS



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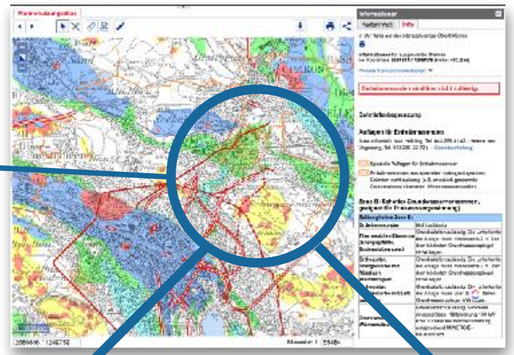

GIS Wärmeatlas
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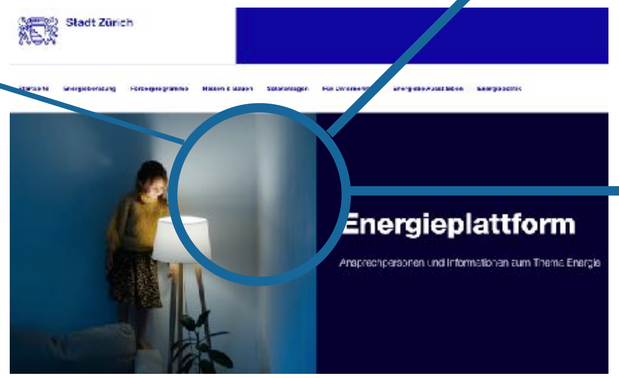

Energieplattform
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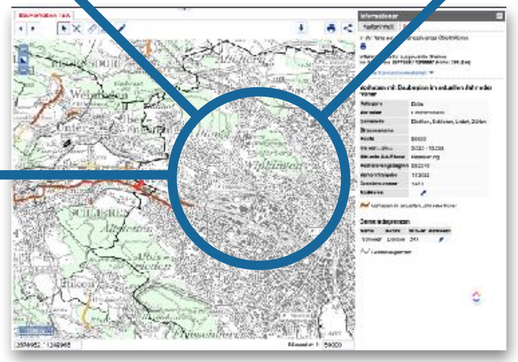

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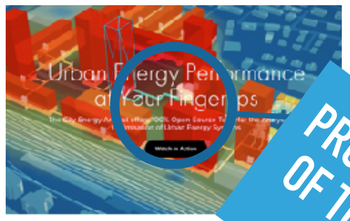
STEP 5. EMPOWER GOOD IDEAS; „ROI IN TONS-CO2“



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PROPOSAL FOR THE USE OF TUNNEL WASTE HEAT

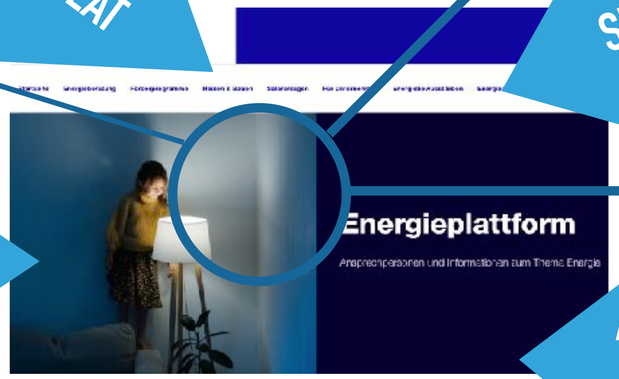
GIS Wärmeatlas
iktionen

Energiekarte
=Potenzial

BUILDING APPLICATION SUBMITTED FOR PROJECT IN ENERGY HARVESTING AREA

metabuild.io

PROPOSAL FOR THE USE OF LIMMAT WATER AS HEATPUMP SOURCE



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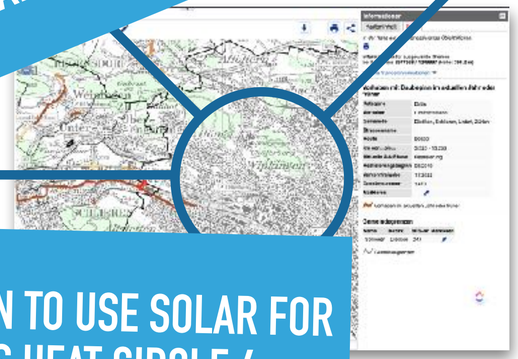

APPLICATION TO USE SOLAR FOR PROCESS HEAT CIRCLE 4

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Everything is compared and evaluated with the same trustworthy data and simulations.

NEXT STEPS (MORE POC TO COME)

POC	Name	Description	Outcome
0	MVP	Basic setup and integration of un-semi-structured sources into one privat db	Modelviewer on top of DB, Frontend to data ICDD Container
1	Connectivity	Building a p2p network of three and query across all parties	Network of 3 Pup setup Queryable
2	Quality	Transform models into readable schema (Bot, Brick) and running SHAQL as QS	Hierachfree way to display models Readable schema Qualitychecks
3	ICDD	Using ISO21597 as LCDE backbone structure, Producing ICDD container easily	ICDD Zip National Extension Organisational Extension
4	Speed	Proofing the power of graph in siloed and related data	Speedtest standards query Portfolioquery
5	UX	Making data and relations readable and understandable to user	Dashboard (d3) Modellviewer (idc.js, unreal, softvise)
6	Reorganisation	Enabling reorganization of data according to need in phase of the project	Planning stage Construction stage FM and Operation stage
7	Trust and security	Brining back trust in the process by using blockchain (in the p2p network) as log file	Trustworthy token Energy saving measures