BIM Health and Safety Support Framework for Construction

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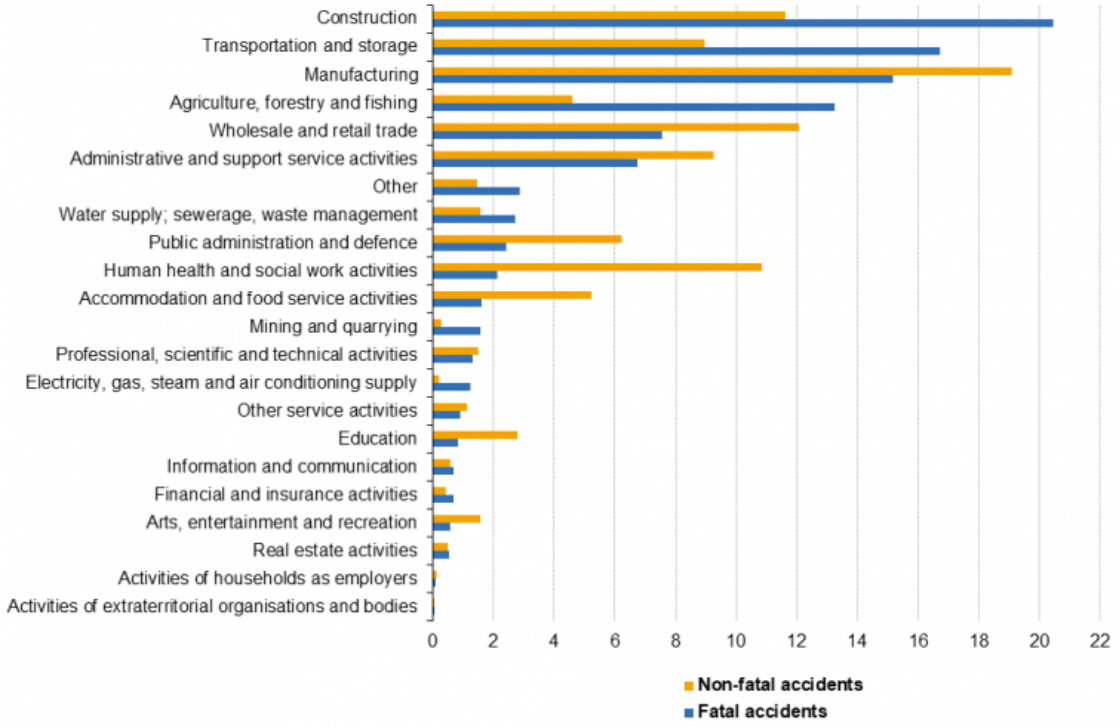
Problem statement

The occurrence of serious accidents is still unacceptably high in the construction sector

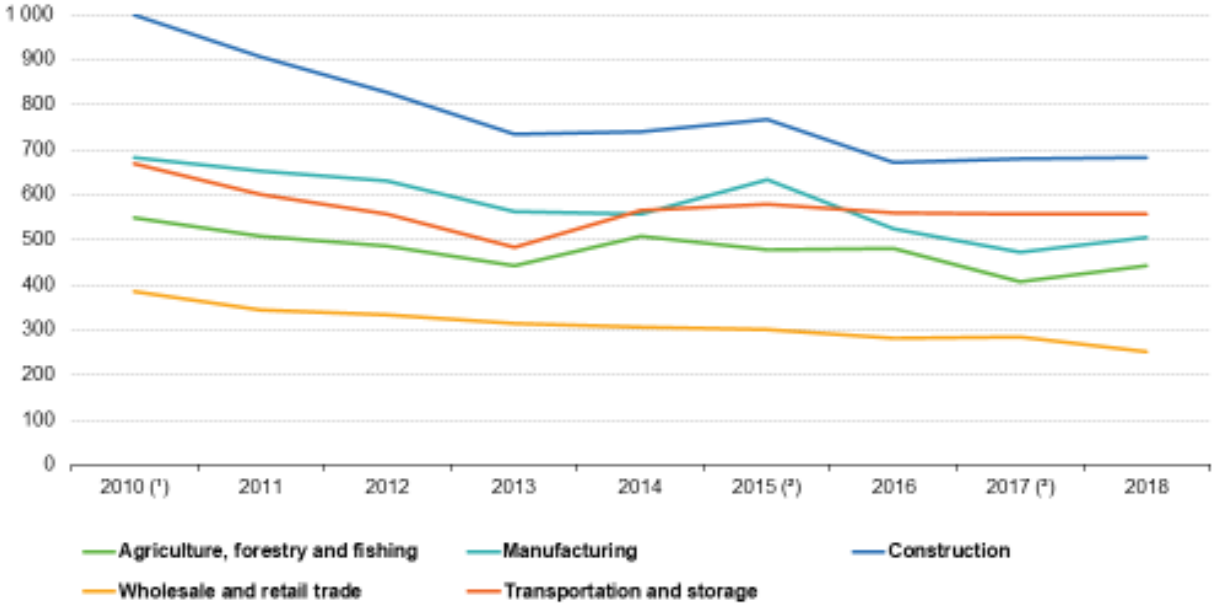
Fatal and non-fatal accidents at work by NACE section, EU-27, 2018
(% of fatal and non-fatal accidents)



Note: non-fatal (serious) accidents reported in the framework of ESAW are accidents that imply at least four full calendar days of absence from work. Ranked on the values for fatal accidents.
Source: Eurostat (online data codes: hsw_n2_01 and hsw_n2_02)

eurostat

Development of fatal accidents at work for the five NACE sections with the highest risk levels, EU-27, 2010-2018
(persons)



(1) Estimates, except for agriculture, forestry and fishing and manufacturing.
(2) Agriculture, forestry and fishing and wholesale and retail trade: low reliability. Manufacturing, construction and transportation and storage: estimates.
(3) Low reliability.
Source: Eurostat (online data code: hsw_n2_07)

eurostat

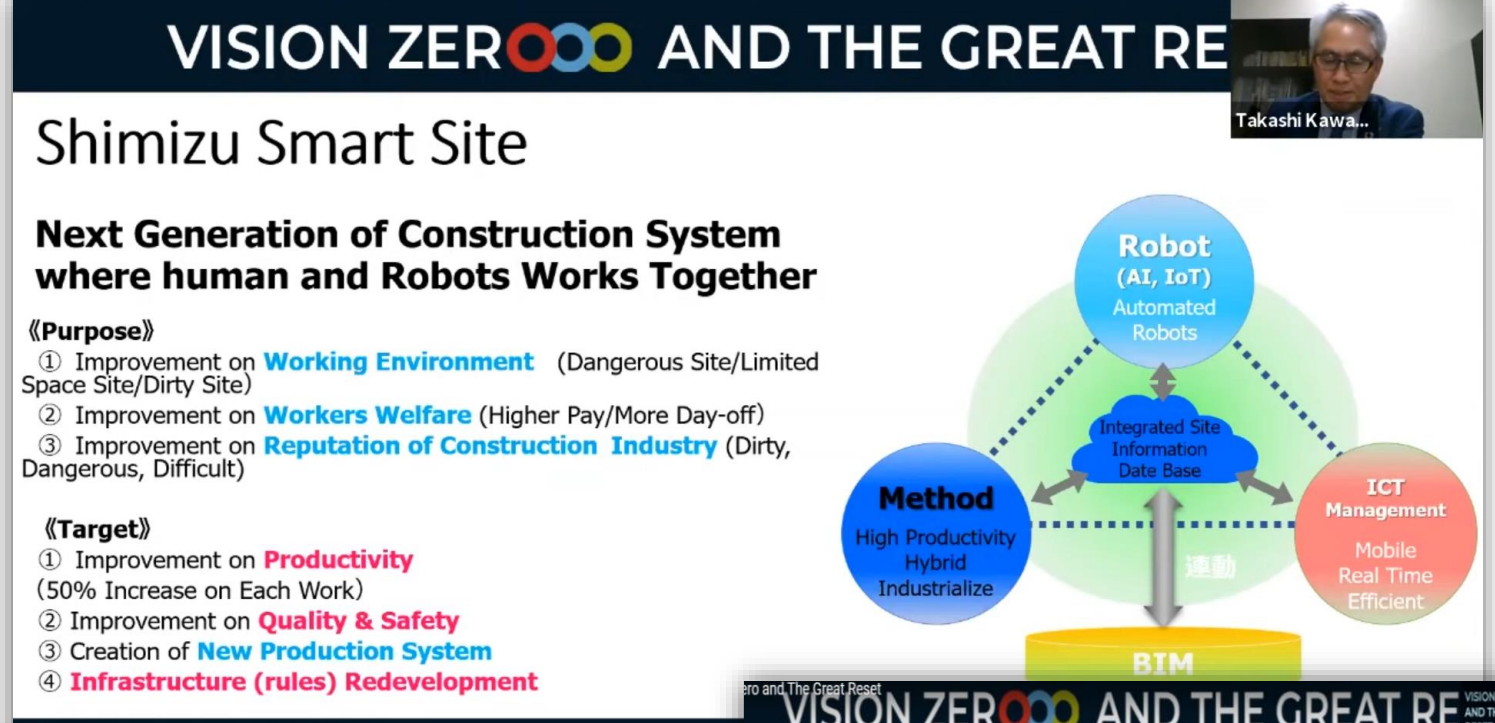
Problem statement

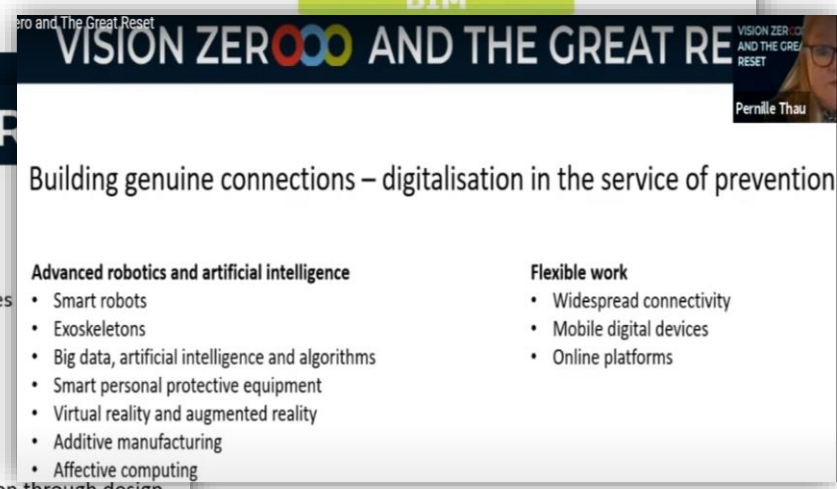
Construction Accidents

- One fatal injury costs an average of $991,027 in hospital costs. [ConvergePoint]
- The 5,333 fatal occupational injuries in 2019 represents the largest annual number since 2007.
- A worker died every 99 minutes from a work-related injury in 2019. U.S. BUREAU OF LABOR STATISTICS
- Fatalities in the private construction industry increased 5% to 1,061–the largest total since 2007. U.S. BUREAU OF LABOR STATISTICS
- Fatalities among workers age 55 and over increased 8% from 1,863 in 2018 to 2,005 in 2019, which is the largest number ever recorded for this age group. U.S. BUREAU OF LABOR STATISTICS
- Work-related injuries have caused companies to lose 104,000,000 production days. [National Safety Council]
- Injury related Indirect costs in the construction can be 17 times more than direct costs. [Safety & Health Magazine]

Technology Solutions That Can Help Provide Better Risk Monitoring, Inspection, Identification Or Safety Training are Still Largely Unproven And Ill-defined

Interesting Points of Vision Zero To Consider

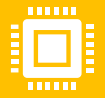




Idea/Hypothesis

BIM can provide models with necessary geometric and non-geometric information to characterise site conditions, however there is no such thing as a formal description of "BIM for safety" unlike what happens for other BIM uses such as quantity takeoff or facility management

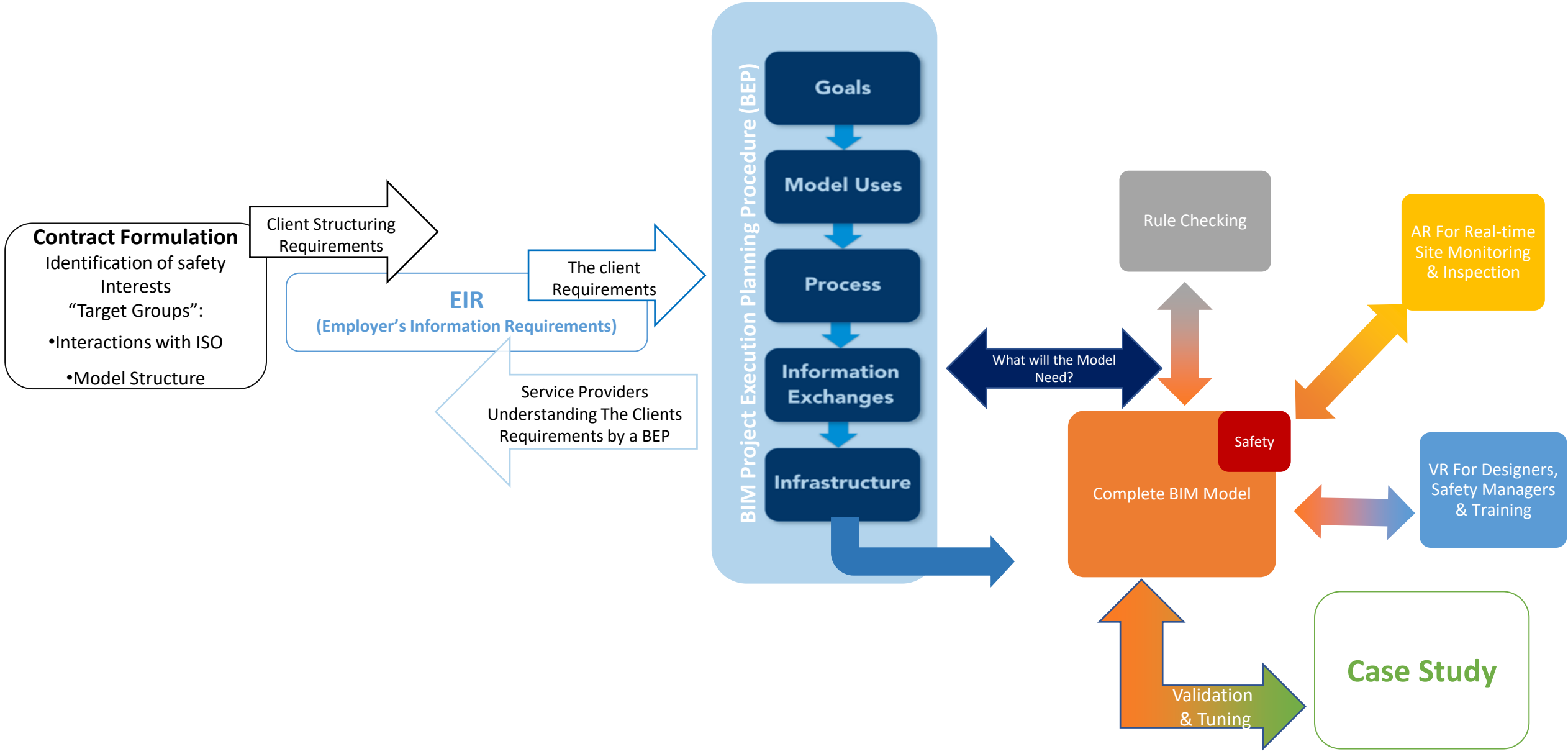
This work will be based on construction safety standards such as “ISO 19650 , PAS 1192-6:2018 "Specification for collaborative sharing and use of structured H&S information using BIM, and the Directive 92/57/EEC, implementing minimum H&S requirements at temporary or mobile construction sites”.



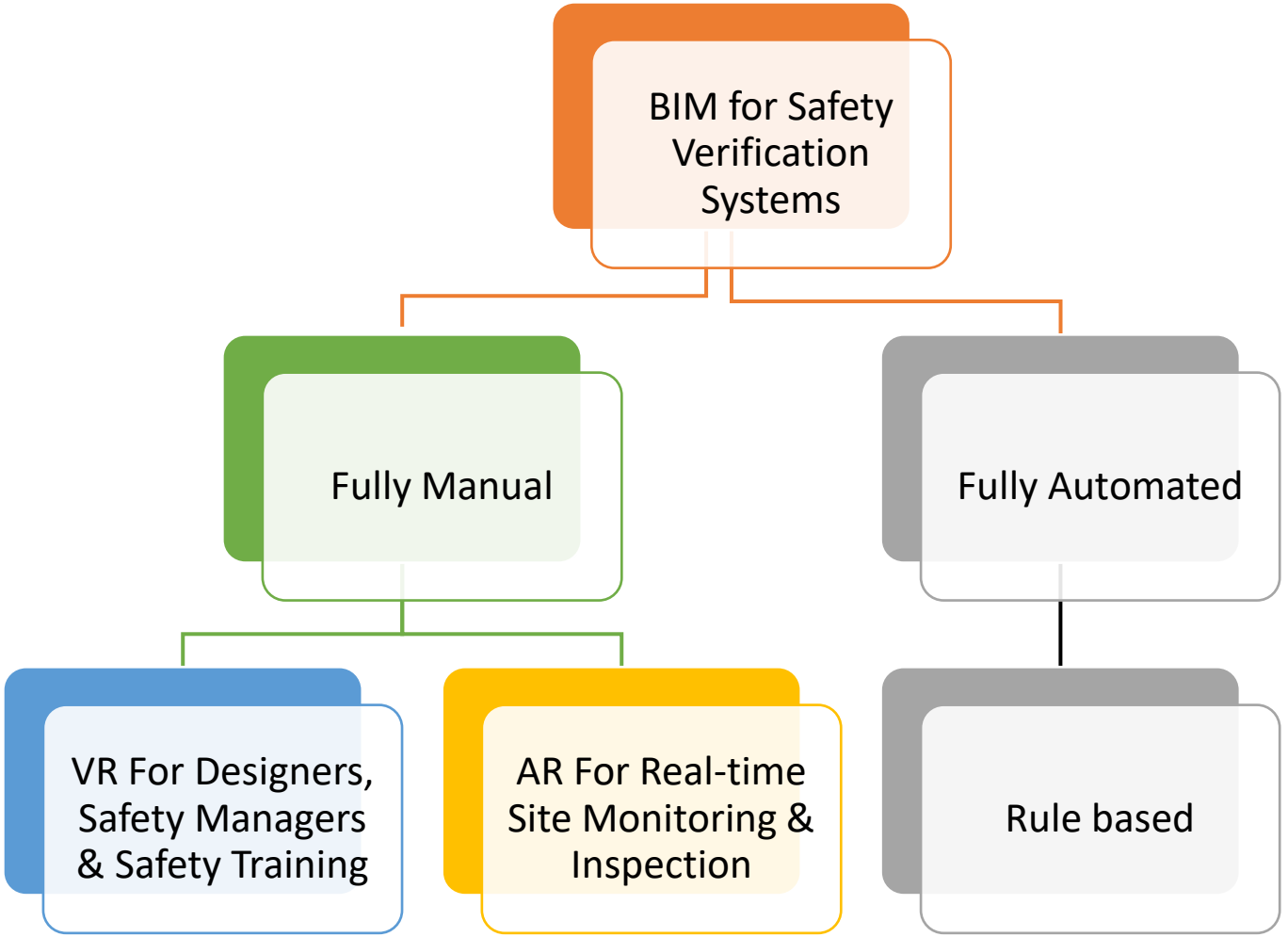
The framework will cover training and risk identification, monitoring and inspection. Immersive interfaces will allow different types of users to access BIM content and to simulate specific site conditions before entering the worksite.

Existing rule-checking tools and catalogs will be used to identify potentially risky situations automatically from the BIM model

BIM for Safety Template, General Framework



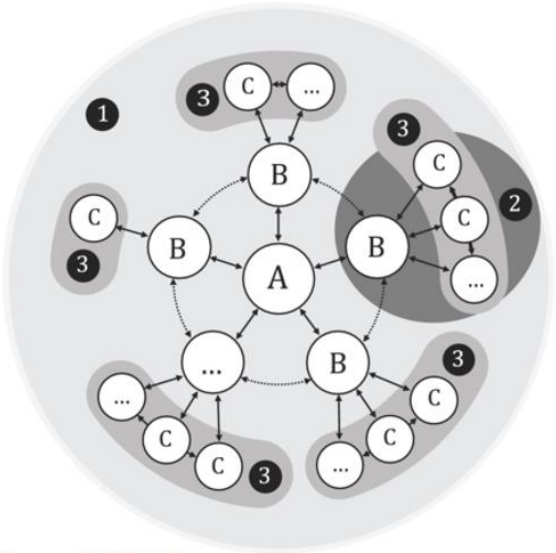
Methodology



BIM for Safety Verification System

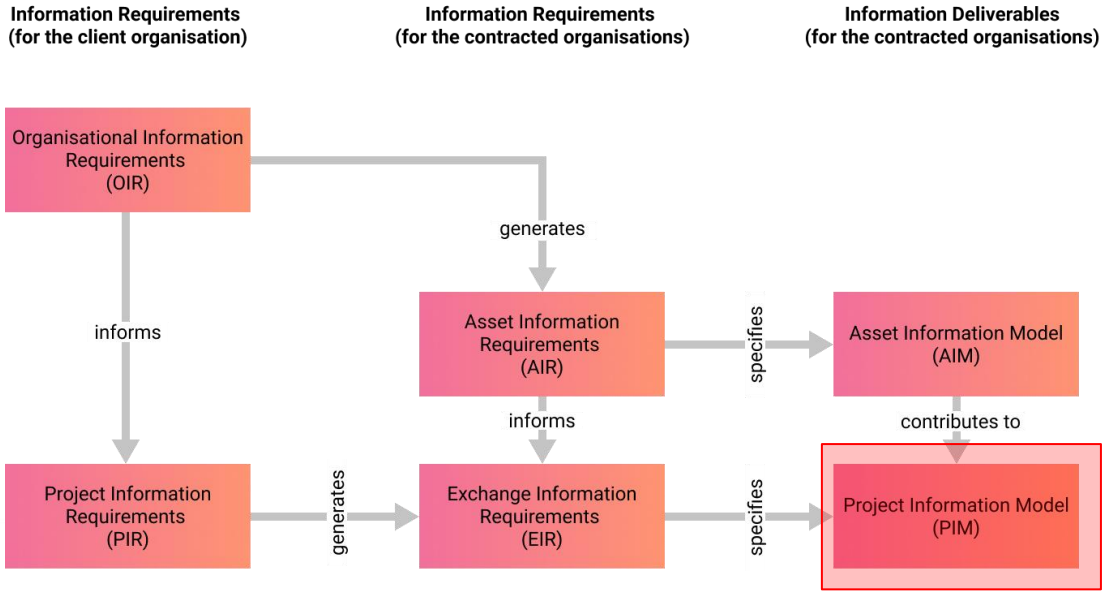
Contract Formulations

Target Groups



A	appointing party
B	lead appointed party
C	appointed party
...	variable amount
1	asset/facility management and operation team
2	illustration of a delivery team
3	task teams
←→	information requirements and information exchange
←⇢	information coordination between lead appointed parties if required by appointing party

Integrations Within ISO



General BIM Relationship

Structuring the Model

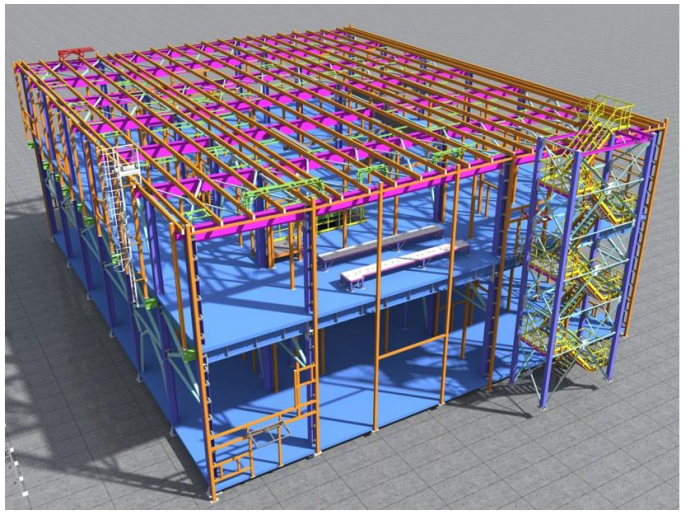


Illustration of spatial federation strategy by discipline in a building project

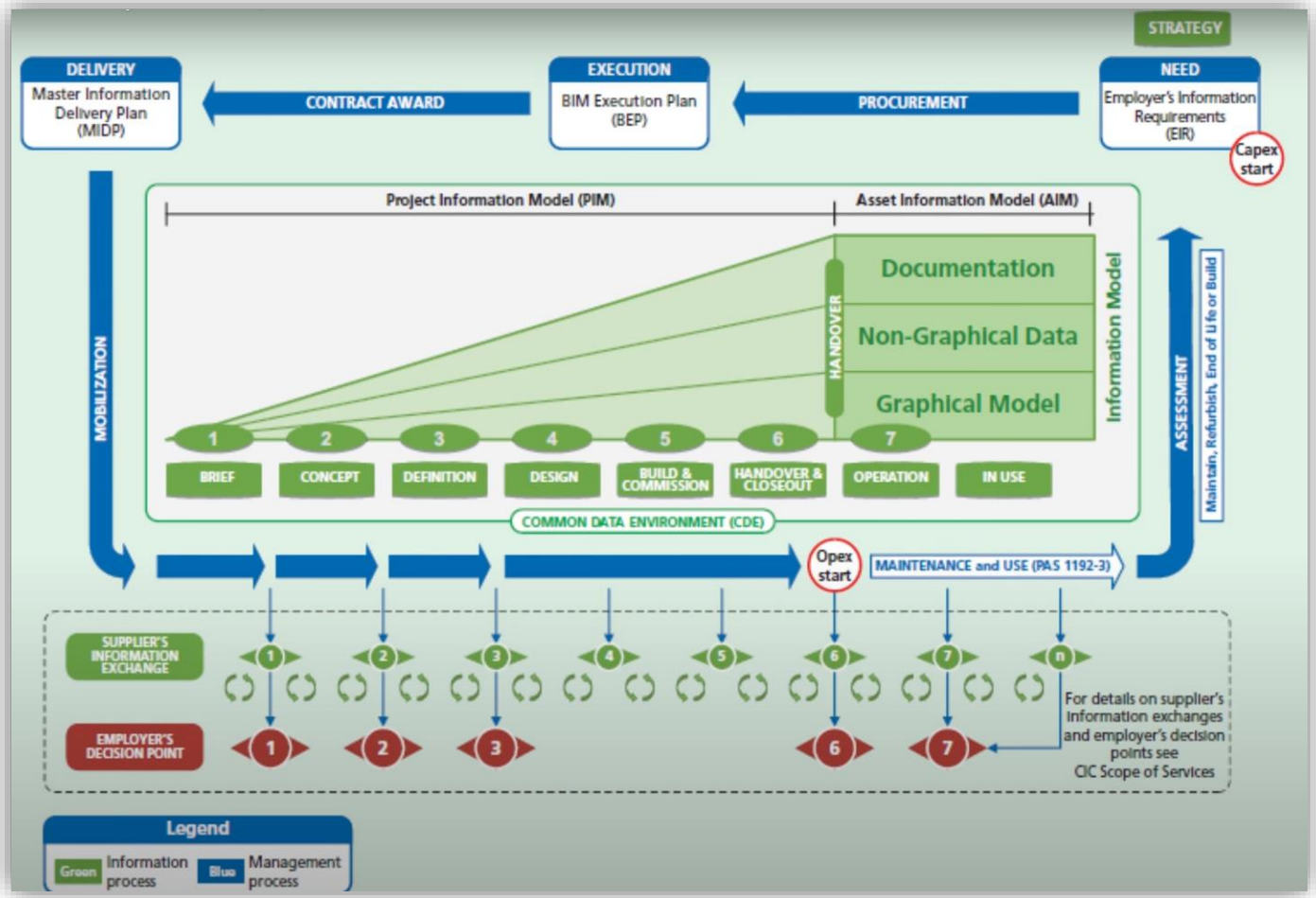
Who is interested in the safety Information?
What level are we operating on?
Task Team or Owner?

How to integrate safety within the delivery?

What should be in an information container for safety?

BIM for safety "on a very operational level" is an information container within a project information model that must be appointed by someone.

Employers Information Requirement (EIR)



- Clients have an idea about the information they would like to see from their project teams during the delivery phase as proposals are being designed and priced up.
- Clear information at handover to be able to run their new building and get the best out of it.
- Employers Information Requirements or EIRs, are the document where those needs are set out.
- EIR is one of the most important pieces of construction using BIM. It is the one document that can drive the process from start to finish and the one document that all parties (designer/contractor) must respond to the owner.
- It must be generated at the start of the project and carefully consider what is going to happen throughout all the stages of the project and set out what must be delivered at the end.

Technical	Management	Commercial
✓ Information format + file types	✓ High-level roles + responsibilities	✓ Strategic purpose
✓ Levels of Definition	✓ Standards	✓ Defined deliverables
✓ Software platforms	✓ Data security	✓ Competence assessment
	✓ Key decision points + information required for them	

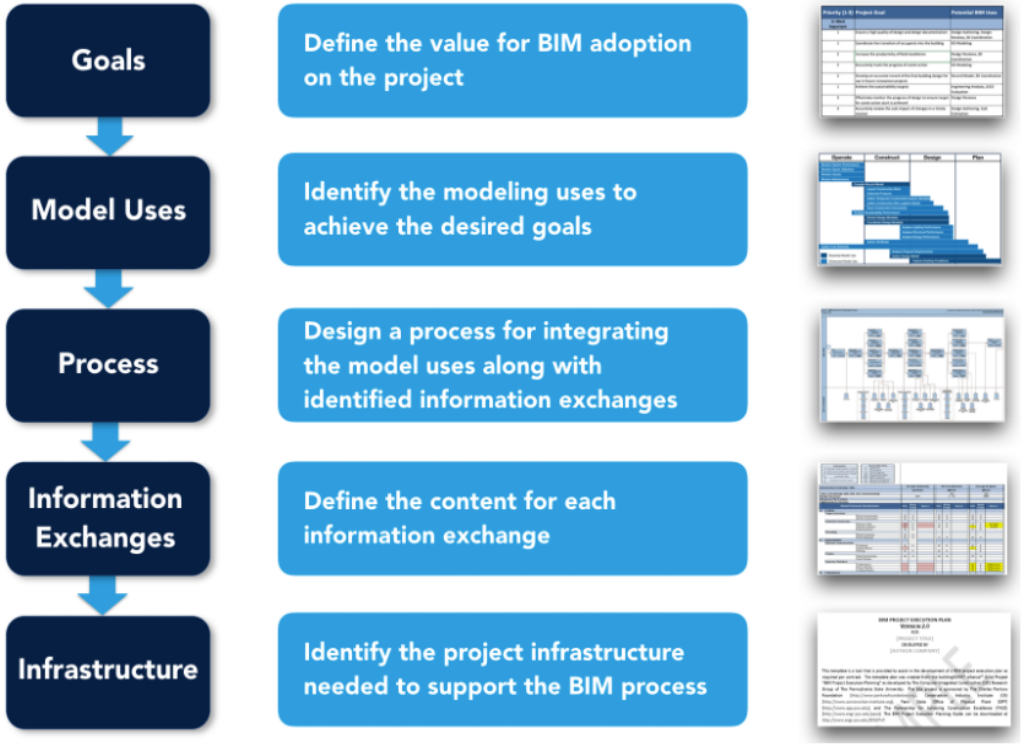
BIM Project Execution Plan (BEP)

Outlines the overall vision along with implementation details for the team to follow throughout the project.

The Plan should be developed in the early stages of a project; continually developed as additional participants are added to the project.

By developing a BIM Plan, the project team can:

- clearly understand the strategic goals for implementing BIM on the project
- Organizations will understand their roles and responsibilities
- The team will be able to design an execution process which is well suited for each team member's business practices and typical organizational workflows
- Outline additional resources, training, or other competencies necessary to successfully implement BIM for the intended uses
- Provide a benchmark for describing the process to future participants who join the project
- The purchasing divisions will be able to define contract language to ensure that all project participants fulfill their obligations
- The baseline plan will provide a goal for measuring progress throughout the project.



Developing Information Delivery Manual (IDM) for Safety

Once we establish our method, we can start drawing the structure of the information container in detail.

Since BIM for safety does not exist, everything is new contract formulation will be an intermediate step to have something that can be used on site.

Done by drawing IDM for Safety, which does not exist inside BuildingSmart **“There Is a Lack Here” .**

Information Delivery Manual (IDM) is a document that captures an internal team process and gives a detailed specification of the information that a user fulfilling a particular role would need to provide, at a particular point within a project.

Developing a Model View Definition (MVD)

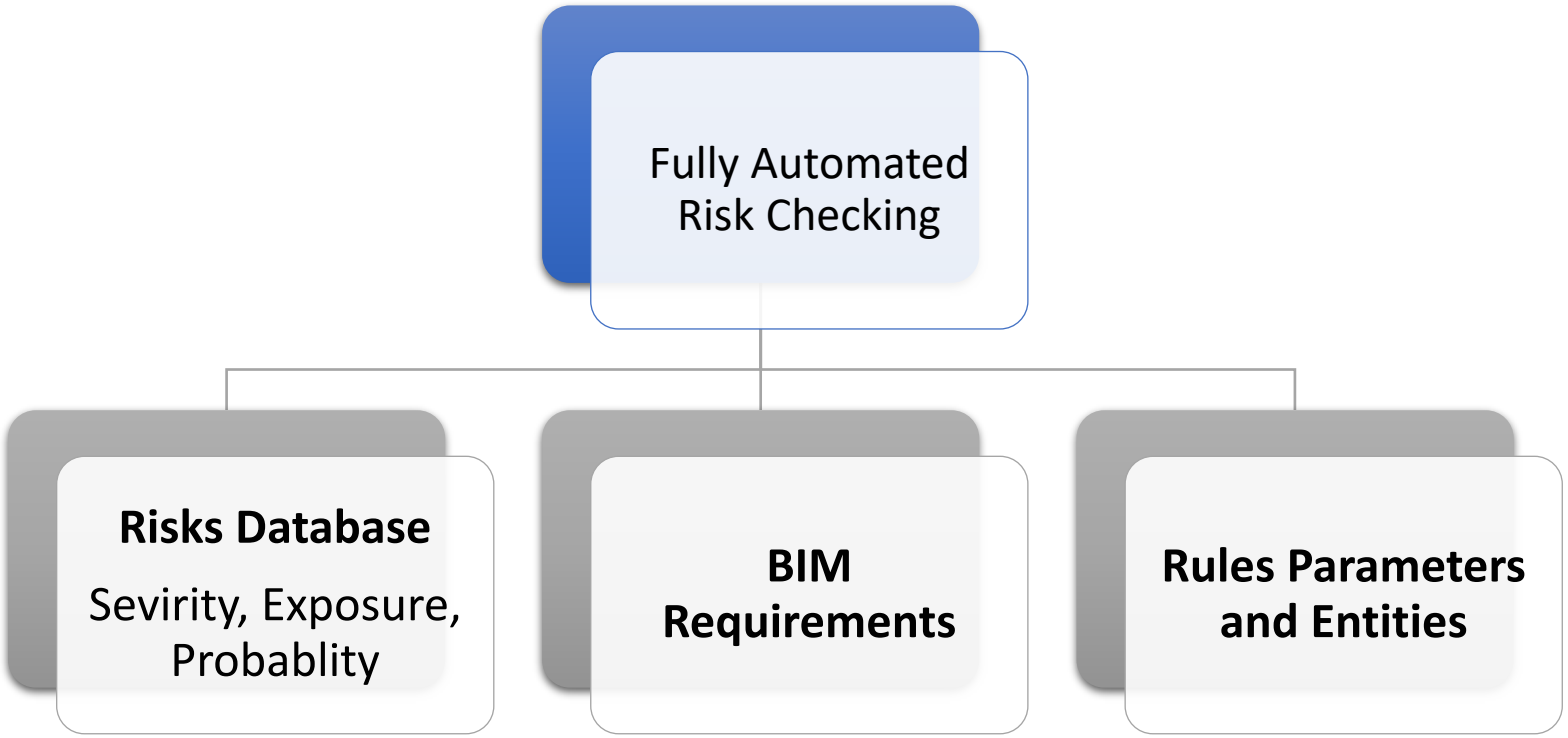
A Model View Definition (MVD) is a subset of the overall IFC schema to describe data exchange for a specific use or workflow, narrowing the scope depending on the need of the receiver

MVD is a filtered view of the IFC allowing users to export specific packages of model information to meet a particular use. MVD is a strong tool in the open BIM workflow, it reinforce clear and structured way of working

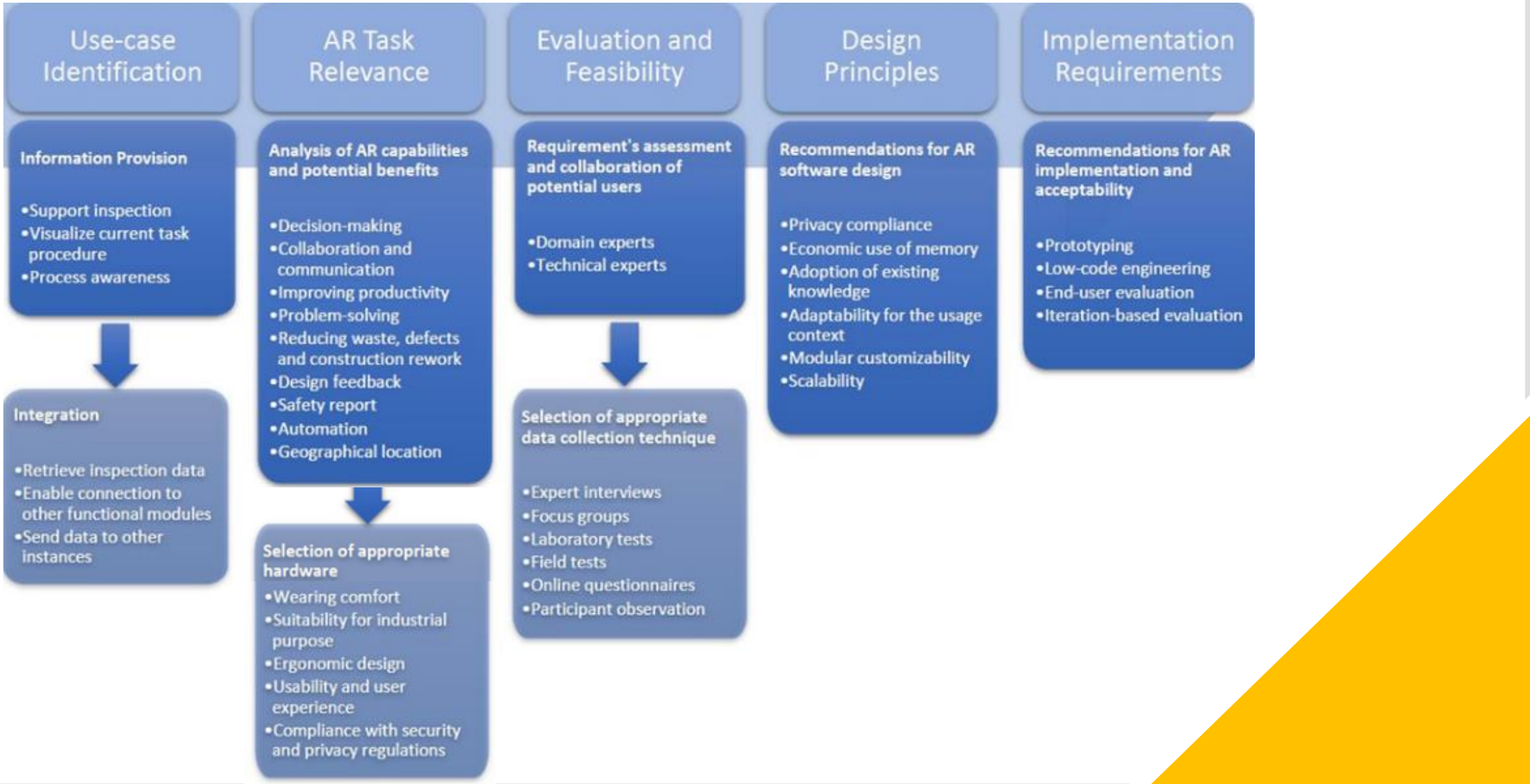
For example, energy analysis MVD exporting only the information relevant the building envelope spaces the U value of the external walls

Same for cost analysis and structure analysis

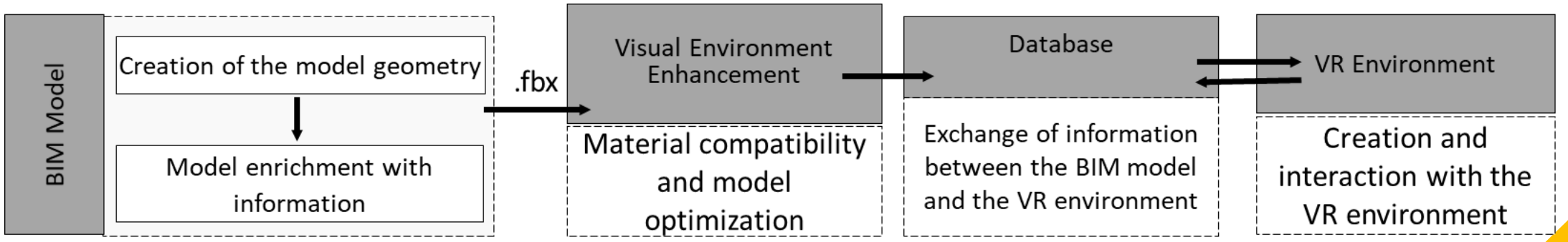
MVD for Safety analysis Does not Exist



Fully Automated Rule Checking Components



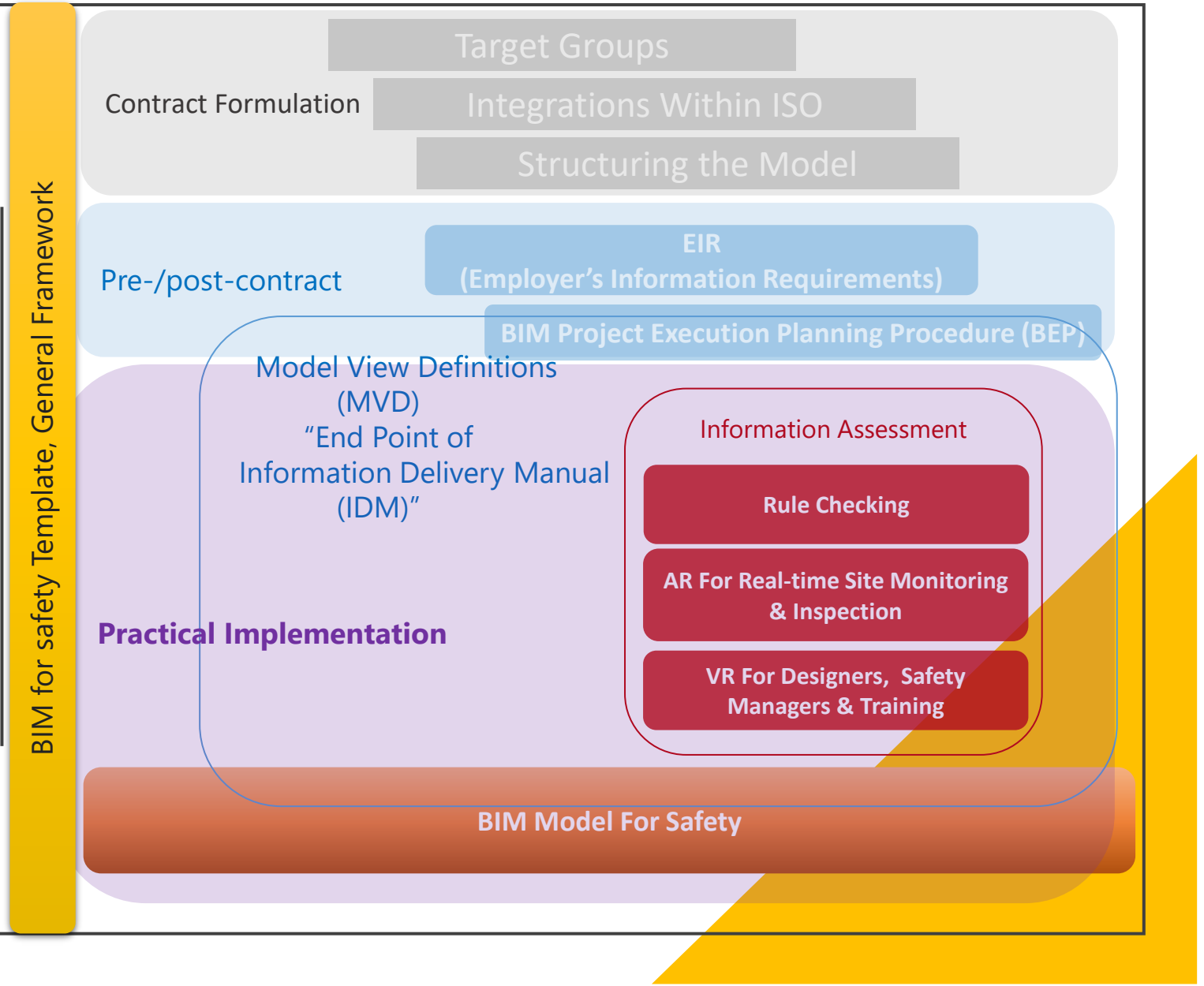
Framework for a Guided Integration of AR in the AECO Sector



BIM-Based VR Development Framework

Conclusion

All the traditional process mentioned before will be made.



Proposed Case Study

- A case study will be made implementing the framework into an actual industrial project in Portugal.
- Provide evidence for the developed system’s functionality in coordinating concurrent onsite processes and foreseeing conflicts as well validating the framework with the assistance of safety professionals.
- Elaborate on the proposed safety monitoring and inspection implementation in real practice and presents an illustrative example to showcase the added opportunities.

Thank you for your Attention!