Development – and use of digital building permit solutions

- What are the hidden challenges?

Critical, creative and constructive viewpoints

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Key-note presented at
CIB-W78 Code Checking workshop
14th Sept. 2021

After some many years – I had hoped to see

Digital processing of building permit applications

- Building permit application is a default threshold in all countries
  - It is also something that can help you to design and build “good”
  - There should be ongoing efforts to improve these solutions to increase the level of service for all stakeholder involved in the design and production process

- ***However, this is not the situation from my point of view***
  - I do hope I am wrong
- What is this the situation
- Why is it this way?
- Want can WE do about this situation?

…. you get what you want,

but not what you need…

Fix you, Coldplay

- http://www.metrolyrics.com/fix-you-lyrics-coldplay.html

Development – and use of code compliance solutions are

Alternative 1.

- ***Like a walk in the park***

- A stepwise process where the you start with adding rules / content of information in the BIM file

- "My solution" solves the problem
- "My advanced methodology" is the answer ---- that I really do not understand

Alternative 2.

- ***Like a walk in the jungle?***

- A highly integrated and iterative process including may stakeholder and information sources.

- …We want to develop
- …solution" solves the problem

What are the real purpose with building permits?

- An approved building application is the quality assurance (QA) process
- offered by the society to ensure relevant quality of the built environment.

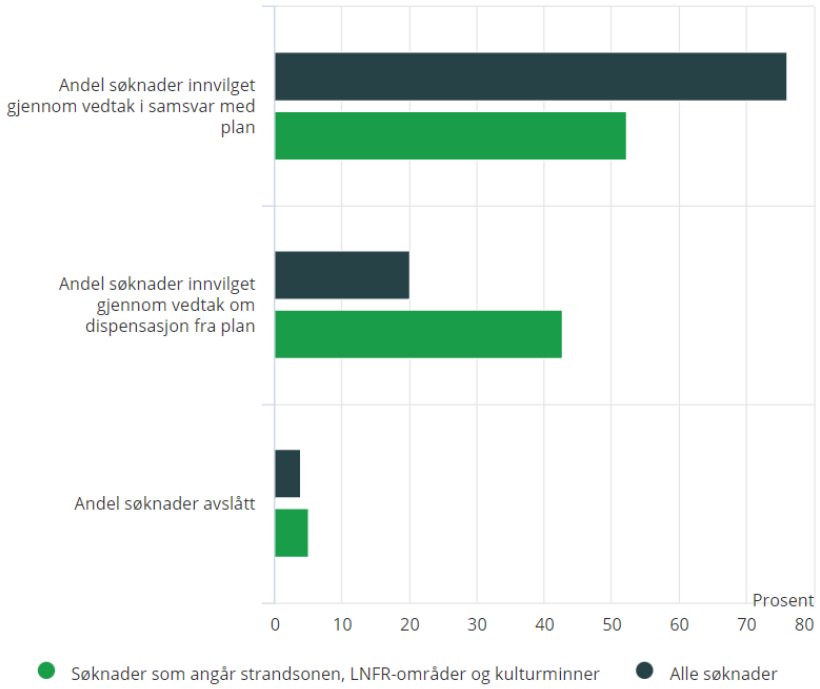
- It started with focus on
  - Structural safety, and continued with
  - Fire safety
  - Energy
  - Accessibility
  - increase by requirement to include SUSTAINABILTY

- This challenge evolves the entire industry
  – and require redesign of the codes + a lot more information from multiple sources!
  Digital solutions are needed!

Processing of Building applications - Norway

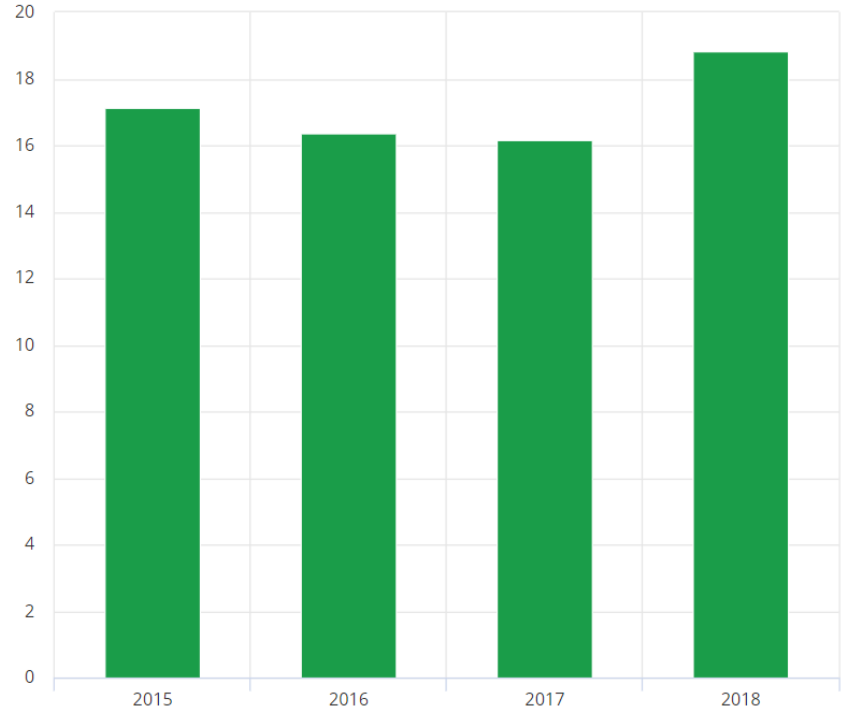
- Average numbers of applications in Norway: 80.0000/year
- Positive – 95% of complete and submitted application is approved
- However, the approval process is time consuming… + 4 months ☹

Figur 3. Andel av byggesøknadene som ble innvilget og avslått 2018. Veid gjennomsnitt for hele landet

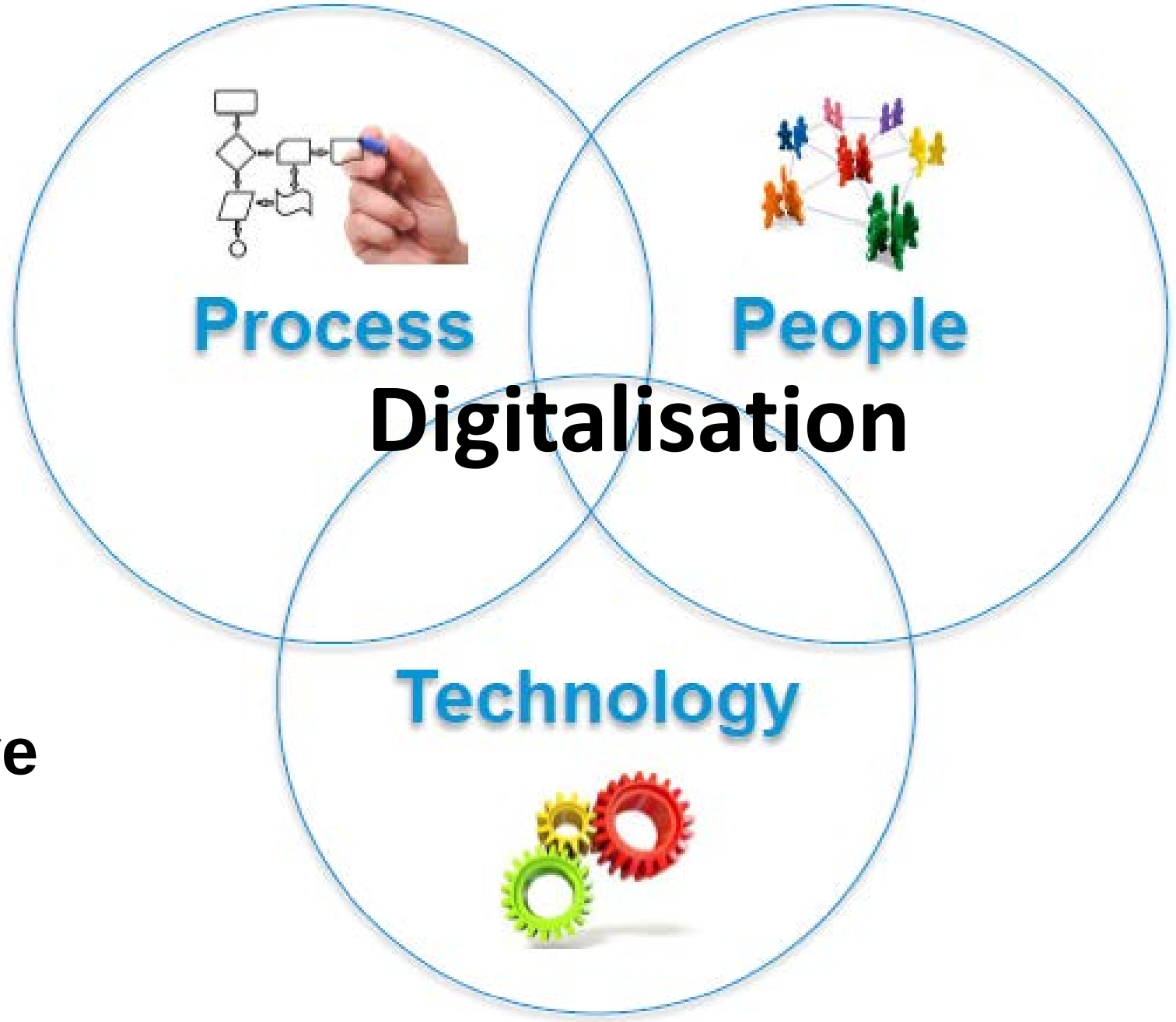


Kilde: Plan- og byggesaksbehandling, Statistisk sentralbyrå.

Figur 2. Veid, gjennomsnittlig saksbehandlingstid for vanlige søknader. Hele landet



Kilde: Plan- og byggesaksbehandling, Statistisk sentralbyrå.



Where do we have the most focus?

Two types of buidling applications

- Be aware of the TWO sides in the building permit application solution

- **Process** – The stakeholders
- – Qualifications and Site regulations – multiple sources
- In Norway, we focus most in this perspective
  - Can you build (involved companies) build this type of building in this “context”?

- **Product** – The building
- – found in the BIM – and IFC file as source
- Is the “designed” solution in the building in compliance with technical requirements in regulations and standards
  - Is this a safe (structural, fire), energy use, accessible building?

Two types of building regulations

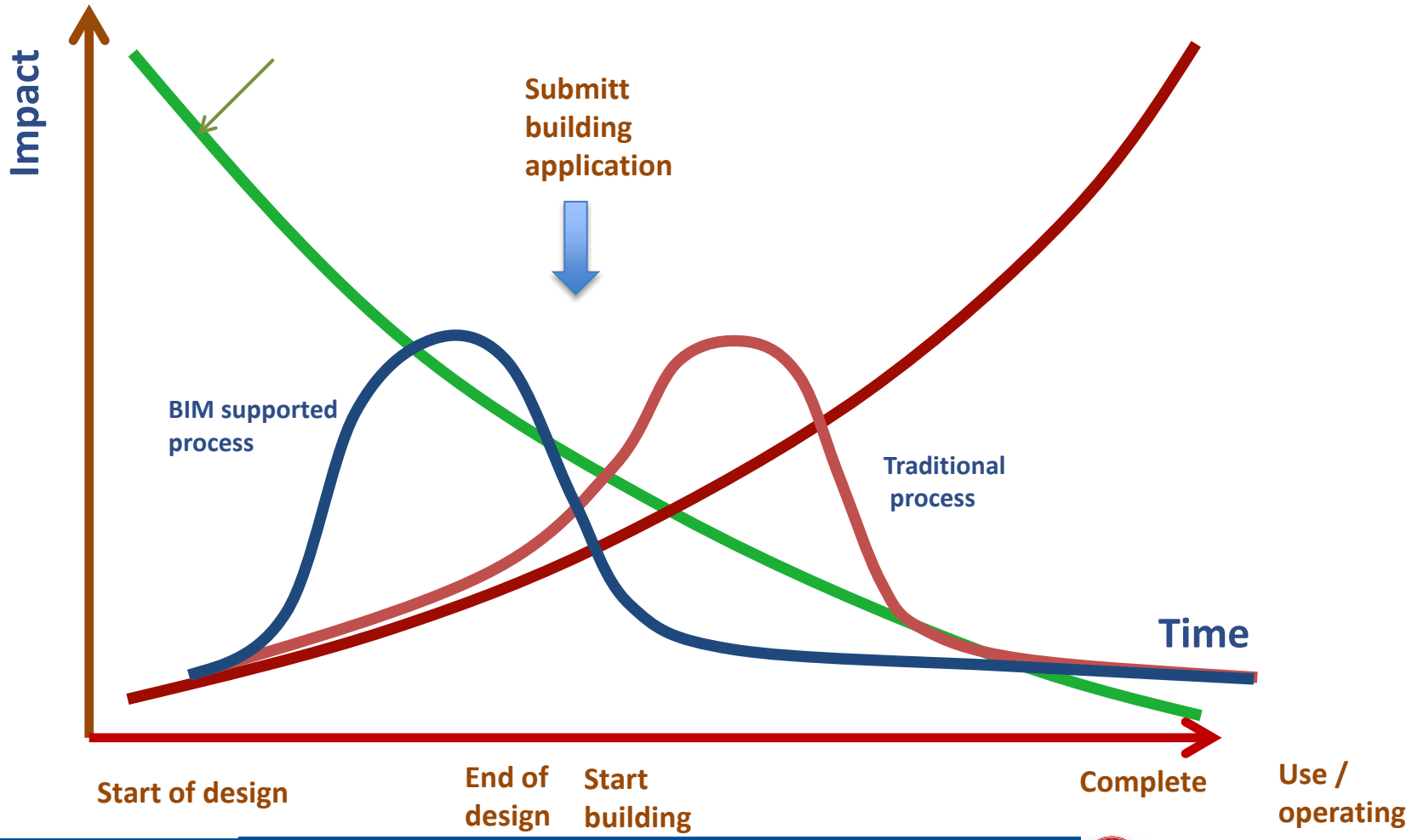
- ***Prescriptive specifications*** are expressed with discrete metrics (more than 900 mm, 2100 mm, 4 m, 12 m^2, 32 kN and so on)
  - **Very easy to test by use of BIM based model checking software**
  - Little motivation for new and innovative solutions in built environment

"Recipe" specifications

- ***Performance based*** specifications are expressed as purpose (function/goal) without discrete metrics;
  - *Requirements has to be interpreted – transferred from qualitative to quantitative rules*
  - Motivating for new and innovating solutions
    – and flexible use or existing solutions in built environment

"End result" specifications

Where do design support create most value?
When is compliance checking done?



Why do we not see more development of digital solutions for processing of building permit applications?

- It can’t be that hard?

- It is just to start with the regulations
- Line by line – and work on….

Interpreting standards and regulations

How to write Standard Norge in:

— Standard Norge

— Standards Norway

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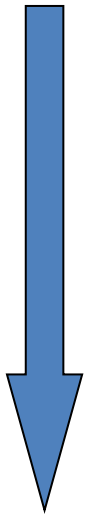
在ノルウェー日本国大使館



Norsk (Norwegian)

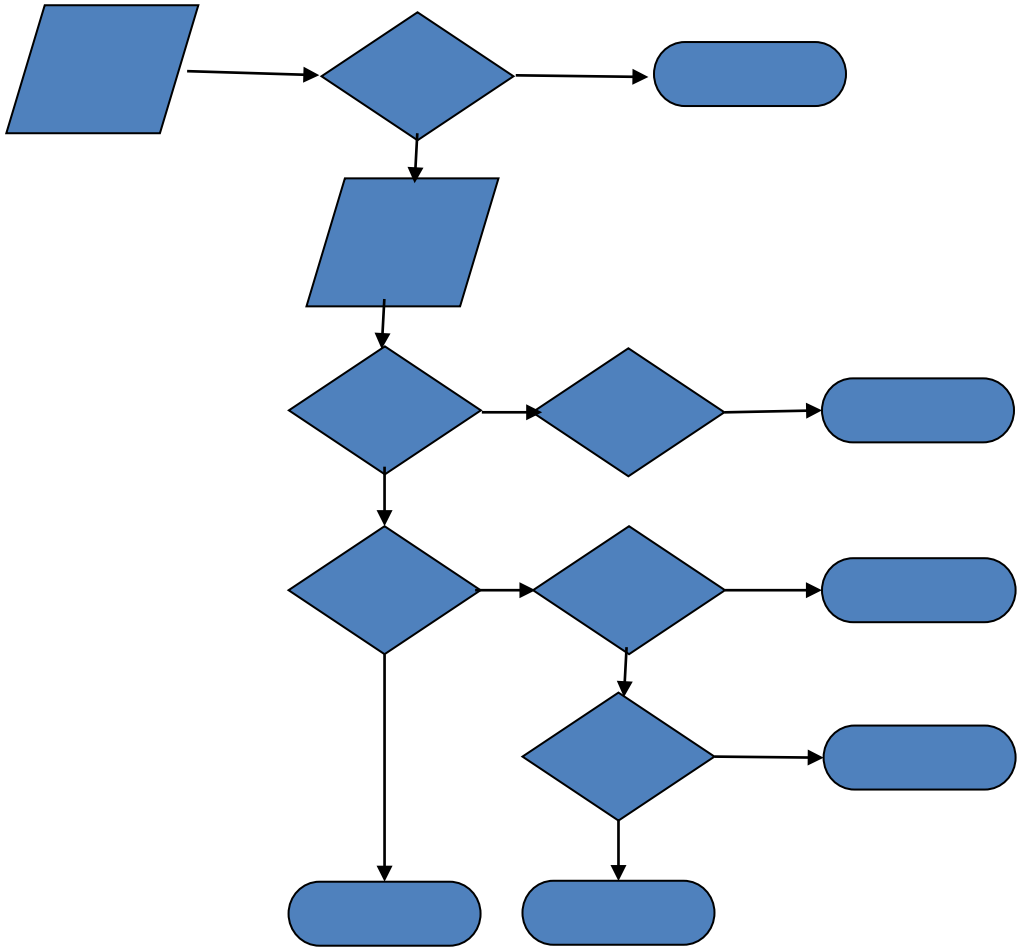
English

Arabian

Japanese

and in «Rulish» (digital structure) :

- How a computer reads regulations:



We need to think structure in a new way when we specify requirements

Why not develop standards and regulations prepared for digital processing?

Knowing in advance how applicable the standard are for digitalization
-- or what the impact is to prepare for digitalisation

We explore following standards:

ISO 15686-4:2014 Building Construction -- Service Life Planning -- Part 4: Service Life Planning using Building Information Modelling

ISO 15686-5:2008 Buildings and constructed assets – Service-life planning -- Part 5: Life-cycle costing

ISO 16745:2015 Environmental performance of buildings – Carbon metric of a building -- Use stage

Examples of assigned Tx3 values in Clause 5 from ISO16745:2015

Table 3: Examples of assigned Tx3values in Clause 5 from ISO16745:2015 [21]

Tx3 classification	Tx3 color	Tx3 value	Clause	Title in standard
			5	Protocol of measuring the carbon metric of a building in the use stage
			5.1	System boundary
Transform		2	5.1.1	Types of carbon metric of a building
Transform		2	5.1.2	System boundary for the carbon metric of a building
Transfer		3	5.2	The carbon metric and carbon intensity
			5.3	Calculation of GHG emissions
Transcribe		1	5.3.1	GHG emissions associated with energy use of a building
Transform		2	5.3.2	Measurement of an energy carrier
Transcribe		1	5.3.3	Exported energy
Transform		2	5.3.4	Energy and use
Transform		2	5.3.5	GHG emissions coefficients
	in average	1,88		

Transcribe =1

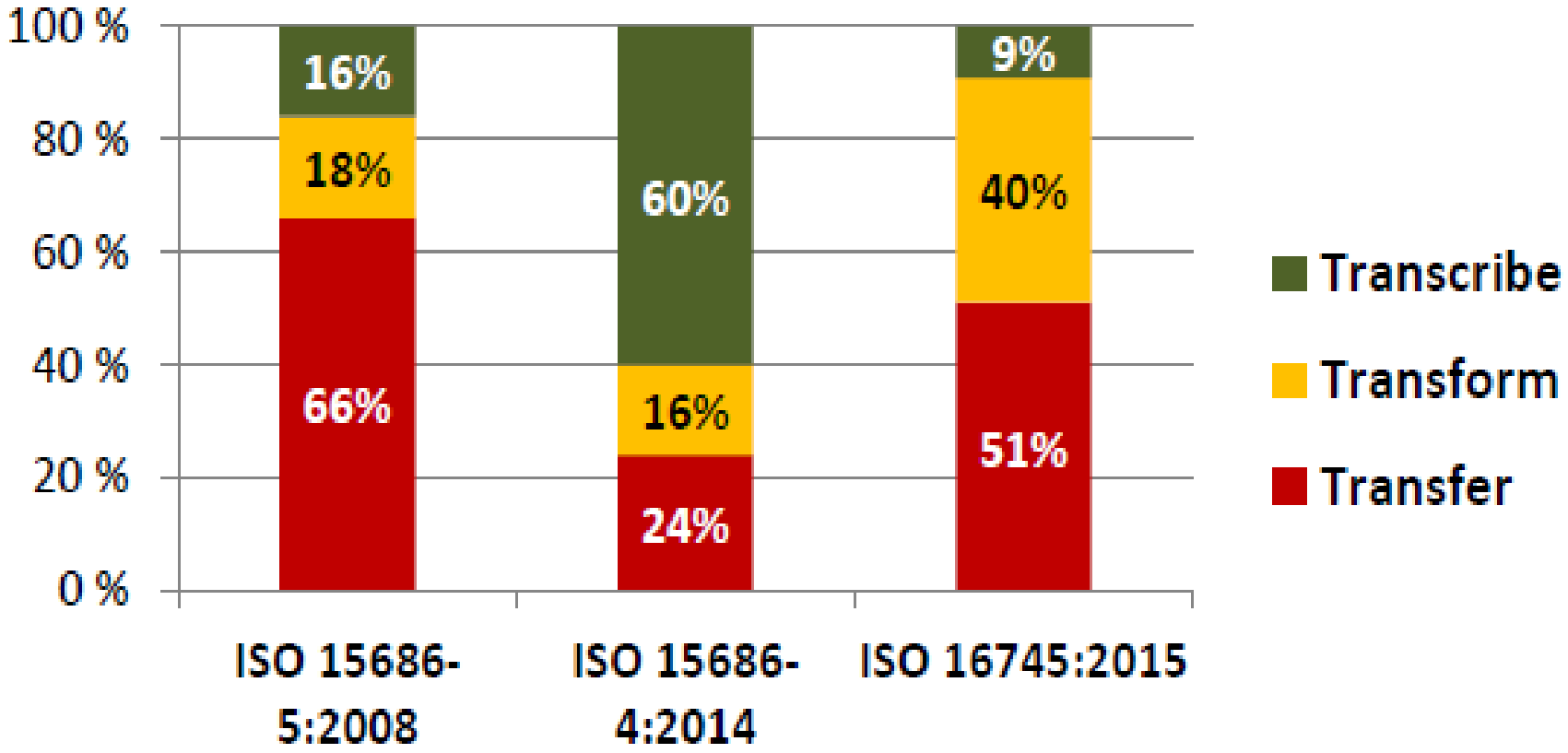
Transform =2

Transfer =3

Low values indicate greater adaptation to digitalization.

How to develop standards prepared for digital implementation?

Degree of computable requirements in ISO standards

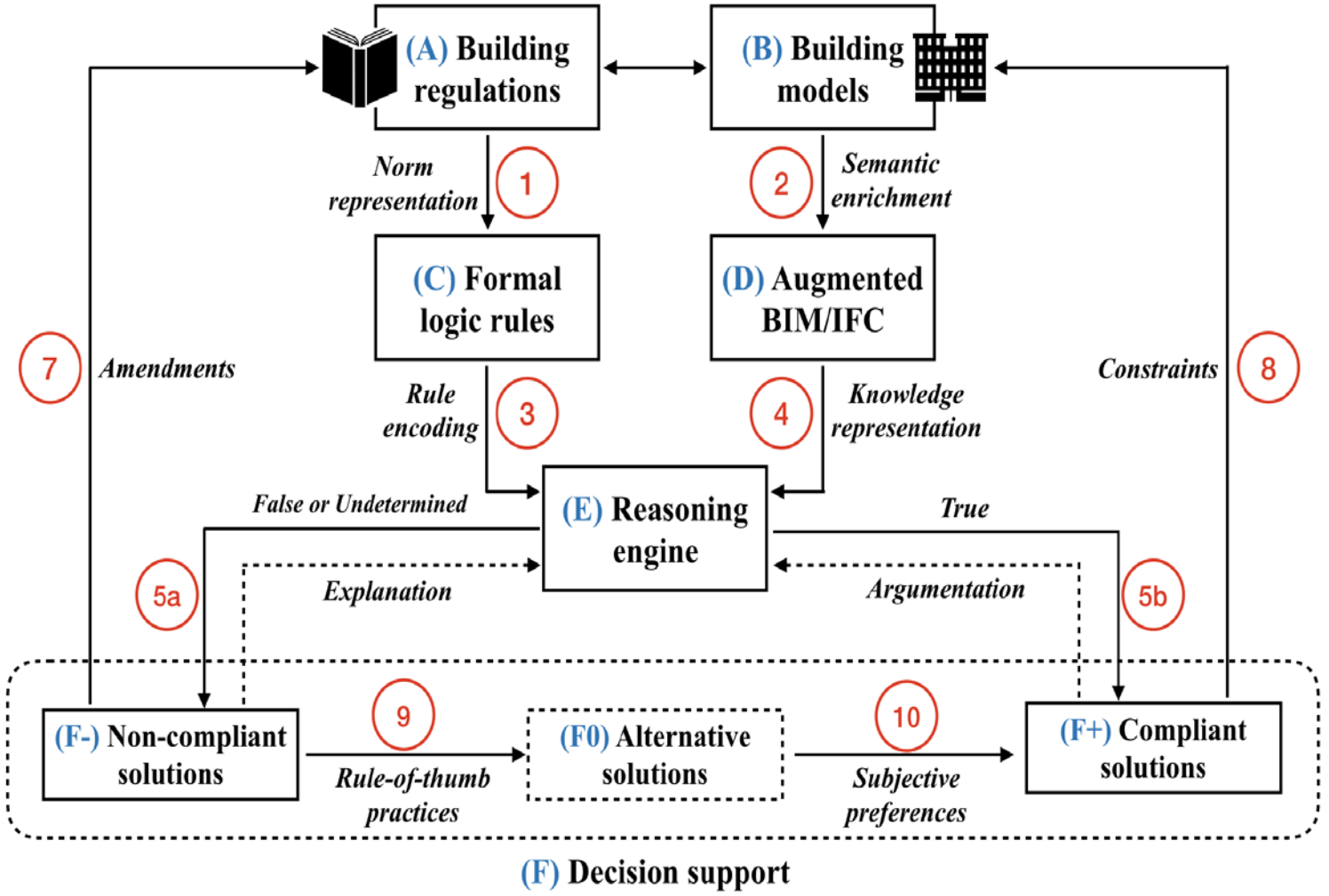


Preparation for automation do not improve by itself (time)

– but by awareness for how to prepare for digital implementations

ISO 15686-4:2014 was developed for use in BIM-based solutions

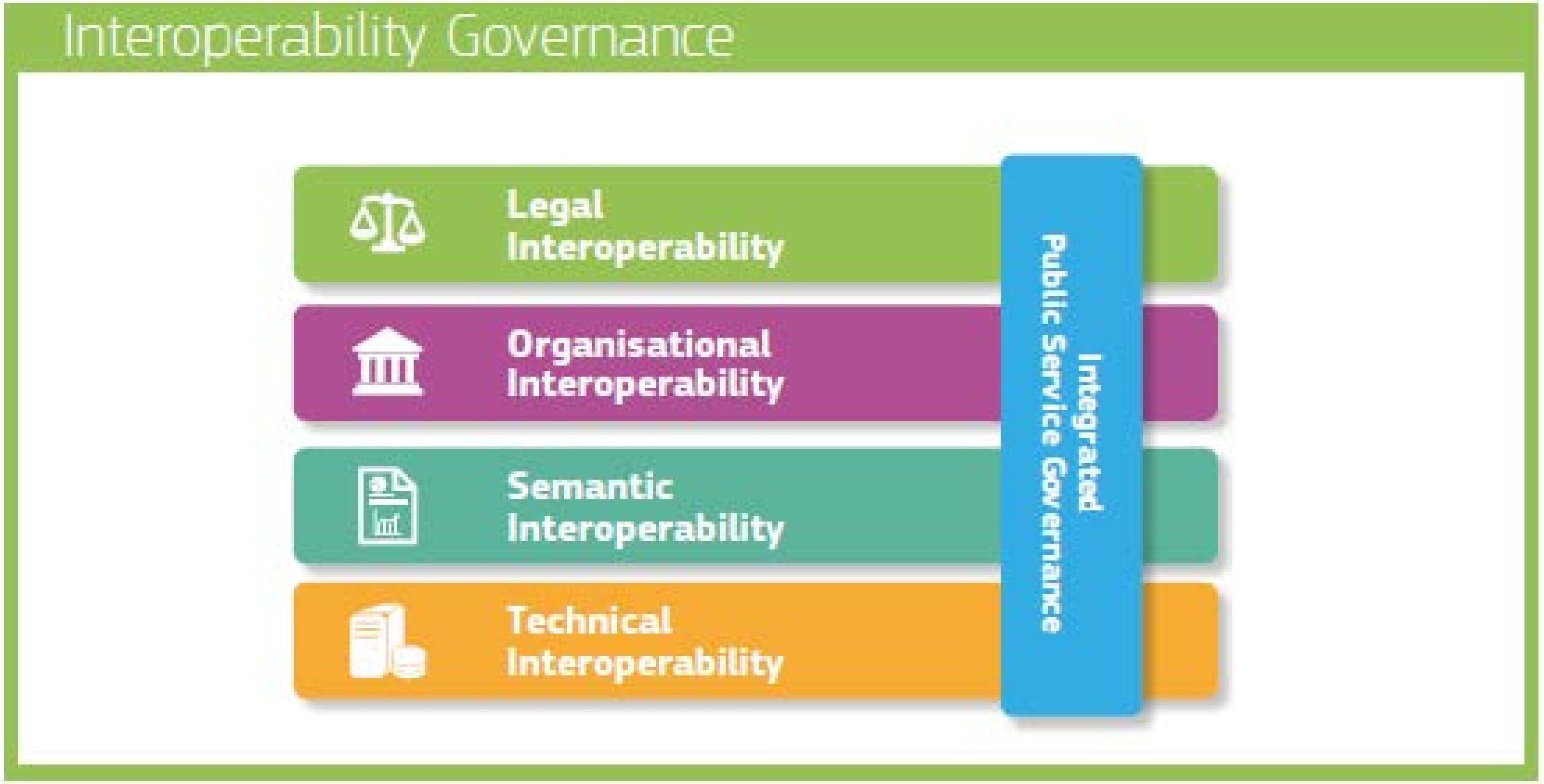
Use of "REASONER" to improve interpretation



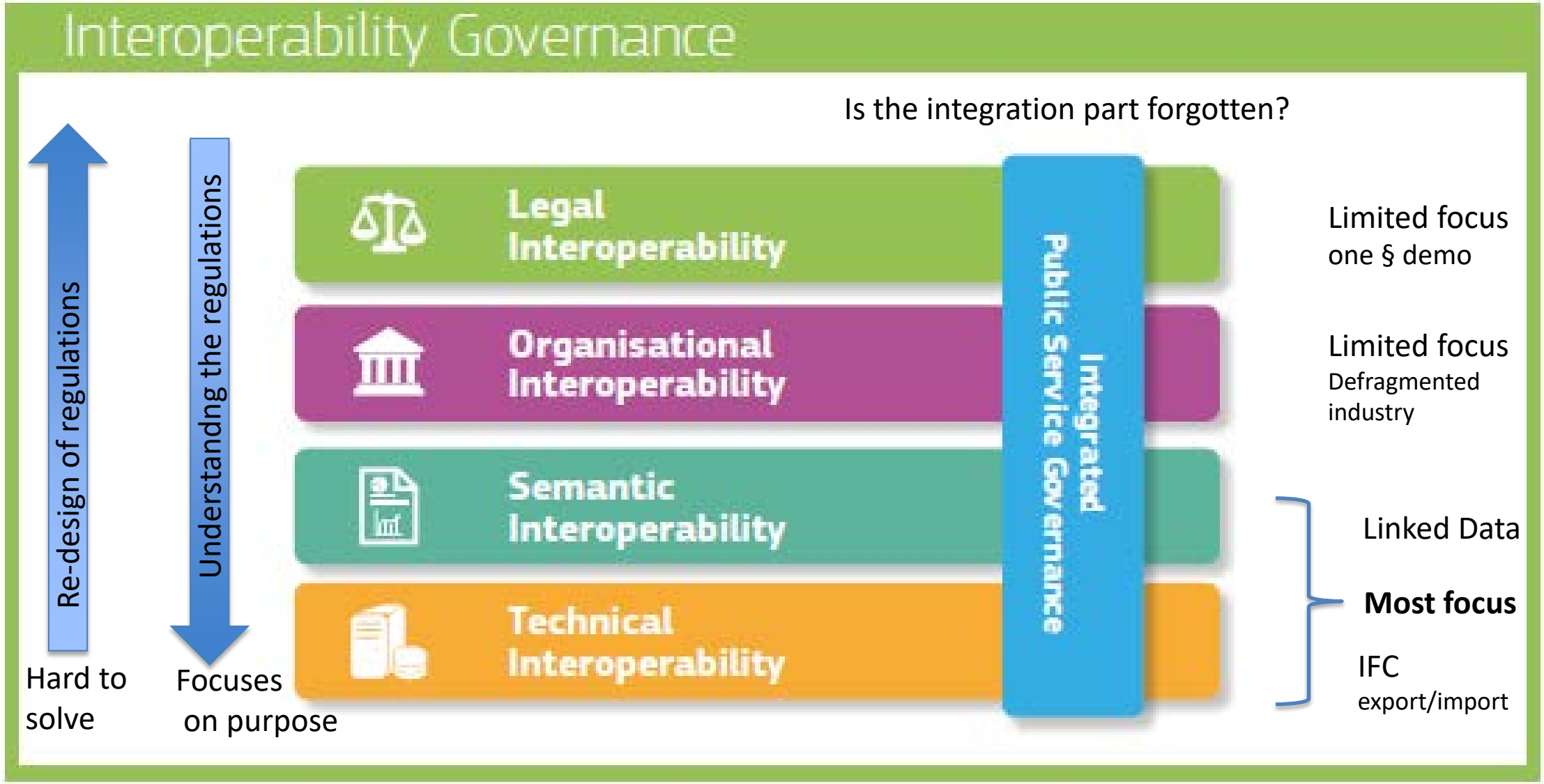
- and by this implementation into software solutions

- This will be followed up in the presentation by Beidi Li

Interoperability layers

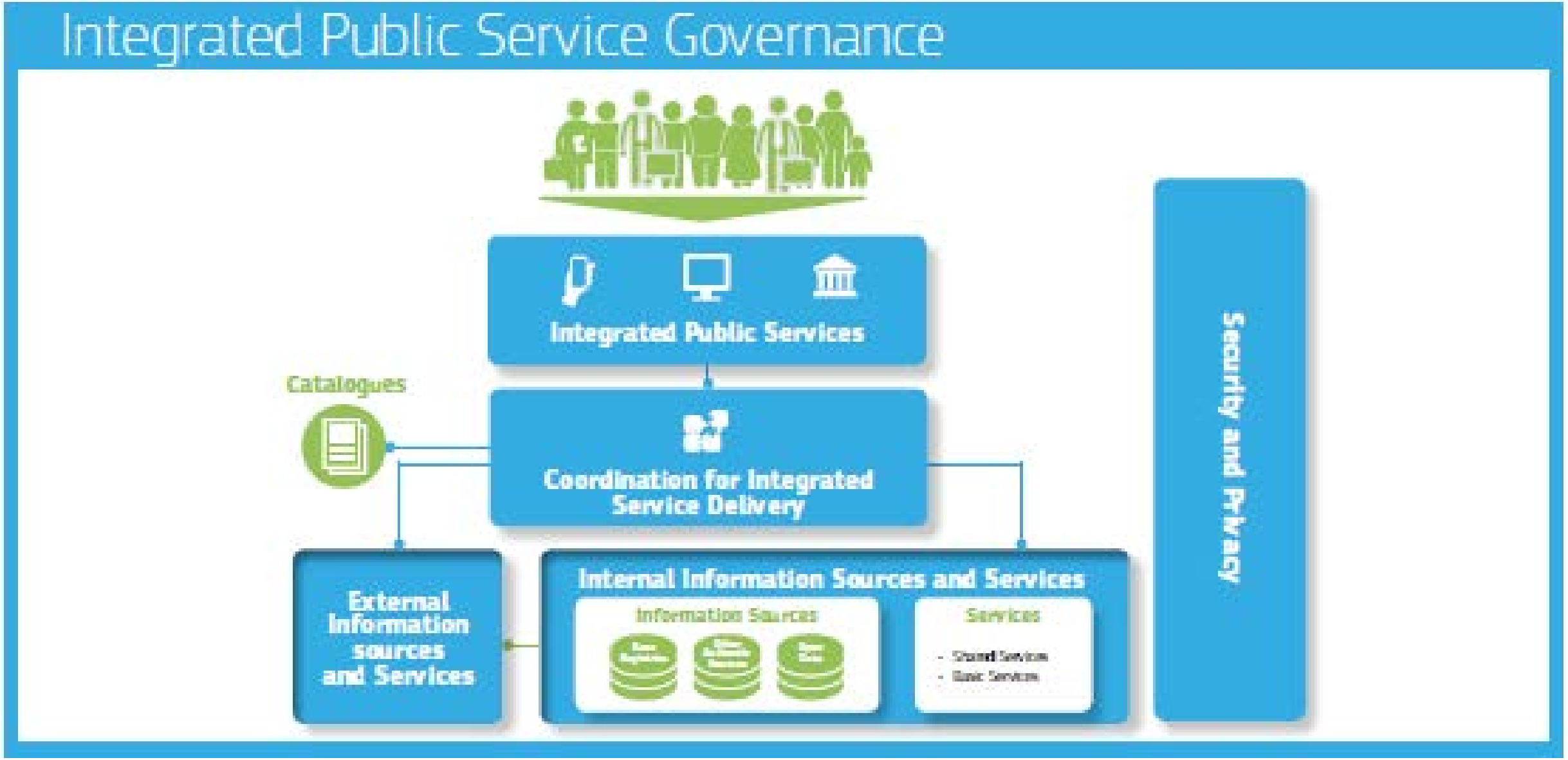


Interoperability layers – What is your use case?

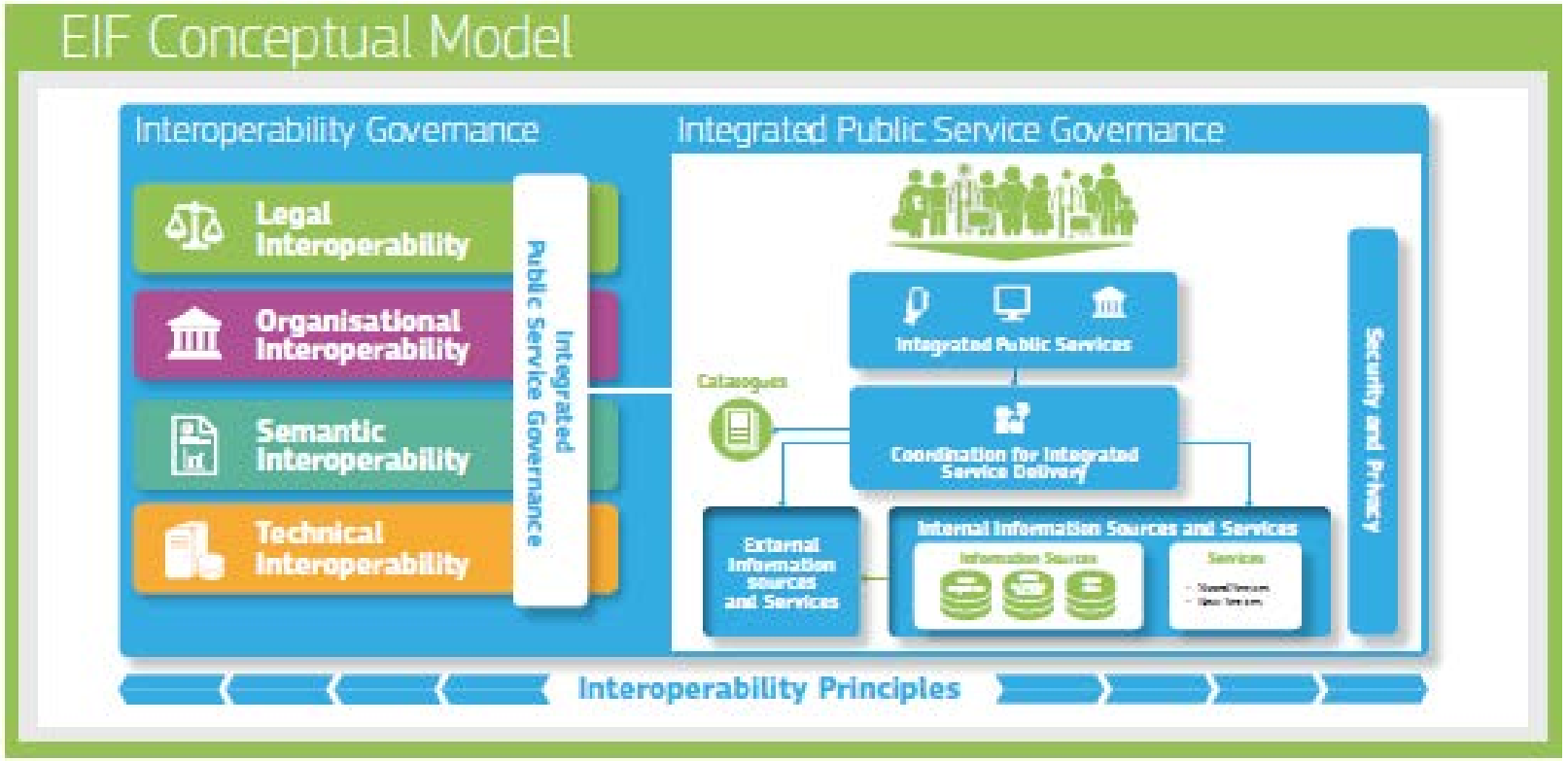


Artur follow up this way of thinking in his presentation

Model overview for



The EIF Conceptual Model - connects all together



- Code checking has to be ***integrated***
- to support ***services*** (plural)
- that gives value for the ***users*** (plural)

Some examples from Norwegian Building Authority – and the software industry

“BuildApply” (ByggSøk) – Old and used solution

- “BuildApply” is a web-based solution for digital submission of building permit applications. Build Apply can roughly be described as:
  ”27 forms are integrated into one single web-based service.”
- IFC is allowed, but drawing in pdf format must be included
- Covers approximately ***70 types of building applications***
- Approx. **80.000 application** process pro year in Norway
- Manual processing at the local authorities

- The system first was launched in ***2003 - and stopped in 2021***

- ***What to do next?***

How to continue?

- **Alt 1.**
- Done by the Norwegian Building Authority
- Proposed project:
- ***ByggNett*** (BuildNetwork)

Alt 2.

- Done by the «industry»
- Commercial software companies develop digital solutions

Alt. 1.: ByggNett (BuildNetwork)

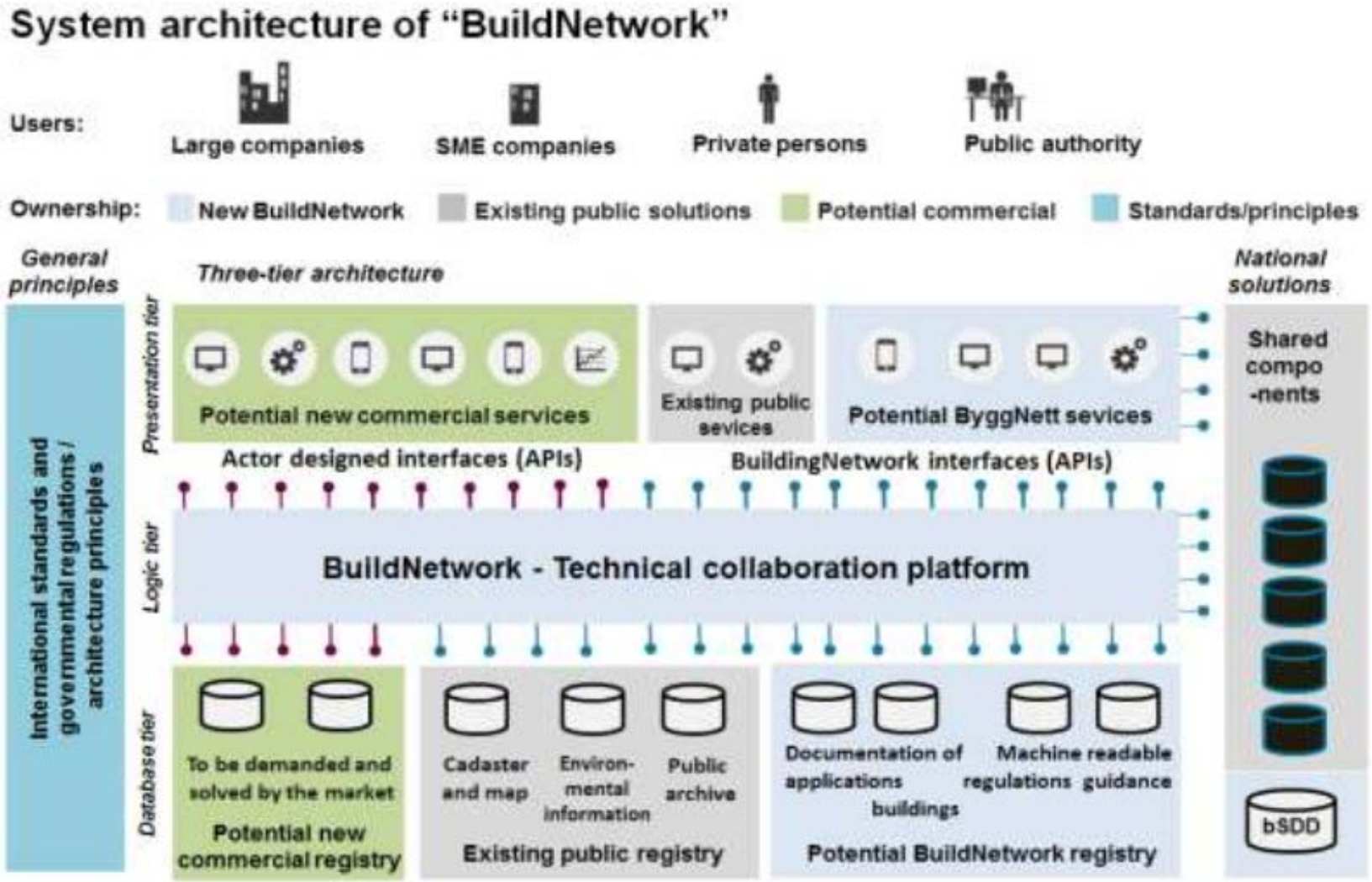


Figure 2. System architecture of "BuildNetwork" (KVU 2014

- BIG
  plans, however not supported…

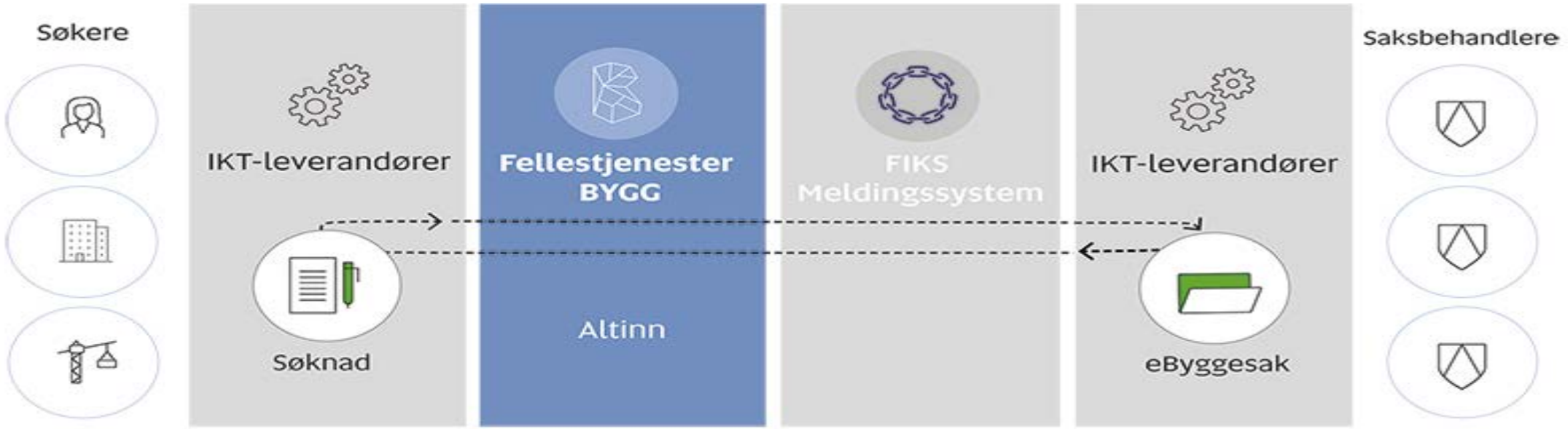
Alt. 2: Development by industry partnering

- Norwegian Building Authority invited the ***software industry*** to develop digital solutions
  - Development should be done in compliance with a limited set of specifications from the authority
  - Priority was given to simple types of applications with high volume and limited need for compliance services

- As foundation:,
  Norway have already developed a national digital information infrastructure as joint foundation

Joint solutions – is the enabler in all solutions
One (small) new joint service for “Buildings” (BYGG)

Applicant | Software developer | «Joint solutions» (national level) | Software developer | Local building authority



DIREKTORATET FOR BYGGKVALITET

Hva søker du? Søk Meny

Forside > Fellestjenester Bygg > **Tjenestene**

Lage byggesøknad? Bruk digitale løsninger

Velg om du skal søke som privatperson eller om du søker som profesjonell.

Professional

Profesjonell søker? Se hvilke løsninger du kan bruke

Private

Privatperson? Se hvilke løsninger du kan bruke

Fra ByggSøk til nye løsninger

- ByggSøk er stengt for nye søknader
- Avslutte saker i ByggSøk
- Få hjelp til å konvertere byggesøknader

The “Neighbor alert” solution

- Every applicant must inform their neighbor
- Validate which neighbor must receive “Neighbors warning” about their project
- The get this information in the digital mailbox

- Norway has a well-developed cadaster system and highly digitalized Map authority and joint digital national solutions

- We have after ***6 months of use registered 500,000 neighbor alerts*** through the new solution
- (Approx. 40.000 applications was sumbitted in this period)

Privat services

- Only one company offer a digital solution
- Neighbor alert
- And pdf-forms for manual use

Digitale tjenester for byggesøknader

Privatpersoner kan sende inn nabovarsel og byggesøknad digitalt.

Sist endret 21.09.2021

Digital byggesøknad for privatpersoner

Veiviseren fra Norkart hjelper deg å finne ut om du må søke og hvilken søknad du må sende. Du kan bruke løsningen til å sende søknaden digitalt til kommunen.

Alle kan bruke tjenesten til Norkart.

Gå til leverandøren

Nabovarsling for privatpersoner

Manuelle skjemaer for byggesøknader

Professional services

- 6 companies / organisations
  - Different level of integration and automation
  - Automatic “Neighbor alert” included in more solutions

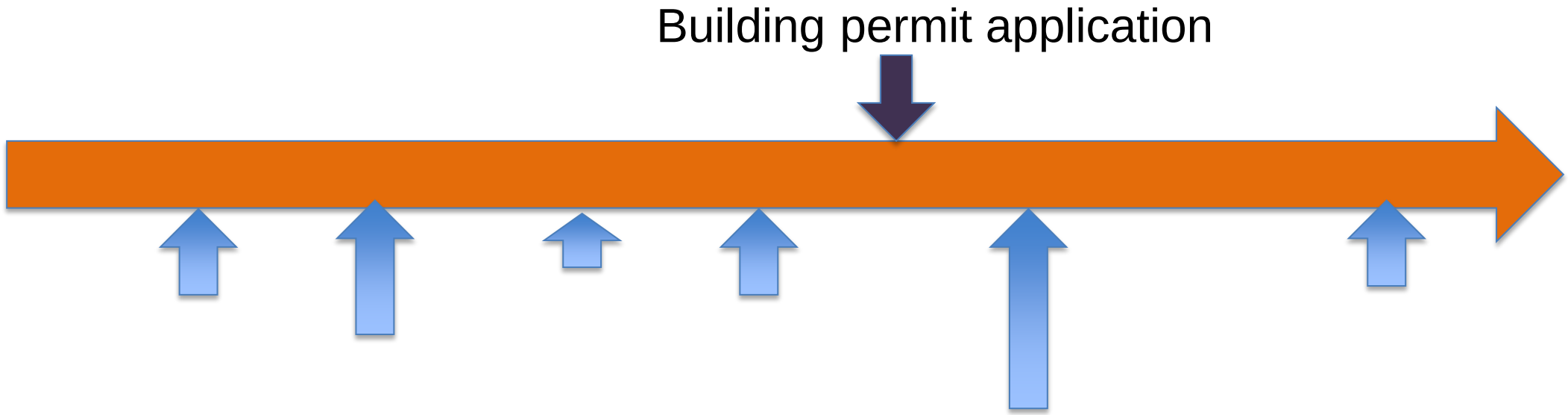
Digitale løsninger for byggesøknader

Nye, digitale løsninger for byggesøknader gjør det enklere å levere kom som gir raskere saksbehandling. Her finner du informasjon som hjelper riktig løsning for deg.

Sist endret 24.10.2020

- Byggesøknaden.no fra Ambita og Norconsult
- eByggesøk fra Norkart
- Holte Byggsøk fra Holte
- MAKS-søk fra Arkitektbedriftene
- Cordel Byggsøk fra Rørentreprenørene
- Byggesøknad for fagfolk fra Oslo kommune

Summary statements: A – Continuously checking

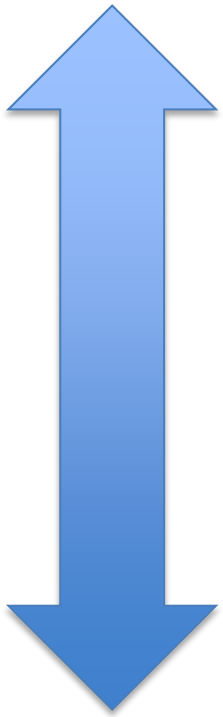
- Compliance checking solutions must give value during the design can construction process / life cycle
- 

- Support to the team working with design and construction

Summary statements: B - Partnering

- Development of solutions – Think Software as a Service (SaaS)

- Public
-
- Private

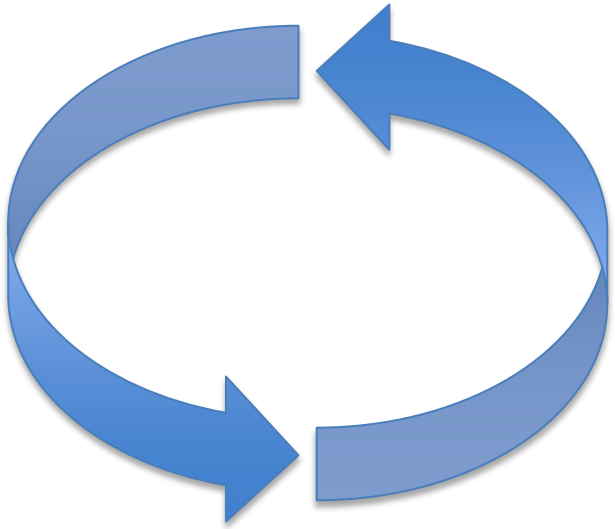


collaboration

Multiple solutions for multiple type of use and users

Summary statements: C - Rethinking

- To obtain circularity – or increased sustainability
- more dynamic design and construction processes



Now you must know «everything» in advance
Must be more dynamic to re-use products in the market
Platform ecosystem way of thinking

We need to re-think our thinking of development and use of public compliance checking

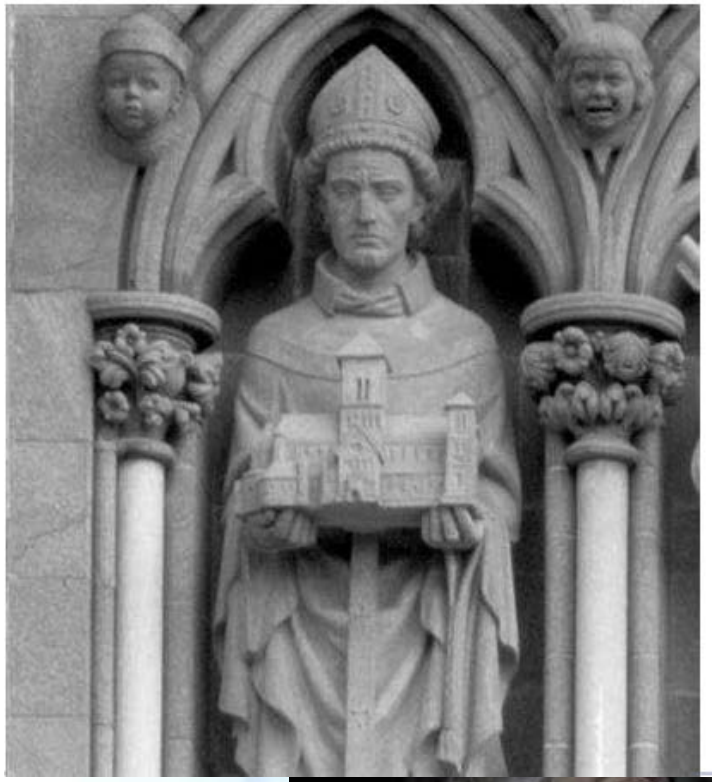
Be aware of ongoing initiatives

https://3d.bk.tudelft.nl/projects/eunet4dbp/

Invitation to ECPPM 2022

- Compliance checking will be a topic in next
- European Conference on
  Product & Process Modelling
- scientific conference in Trondheim,
- 14th – 16th September 2022
- Submit abstract before 15th November 2021

- Some information at:
  https://www.ecppm2022.org/



We have long history for use of models ;-)

We will visit Nidaros Cathedral
https://en.wikipedia.org/wiki/Nidaros_Cathedral

Thank you
for your attention!

- Please contact me at
- eilif.hjeleth@ntnu.no

NTNU | Norwegian University of Science and Technology

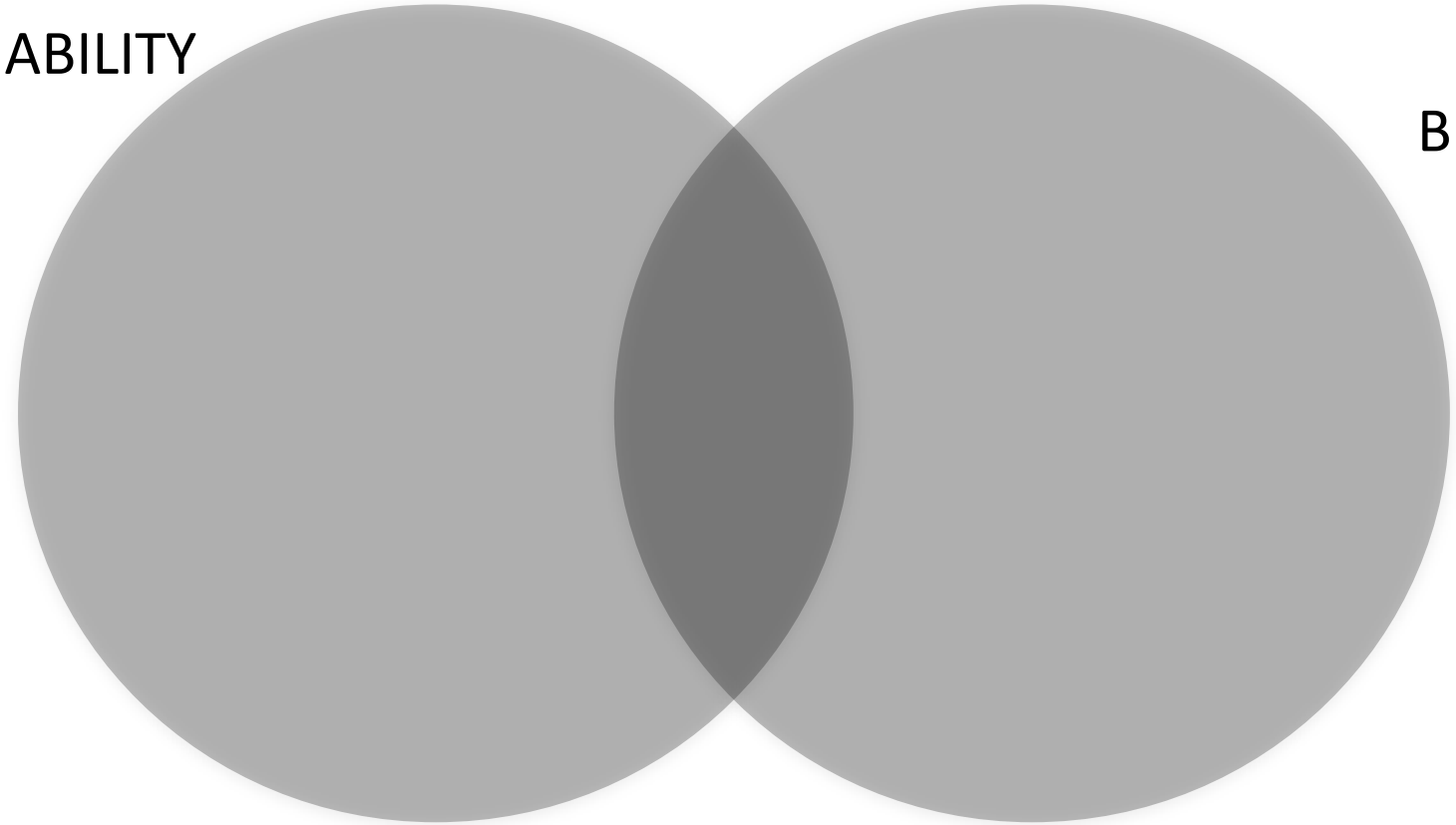
From bold sustainability objectives to BIM requirements

Artur Tomczak, 14.10.2021, Luxembourg

Baerum case-study

Mapping objectives with BIM

DEFINED SUSTAINABILITY OBJECTIVES



BIM MODEL

Mapping objectives with BIM - limitations

Global Warming Potential (GWP) comparison of structural materials

		A1-A3
		cradle-gate
Concrete	Ready-mix	238.2
	Prefabricates (HDS)	200.2
Steel	Steel profile	1.0
	Steel reinforcement	0.6
Timber	CLT	34.0
	Glulam	44.0

EPD comparison based on data from EPDnorge.no

Mapping objectives with BIM - limitations

Global Warming Potential (GWP) comparison of structural materials

		A1-A3	Unit	A1-A3/t
		cradle-gate	kgCO2eq	cradle-gate
Concrete	Ready-mix	238.2	/m3	108.3
	Prefabricates (HDS)	200.2	/t	200.2
Steel	Steel profile	1.0	/kg	1030
	Steel reinforcement	0.6	/kg	581
Timber	CLT	34.0	/m3	79
	Glulam	44.0	/m3	87

EPD comparison based on data from EPDnorge.no

Mapping objectives with BIM - limitations

Global Warming Potential (GWP) comparison of structural materials

		A1-A3	Unit	A1-A3/t	A4/t
		cradle-gate	kgCO2eq	cradle-gate	transport
Concrete	Ready-mix	238.2	/m3	108.3	0.2
	Prefabricates (HDS)	200.2	/t	200.2	17
Steel	Steel profile	1.0	/kg	1030	19.1
	Steel reinforcement	0.6	/kg	581	174
Timber	CLT	34.0	/m3	79	14
	Glulam	44.0	/m3	87	183

EPD comparison based on data from EPDnorge.no

Mapping objectives with BIM - limitations

Global Warming Potential (GWP) comparison of structural materials

		A1-A3	Unit	A1-A3/t	A4/t	utilisation	distance
		cradle-gate	kgCO2eq	cradle-gate	transport	%	km
Concrete	Ready-mix	238.2	/m3	108.3	0.2	53	3
	Prefabricates (HDS)	200.2	/t	200.2	17	70	200
Steel	Steel profile	1.0	/kg	1030	19.1	39	120
	Steel reinforcement	0.6	/kg	581	174	26	1270
Timber	CLT	34.0	/m3	79	14	75	269
	Glulam	44.0	/m3	87	183	53	2075

EPD comparison based on data from EPDnorge.no

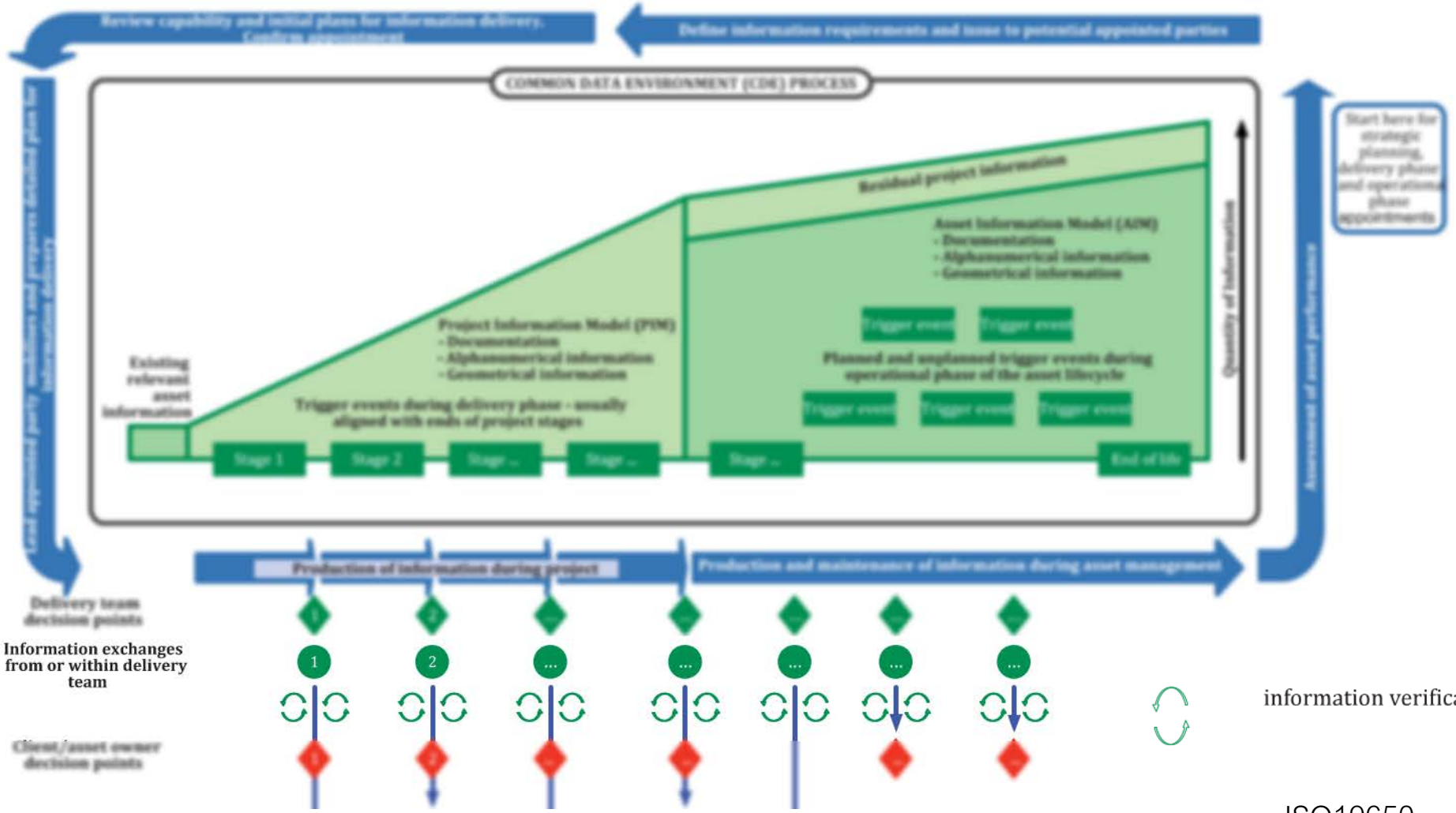
Mapping objectives with BIM - limitations

Global Warming Potential (GWP) comparison of structural materials

		A1-A3	Unit	A1-A3/t	A4/t	utilisation	distance
		cradle-gate	kgCO2eq	cradle-gate	transport	%	km
Concrete	Ready-mix	238.2	/m3	108.3	0.2	53	3
	Prefabricates (HDS)	200.2	/t	200.2	17	70	200
Steel	Steel profile	1.0	/kg	1030	19.1	39	120
	Steel reinforcement	0.6	/kg	581	174	26	1270
Timber	CLT	34.0	/m3	79	14	75	269
	Glulam	44.0	/m3	87	183	53	2075

EPD comparison based on data from EPDnorge.no

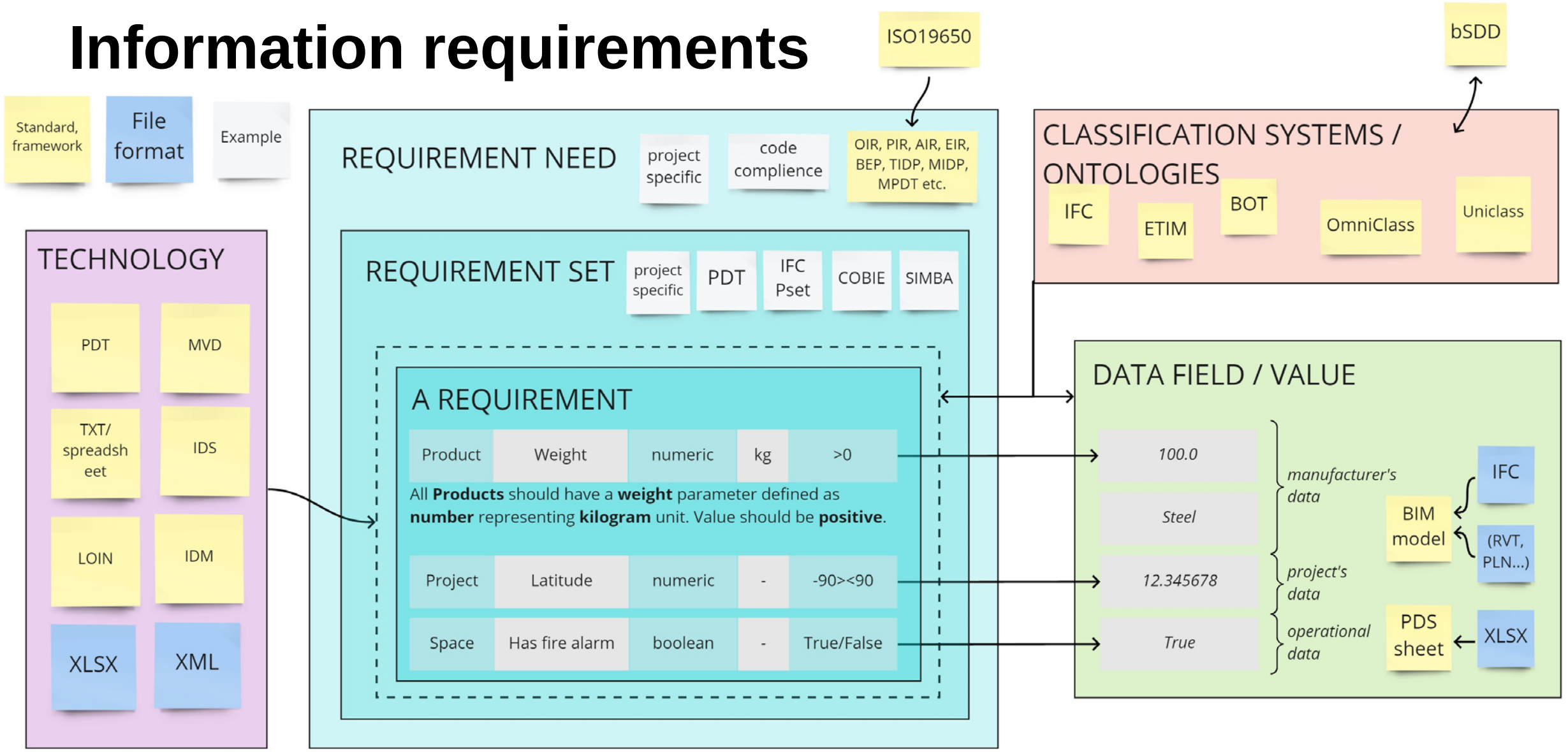
Data quality assurace



information verification and validation

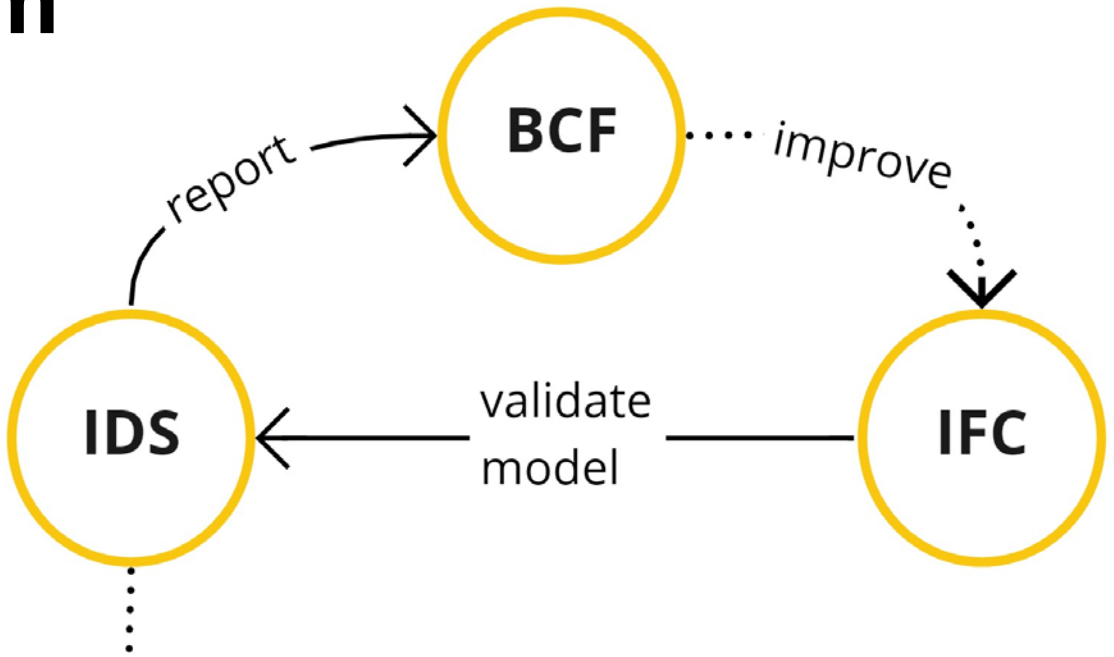
ISO19650

Information requirements



IDS at Baerum

Information Delivery Specification



github.com/IfcOpenShell

1. Environmental specification of concrete elements

All elements	of entity	IfcWall	IfcSlab	IfcColumn	+	should have	a property	GWP	from set	EPD	of value
	of material	Reinforced Concrete					a property	Reference	from set	EPD	of value https://epdr
	+						a classification	Green|Yellow|Red	from system	Environmental	
							+				

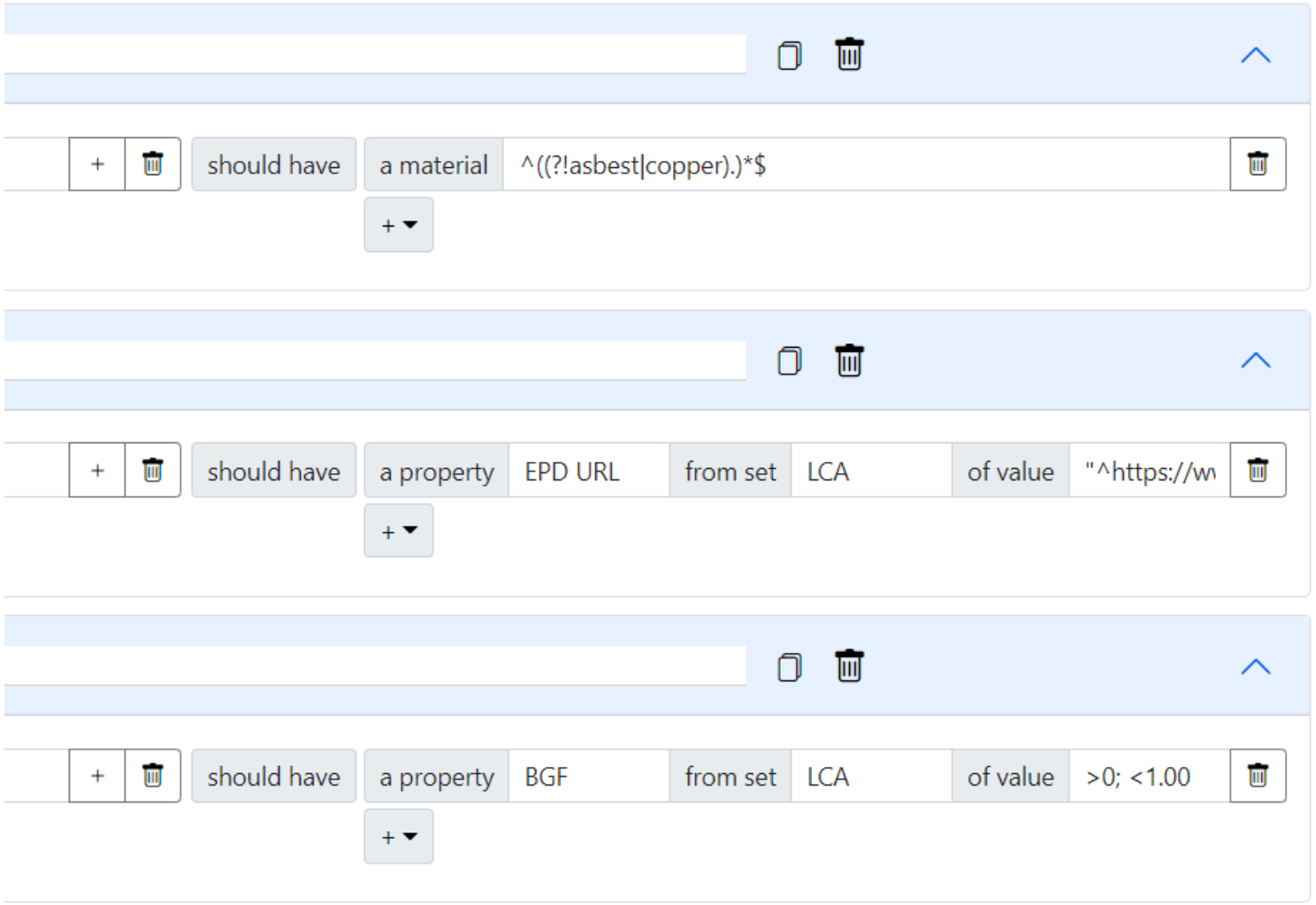
IfcOpenShell
the open source ifc toolkit and geometry engine

OSArch Community

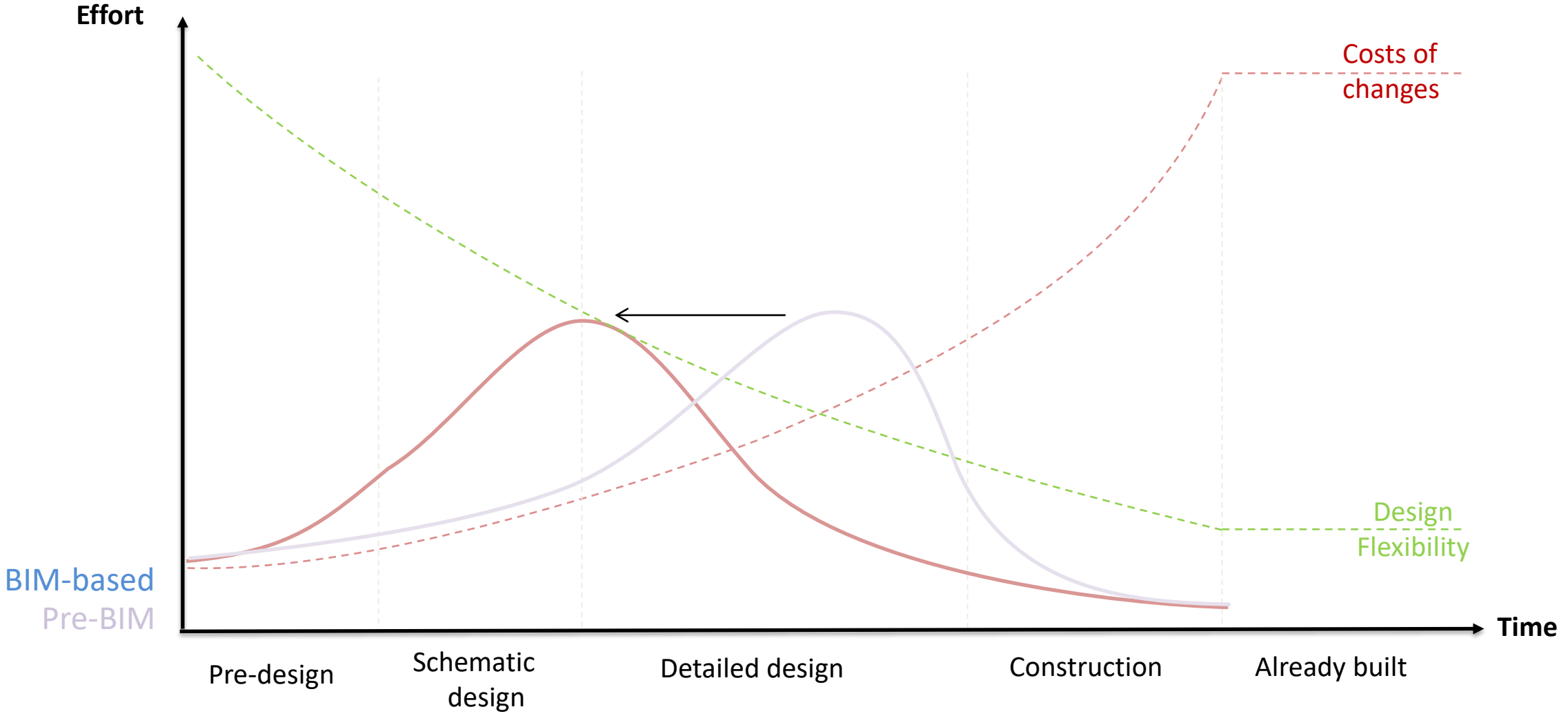
Google Summer of Code

buildingSMART International

IDS at Baerum

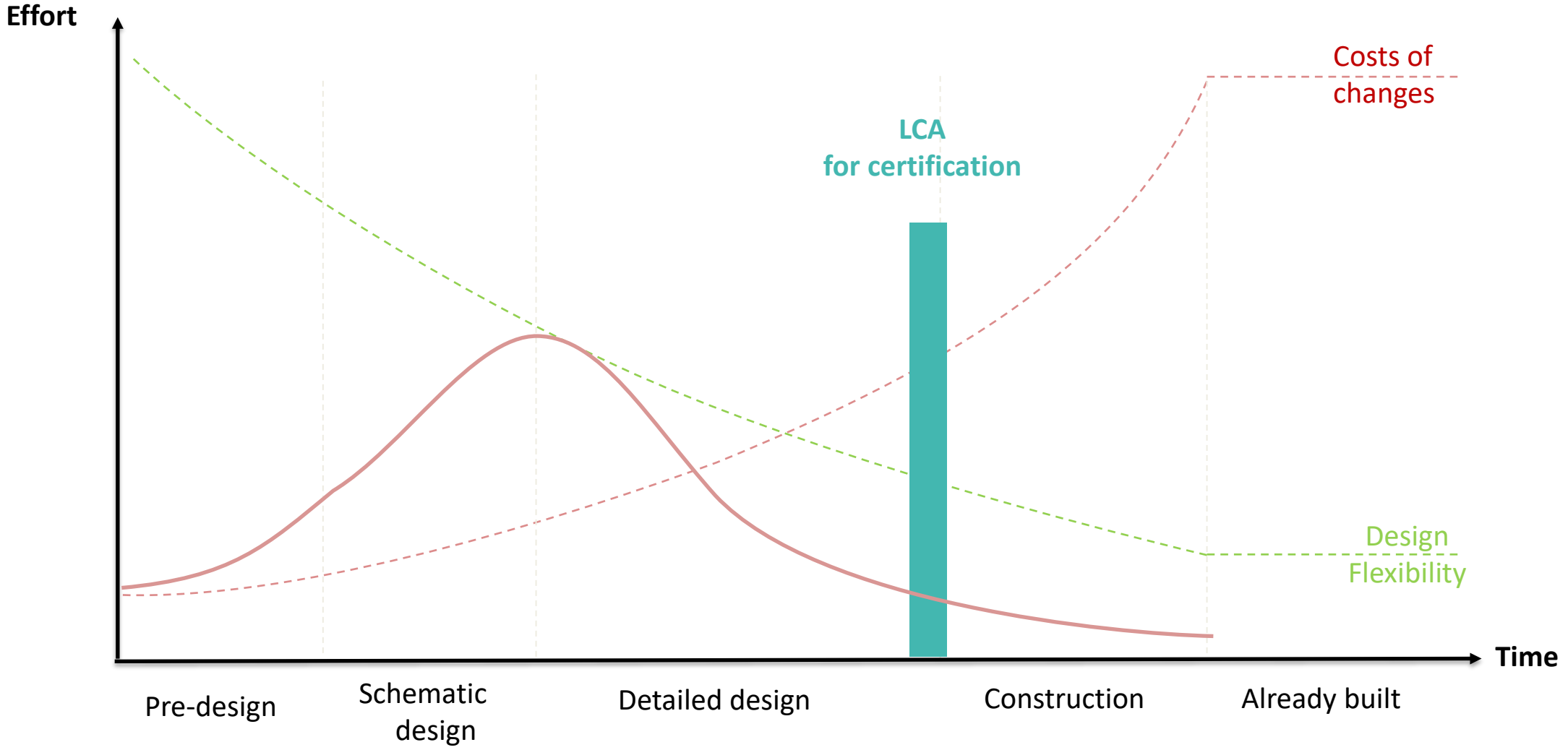


Shift of efforts



Based on Borrmann et al. 2018 after MacLeamy 2004

Shift of efforts



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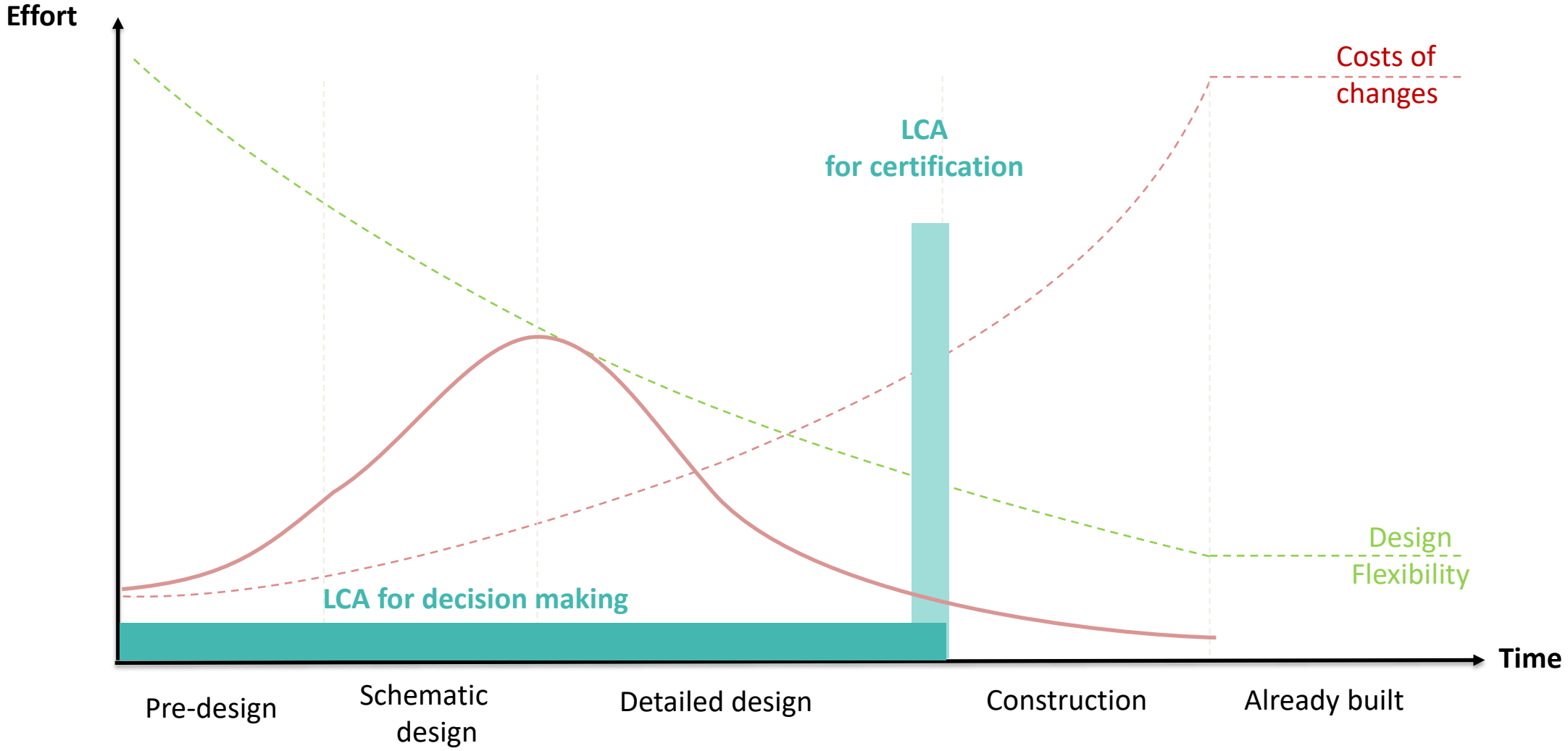
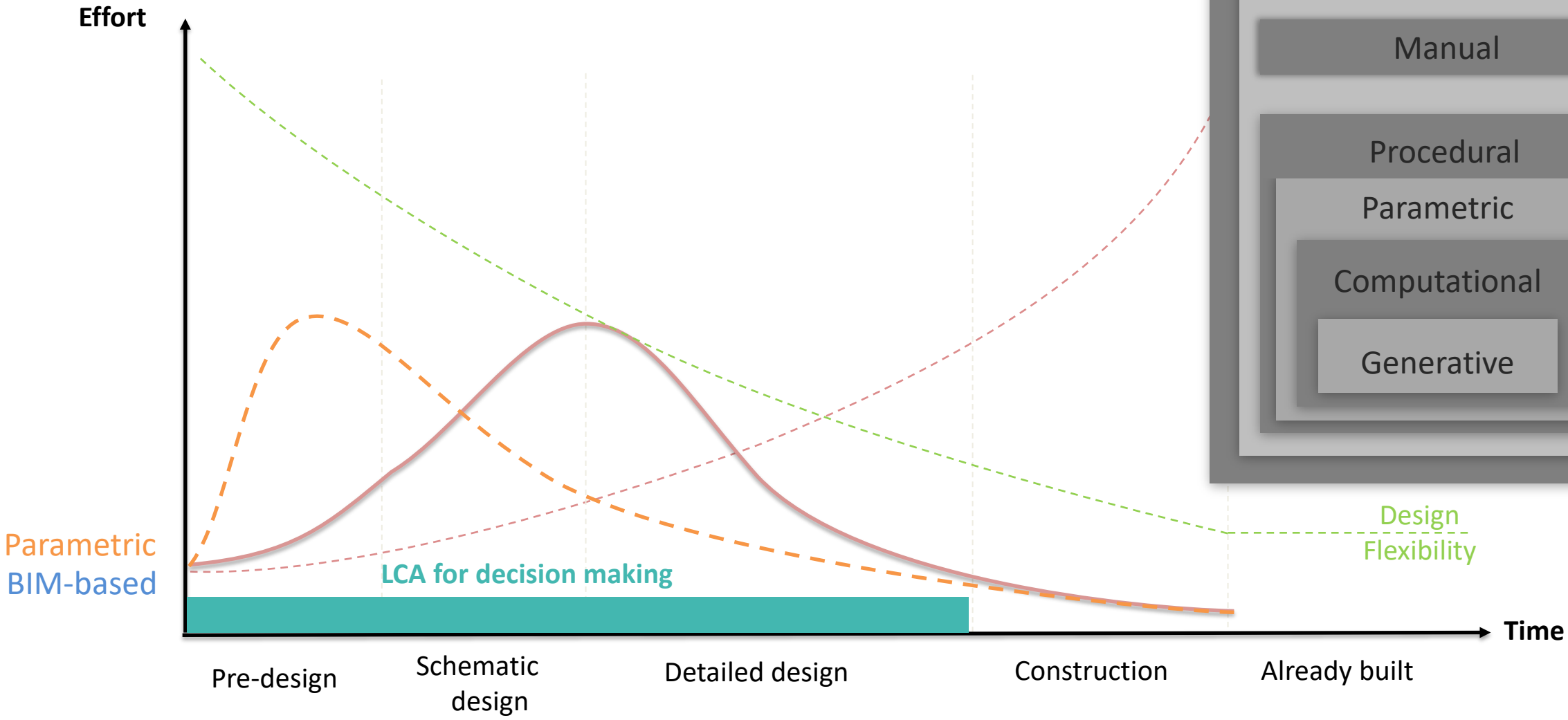
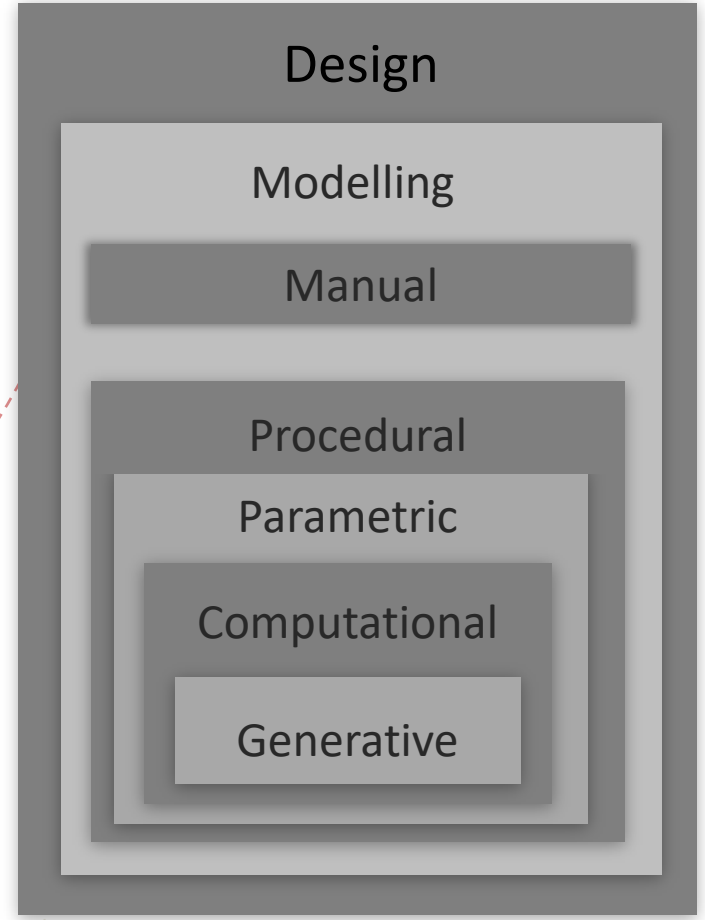


Based on Borrmann et al. 2018 after MacLeamy 2004

Shift of efforts





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Conclusions