Assets decarbonisation through reuse of key materials

14 May 2024

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Research project: RECONMATIC (automated solutions for sustainable and circular construction and demolition waste management)

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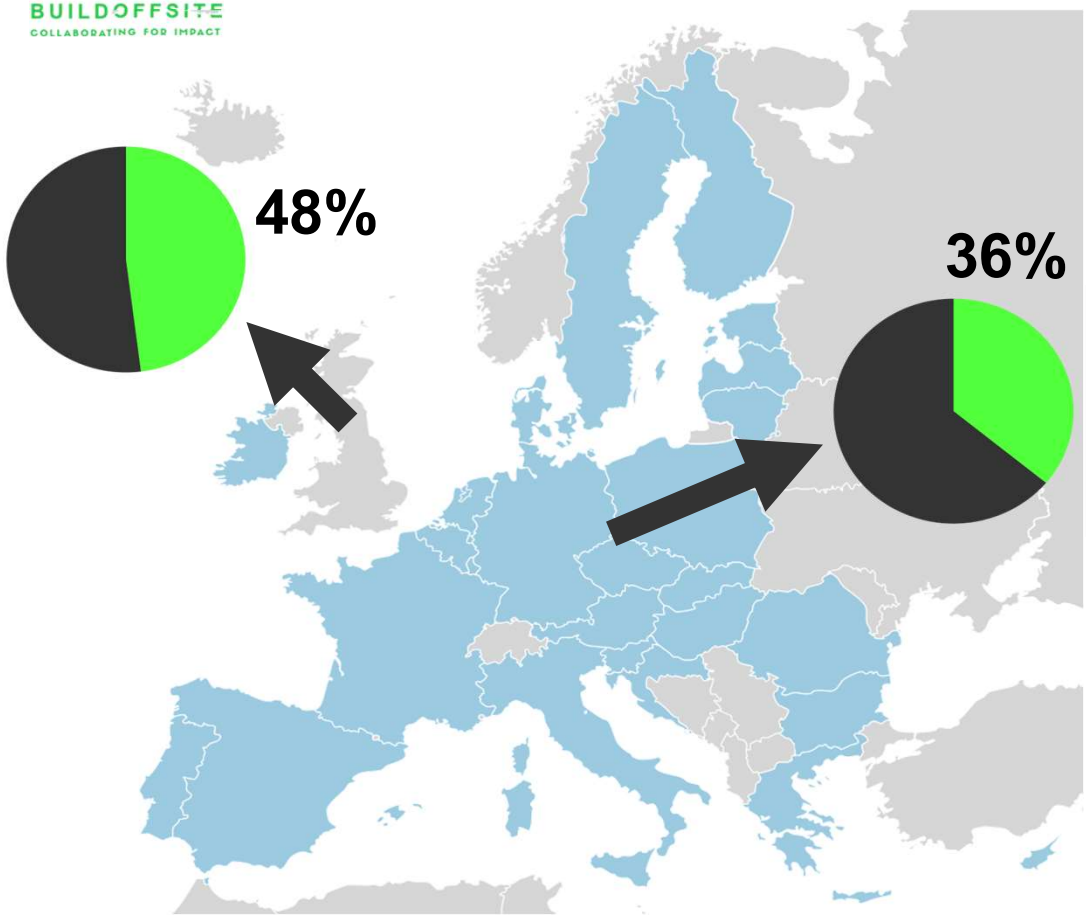

CONSTRUCTION AND DEMOLITION WASTE PROPORTION

- MORE THAN 10 BILLION TONNES IN THE WORLD
- 35%-65% OF LANDFILL VOLUME OCCUPATION
- CHINA, US AND EU ARE THE BIGGEST PRODUCERS
- EU-28 RECOVERY RATE AROUND 90%
- MAINLY IN LOW VALUE USES
- CHALLENGES TO ACHIEVE :
  - THE NEW GREEN EUROPEAN DEAL
  - EU FRAMEWORK DIRECTIVE
  - ZERO ENERGY AND WASTE TARGETS BY 2050

AIM:

To identify the main challenges to successfully implement the principles of circular economy in CDW management and outline digital and automated solutions to be developed in the RECONMATIC project.

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CDW whole value chain

- Digital protocol for sustainability and circular assessment
- Digital information management system for integration of solutions and stakeholder collaboration

Design and construction

- Material mapping tools for reusability
- BIM waste predictive tools
- Advanced BIM models with active waste management processes
- Blockchain tracking tools

Use and end of life

- Digital twin generation with as-built material identification
- EoSL material datasets
- Automation of waste audits

Off-site sorting and logistics

- AI-based automation for waste sorting
- Improved logistics for waste collection and automated management at off-site treatment
- Automated recognition by sensors
- Processing of new recycled materials

New materials derived from CDW

- Extension of material service life
- Added value assessment of new materials
- QC & QA
- Overcoming market barriers

Communication & dissemination

- Training material and sessions
- Communication, dissemination, branding
- Contribution to legal, regulatory and standardization frameworks

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- CVUT, ENVI, STR, JAIP
- TEC, ICAT, AEICE, ITC-AICE, RECSO
- USAL, UMAN, MS, LECYC
- UTH, ANAK, AUTH, ERGO, SKYDE
- FN
- ITFR
- ETRI, CACE
- Demonstration cases

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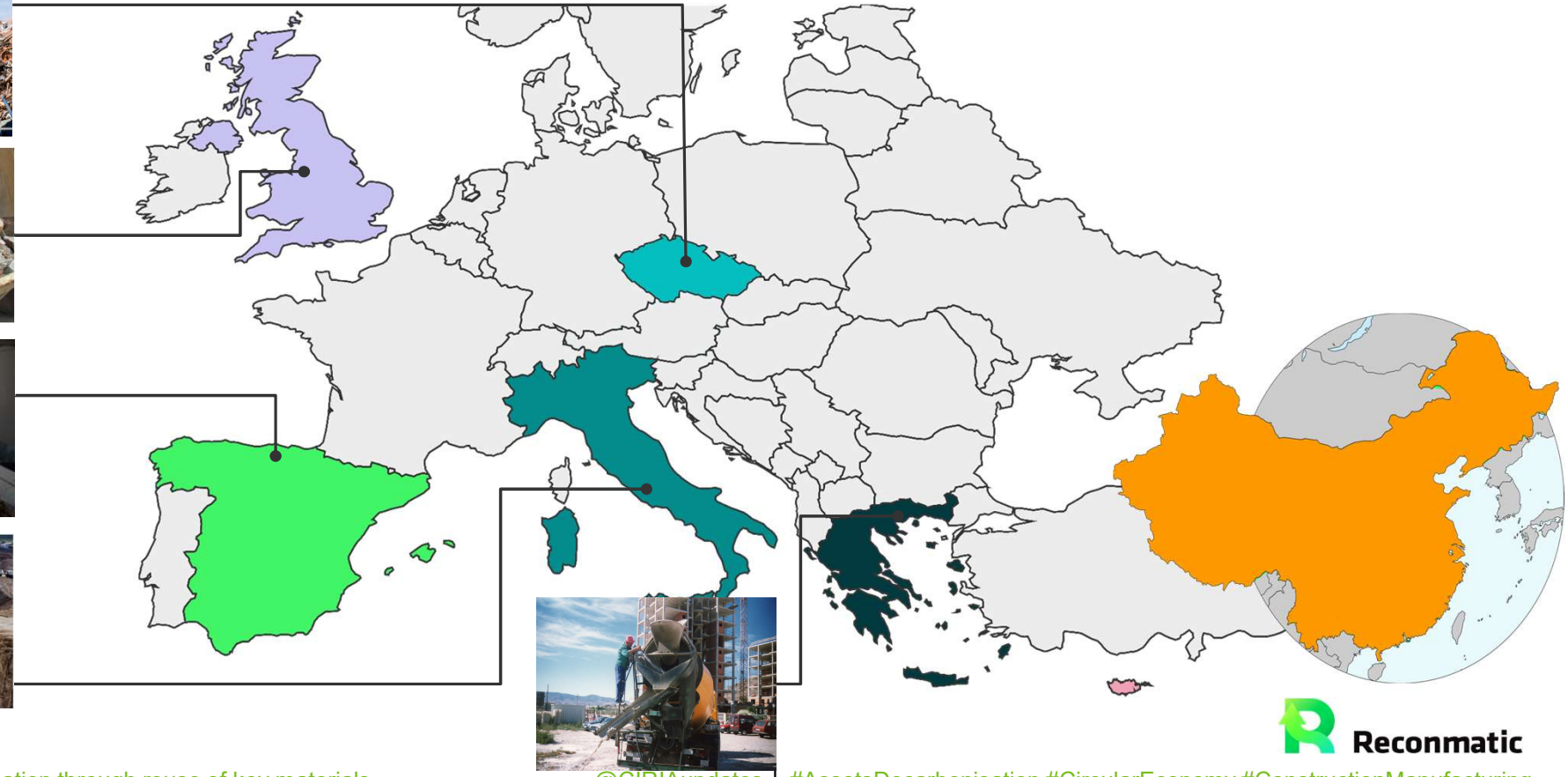

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Review & benchmarks

Country benchmarks

50 KPI

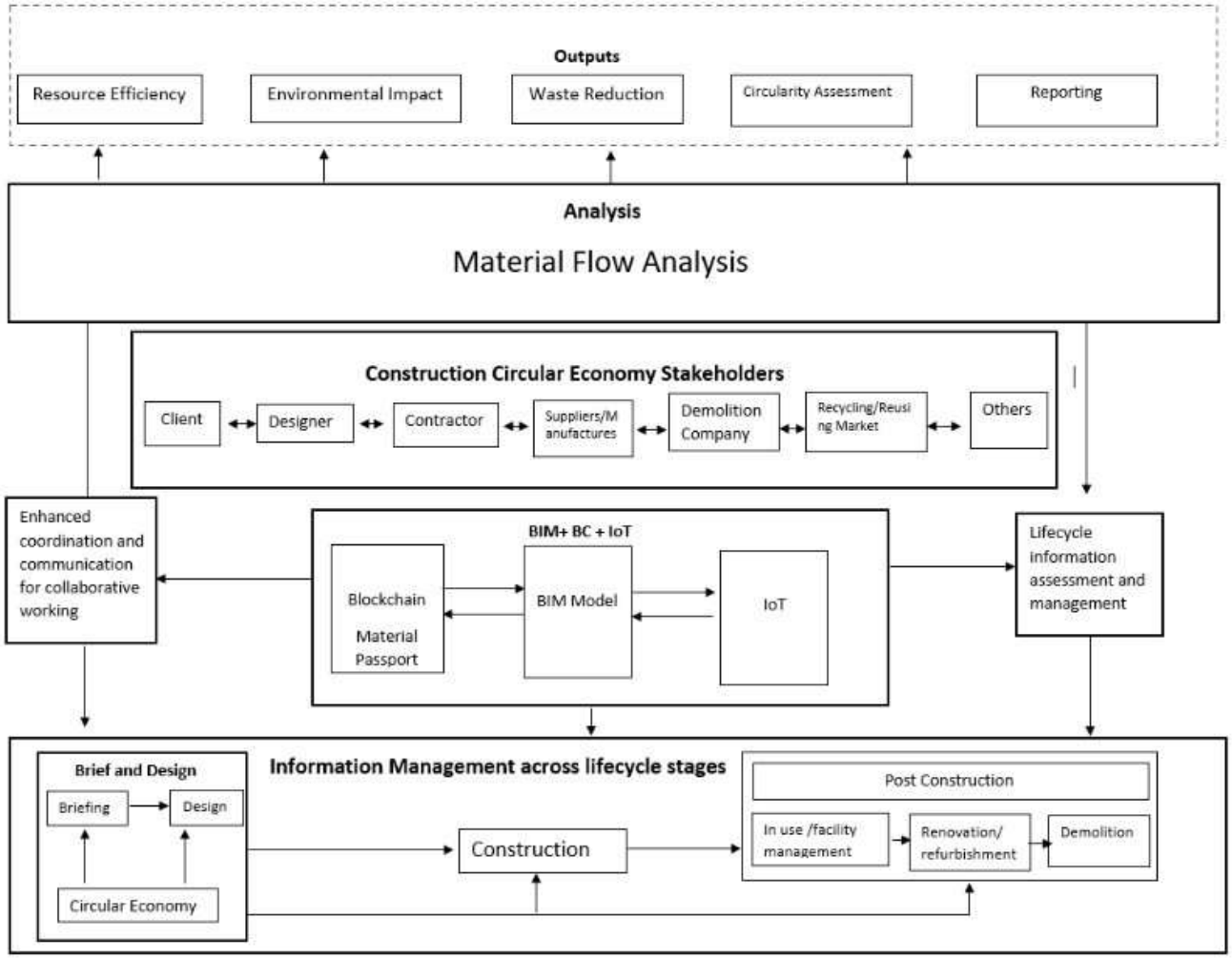
Categories:
- Governance
- Managerial
- Technological
- Economic
- Societal
- Environmental

UK Benchmark sample

Category	Sub-category	KPI Code	Level 1	Level 2	Level 3	Level 4	Level 5
Governance	Mission / Vision / Values	GM1			■		
		GM2			■		
		GM3					■
	Corporate environmental responsibility	GC1				■	
		GC2		■			
		GC3		■			
		GC4				■	
		GC5		■			
		GC6					■
	Assessment and certification processes	GA1		■			
		GA2			■		
	Green finance businesses (taxonomy)	GG1		■			
Managerial	CE management	MM1			■		
		MM2	■				
		MM3				■	
		MM4			■		
Technological	IT and digital systems	TT1			■		
		TT2	■				
		TT3		■			
	Data management	TD1			■		
		TD2			■	■	
		TD3	■				
	Infrastructures	TI1			■		
		TI2		■			
		TI3				■	

- Absence of a comprehensive digital information management system across the whole project lifecycle
- Lack of clarity regarding the roles and engagement of various stakeholders within these digital systems.
- Lack of digital systems that focus on Material Flow Analysis and its utilisation for decision-making in moving towards a circular economy.

Initial framework analysis



Currently:

- Consultation process

Next steps:

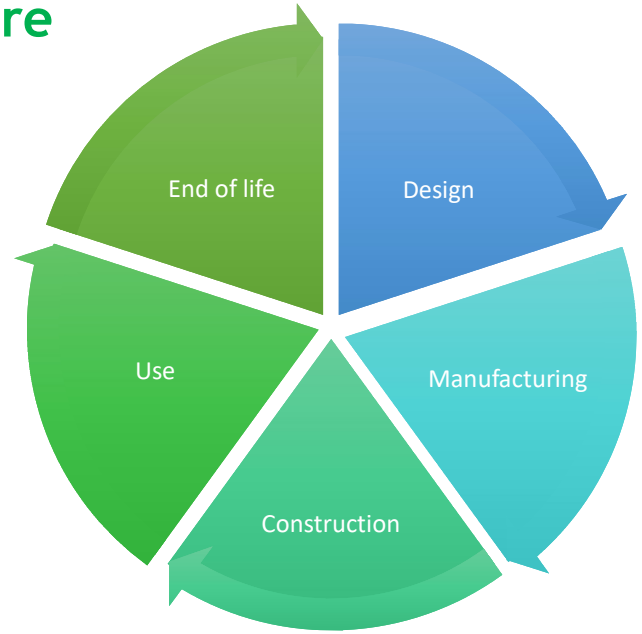
- Reformulation of framework
- Data flows
- Sources
- Interactions
- System architecture

Data structure

Common terms
Searchable and reusable

Structured

AEC software compatible



PRODUCTS vs MATERIALS

Reuse

Recycle

IFC

bSDD ® a service by buildingSMART International

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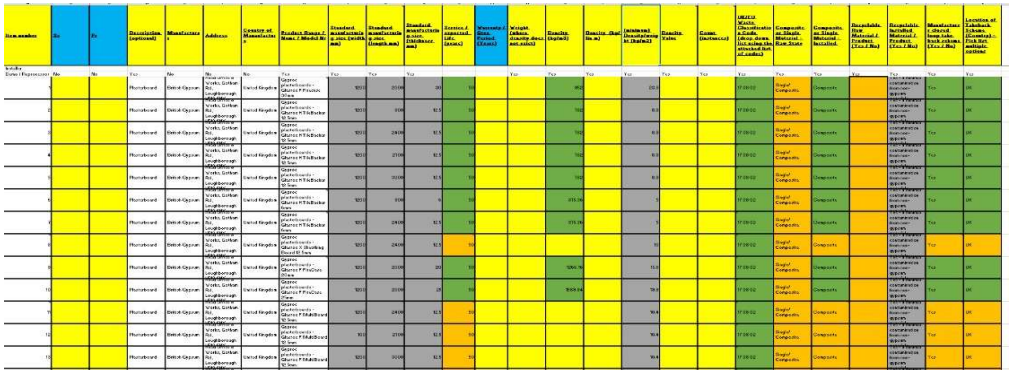
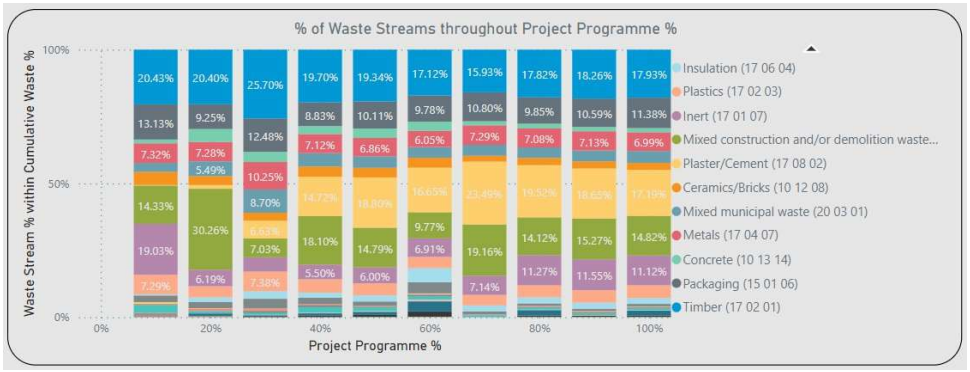
Derived design & construction tools





WASTEie

New dataset with attributes to

- describe waste
- identify waste avoidance in design
- Identify waste streams in construction
- Identify waste streams in operation and beyond
- Enable BIM model links to benefit other workpackages

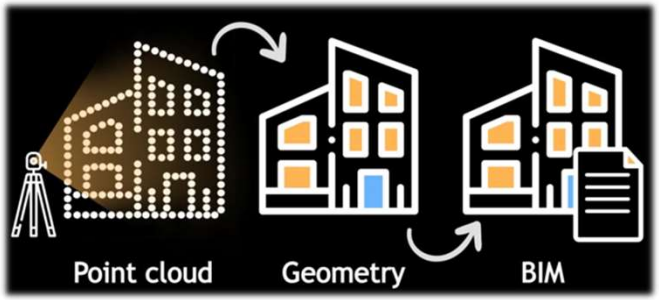
Material Data Bank

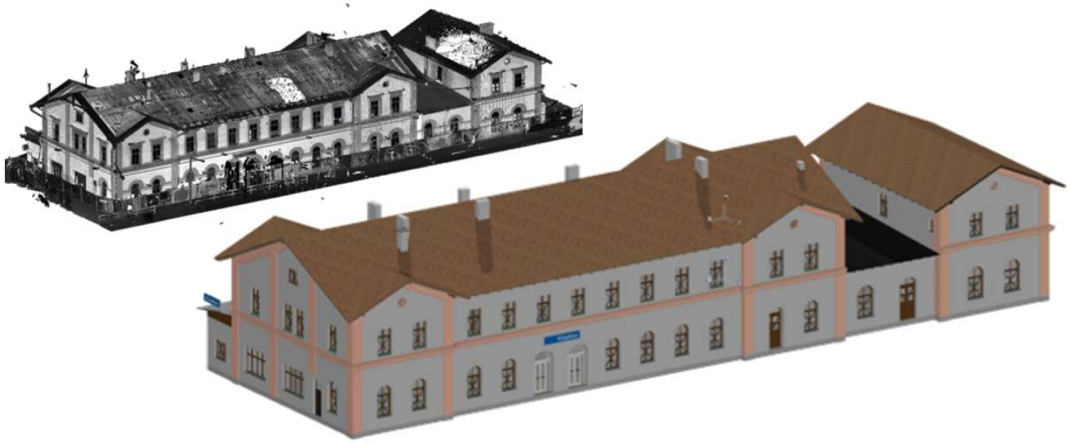
Using WASTEie and other manufacturer and industry information as a repository for designers / specifiers / constructors / clients / FM / Demolition Contractors and Reprocessors to make intelligent decisions and to create BIM model links

Waste Predictor

Suite of tools to accurately predict waste at each project stage then compare with actuals to enable the tools to learn and better predict based on key building metrics and later stages BIM models

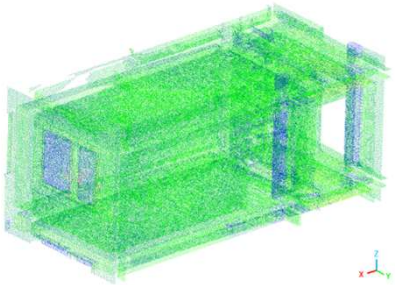
Digital twins. No previous CAD drawings



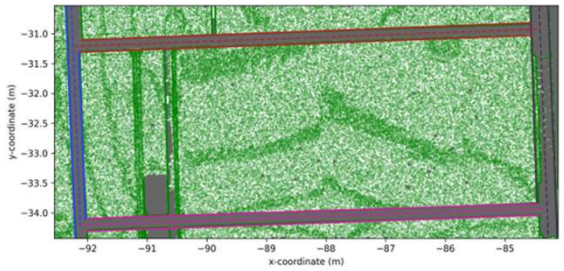


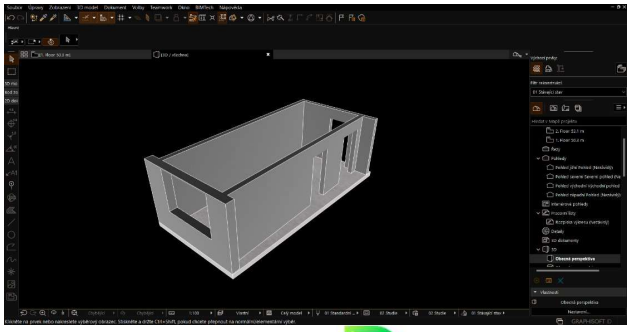
Techniques towards identification of:

- Slabs
- Walls
- Windows



Creation of algorithms





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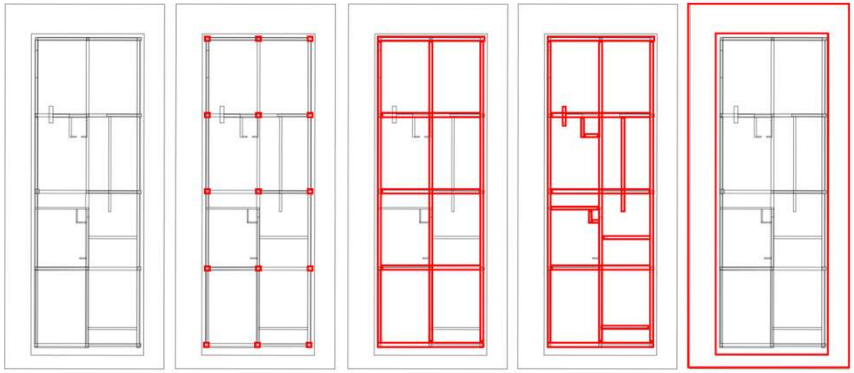
Digital twins. From CAD drawings

	A	B	C	D
1	Name	Category	Volume	Material
2	location <Not Shared> 309082	Element		None
3	Floor_Timber_22Cbd-225Joist 309091	Floors	2829.896319	Wood Sheathing, Chipboard Structure, Timber Joist/Rafter Layer
4	Floor_Timber_22Cbd-225Joist 309100	Floors	4544.546512	Wood Sheathing, Chipboard Structure, Timber Joist/Rafter Layer
5	Beams 1 309135	Structural Framing	18	Concrete - Cast-in-Place Concrete
6	Beams 2 309138	Structural Framing	18	Concrete - Cast-in-Place Concrete
7	Beams 3 309141	Structural Framing	18.58676795	Concrete - Cast-in-Place Concrete
8	Beams 4 309144	Structural Framing	18.58676795	Concrete - Cast-in-Place Concrete
9	Beams 5 309147	Structural Framing	18.58676795	Concrete - Cast-in-Place Concrete
10	Beams 6 309150	Structural Framing	18.58676795	Concrete - Cast-in-Place Concrete
11	Beams 7 309153	Structural Framing	18.58676795	Concrete - Cast-in-Place Concrete
12	Beams 8 309156	Structural Framing	104	Concrete - Cast-in-Place Concrete
13	Beams 9 309159	Structural Framing	24	Concrete - Cast-in-Place Concrete
14	Beams 10 309162	Structural Framing	28.49619116	Concrete - Cast-in-Place Concrete
15	Beams 11 309165	Structural Framing	17.33333333	Concrete - Cast-in-Place Concrete
16	Beams 12 309168	Structural Framing	26.17047551	Concrete - Cast-in-Place Concrete
17	Beams 13 309171	Structural Framing	24	Concrete - Cast-in-Place Concrete
18	Beams 14 309174	Structural Framing	28.49619116	Concrete - Cast-in-Place Concrete
19	Beams 15 309177	Structural Framing	17.33333333	Concrete - Cast-in-Place Concrete
20	Beams 16 309180	Structural Framing	26.17047551	Concrete - Cast-in-Place Concrete
21	Wall-Ext_215Bwk 309183	Walls	165.0590551	Brick, Common
22	Wall-Ext_215Bwk 309184	Walls	165.0590551	Brick, Common
23	Wall-Ext_215Bwk 309185	Walls	170.4396864	Brick, Common
24	Wall-Ext_215Bwk 309186	Walls	170.4396864	Brick, Common
25	Wall-Ext_215Bwk 309187	Walls	715.2559055	Brick, Common
26	Wall-Ext_215Bwk 309188	Walls	165.0590551	Brick, Common
27	Wall-Ext_215Bwk 309189	Walls	195.9814328	Brick, Common
28	Wall-Ext_215Bwk 309190	Walls	119.2093176	Brick, Common
29	Wall-Ext_215Bwk 309191	Walls	179.986415	Brick, Common
30	Wall-Ext_215Bwk 309192	Walls	165.0590551	Brick, Common
31	Wall-Ext_215Bwk 309193	Walls	195.9814328	Brick, Common
32	Wall-Ext_215Bwk 309194	Walls	119.2093176	Brick, Common
33	Wall-Ext_215Bwk 309195	Walls	179.986415	Brick, Common
34	Columns 1 309221	Structural Columns	60	Concrete - Cast-in-Place Concrete
35	Columns 2 309223	Structural Columns	60	Concrete - Cast-in-Place Concrete
36	Columns 3 309225	Structural Columns	60	Concrete - Cast-in-Place Concrete
37	Columns 4 309227	Structural Columns	60	Concrete - Cast-in-Place Concrete
38	Columns 5 309229	Structural Columns	60	Concrete - Cast-in-Place Concrete

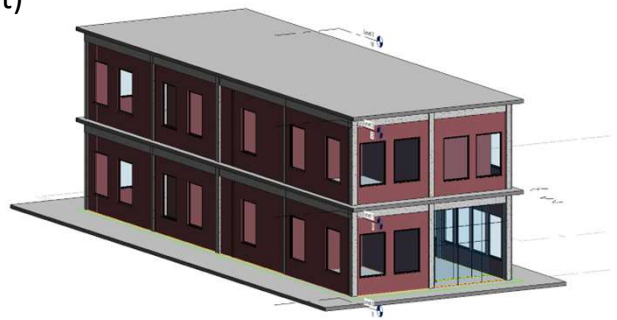
Identification of elements/layers



a) scanned b) columns c) beams d) Walls e) slab

Add missing geometrical info (height)
Add material/element properties

Automated conversion from CAD to 3D model



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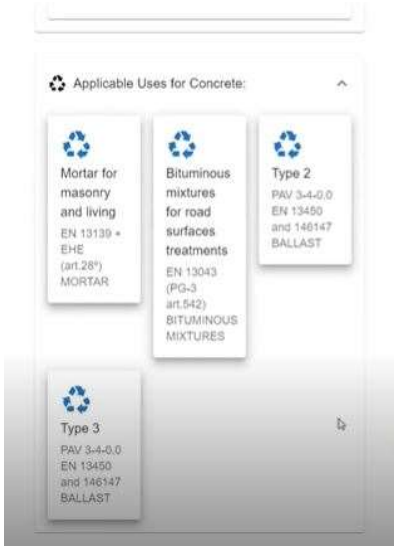
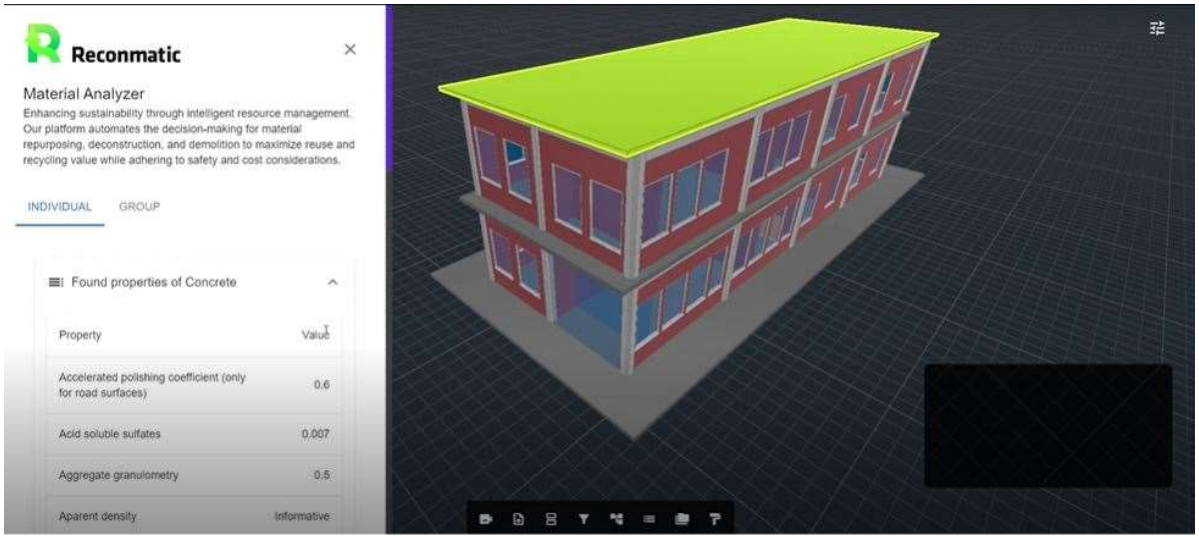
Digitization of pre-demolition audits

- Process map
- Data flow
- Stakeholders involved
- Relationship between parameters
- Identification of critical parameters

Circularity potential

- Reuse potential
- Remanufacturing potential
- Recycling potential



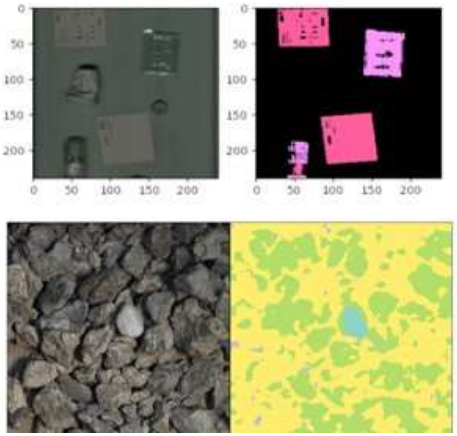


Off-site sorting

Perception: 2D, 3D & Multispectral

AI

Pick and Place Robot



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Summary

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OUTCOMES

- Knowledge of reuse, dismantling and high value recycling of CDW to achieve zero waste
- Heightened awareness of feasibility of technologies and methods/solutions of the project
- Increasing by 50% the reusability of construction products in post demolition and reduce of waste
- New or updated standards for reuse and recycling of CDW and related new materials
- Materials for further educating future stakeholders

IMPACTS

- Holistic and replicable solutions for more circular and climate neutral construction
- Acceleration in green and digital transition of manufacturing and construction sectors
- Sustainable, flexible, responsive and resilient supply chain of construction materials
- Upskilling of workforce in manufacturing and construction
- Creation of high skilled jobs in digitization, automated construction, AI, advanced robotics
- Increased European productivity, innovation, competitiveness, resilience, sustainability
- Major contributions to CO2 reduction, carbon neutral and zero waste initiatives in climate control

Any questions?

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