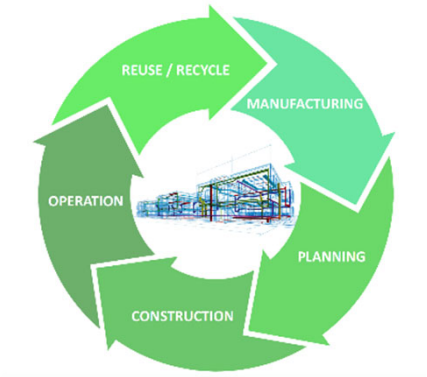
Towards sustainable built environment



Institute Building and Industrial Construction

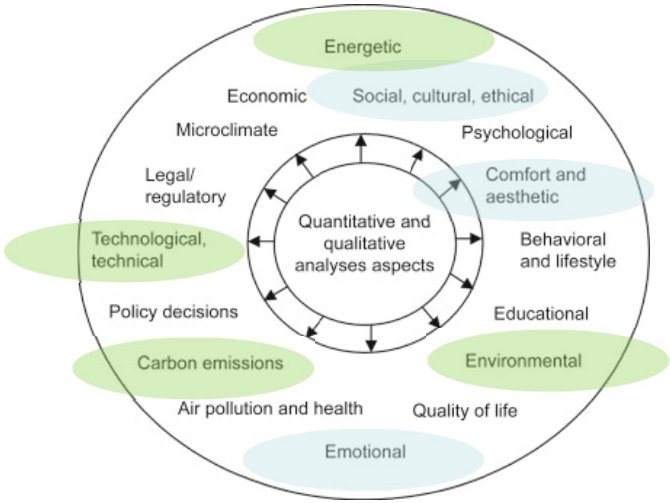
Department Integrated Planning and Industrial Building

Faculty of Civil and Environmental Engineering

Univ. Prof. Dr. Iva Kovacic

BUILT ENVIRONMENT

The term **built environment** refers to the human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighborhoods and cities that can often include their supporting infrastructure, such as water supply or energy networks.

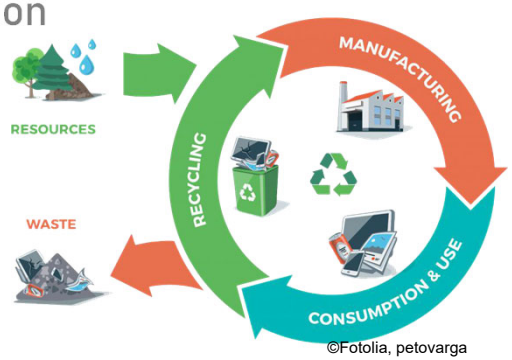


Intelligent decision-support systems and the Internet of Things for the smart built environment
A. Kaklauskas, R. Gudauskas, in Start-Up Creation, 2016

Problem statement

- Built Environment is responsible for 50% of all extracted materials in the EU [1]
- Buildings are responsible for 35% of greenhouse gas emissions [1]
- Buildings are responsible 40 % of EU energy use
- The construction sector is the largest consumer of raw materials [2]

- CIRCULARITY AIMS : reducing waste, using less virgin materials increasing Recycling rates and Re-use, prolonging life duration
- The European Green Deal aims to make Europe climate neutral by 2050.



©Fotolia, petovarga

[1] European Commission, Roadmap to a Resource Efficient Europe, Brussels, 2011
[2] WEF, World Economic Forum, Shaping the Future of Construction: A Breakthrough in Mindset and Technology, 2016

Sustainable Tourism

Environmental Sustainability

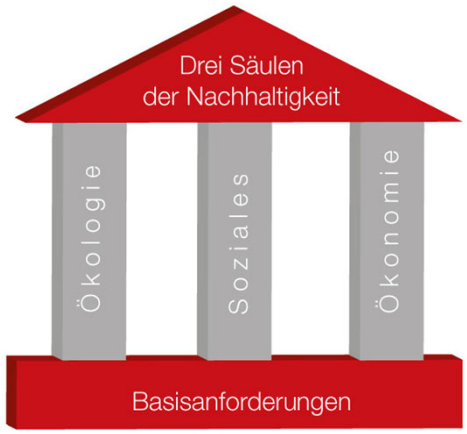
Natural resources may only be used it the way that they can be renewed
The use of natural areas worthy of protection
The conscious and economical use of energy and resources.

Social sustainability

Taking into account the interests of local residents
The involvement of regional actors in relevant projects,
that create good working conditions
Qualifications of the staff
Taking into account the local identity.

Economic sustainability

The project-specific required resources are also secured for the future.
Sufficient Market demand for a product/service is given,
thus securing economic success.



https://www.austriatourism.com/fileadmin/user_upload/Media_Library/Downloads/Marke/nachhaltigkeit_positionspapier.pdf

Sustainable Tourism

Vision Technology

-> aims to achieve a zero balance of all emissions (mobility, heating/cooling, waste, etc.) and optimal cycles for energy and resources.

- Implementation of technologies with high resource and energy efficiency
- Intelligent and system-oriented solutions for optimization of energy systems
- Distribution of transport volume across different means of transport, prefering soft mobility and public transport to motorized individual transport

Gailtal, Hermagor (Nassfeld)
Cimate friendly Mobility
CO2-Reduction by 55 % bis 2030

Sustainable Tourism

Vision Technology

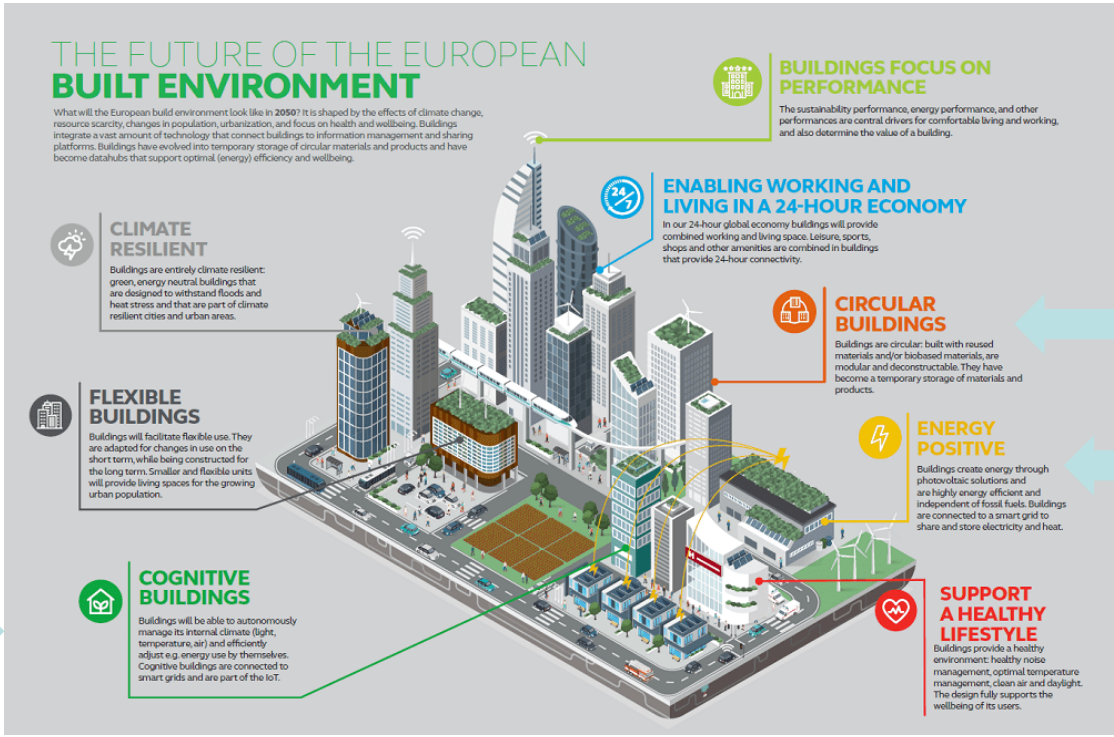
Since 2009, the boutique hotel Stadthalle in Vienna has been the world's first “zero energy balance” hotel and a green oasis in the middle of Vienna.

80 rooms total
38 rooms in the new building, a passive house,
and 42 rooms in the main building, a turn-of-the-century house

130 m² solar system,
93 m² photovoltaic system
a water heat pump
Green facade
Bonus for travellers by train

https://www.zerowasteaustria.at/boutiquehotel-stadthalle.html

BUILT ENVIRONMENT



https://www.simscale.com/blog/smart-built-environment/

SCI_BIM

Scanning and data capturing for Integrated Resources and Energy Assessment using Building Information Modelling

SCI_BIM: Scanning and data capturing for Integrated Resources and Energy Assessment using Building Information Modelling

TU WIEN Bau & Umwelt hib

TU WIEN Bau & Umwelt iwr

TU WIEN dap digital architecture & planning

TU WIEN Institute of Visual Computing & Human Centered Technology

Bauphysik TU

SCI_BIM

STADT der Zukunft

FFG Promoting Innovation.

ZAMG Zentralanstalt für Meteorologie und Geodynamik

VERMESSUNG meixner

Die Umwelt Konsulenten

SCI_BIM: Objectives

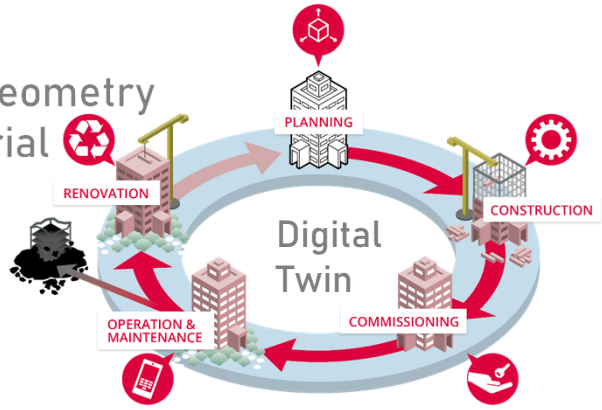
SCI_BIM

- Question: How to use BIM for achievement of
  energy and ressources efficiency in lifecycle?

- Multipurpose BIM
  (Energy Optimisation, Resources Optimisation, Material Cadaster,
  Recycling of Materials, Maintenance, Automated Updating)

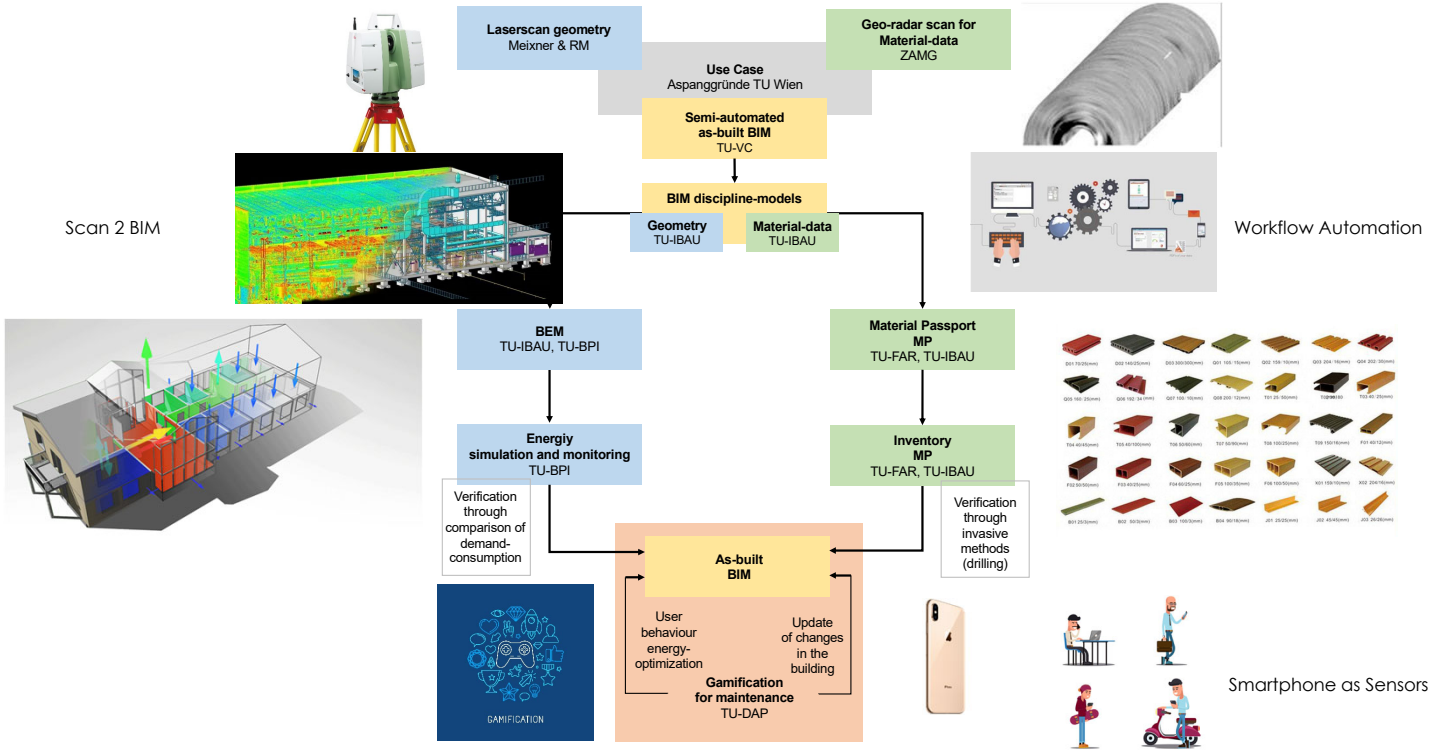
- Methods:
  Laserscans & Photogrammetry -> Assesment of Geometry
  Ground Penetrating Radar -> Assessment of Material
  Smartphone as Sensor

- Results: nD BIM Model for Lifecycle



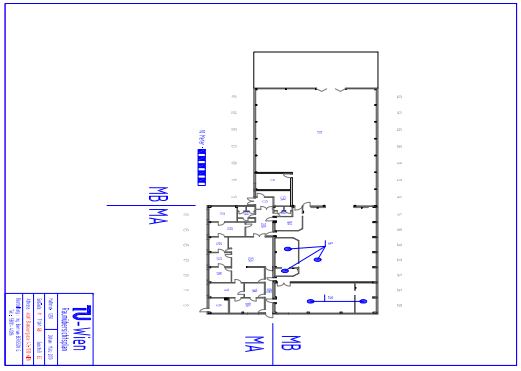
SCI_BIM: Workflow

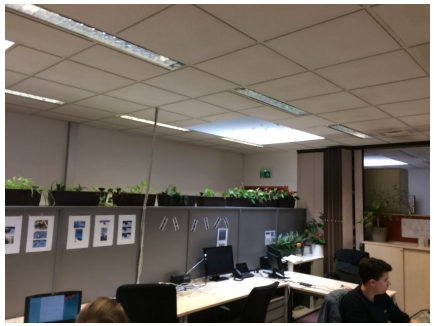
SCI_BIM



SCI_BIM: Use Case Building



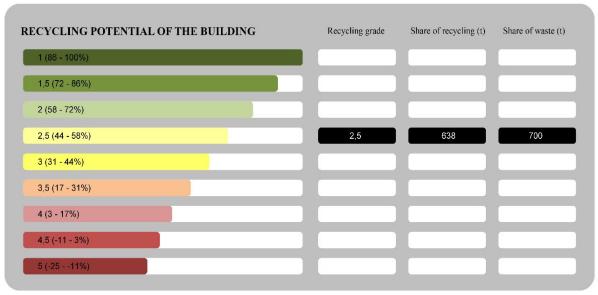


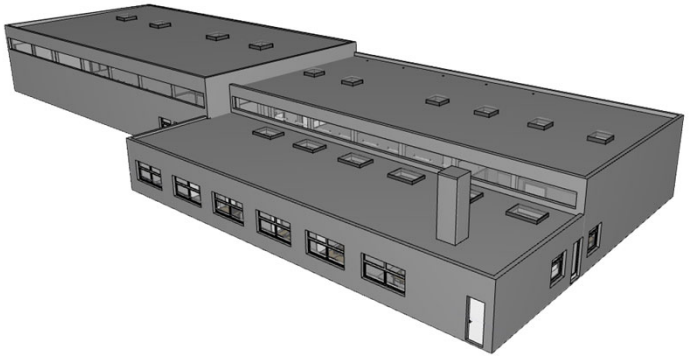

TU Wien building, demolished after project-ending

BIM for Material Passports

SCI_BIM

- Testing the semi-automated workflow for the generation of a Material Passport
  - Creating a BIM-Model based on a point-cloud (semi-automated)
  - Integration of the materials information into the BIM-Modell
  - Compilation of a Material Passport for the existing building



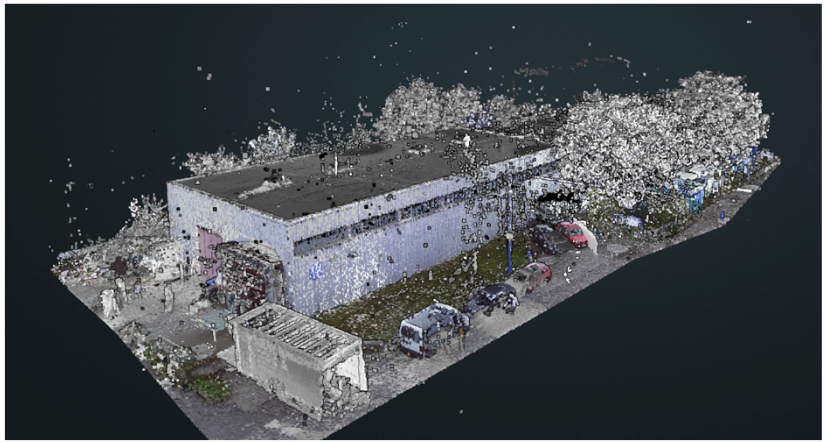


BIM-Model of the use case.

Methods for Data aquisition

SCI_BIM

- Laserscanning for obtaining the geometry
- Ground Penetrating Radar (GPR) for obtaining the material composition of the building elements
- Demolition expert: manual determination of material compostion and quality of materials

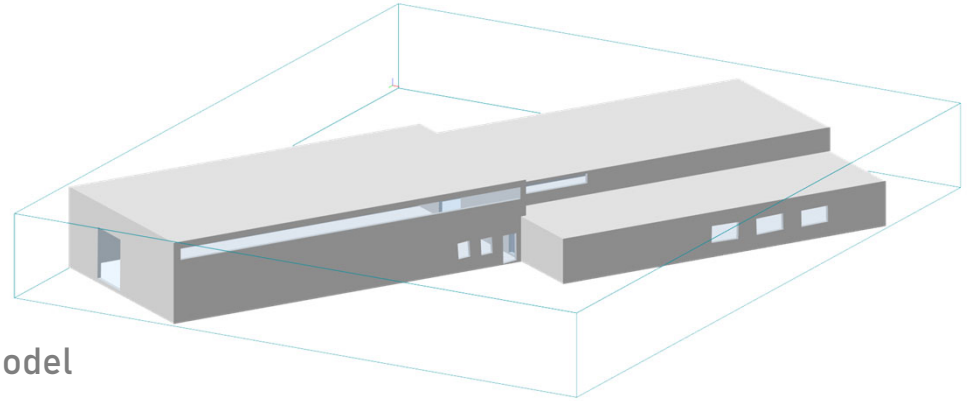


Point cloud of the use case, C1

Automated BIM-generation -Points to BIM

SCI_BIM

- Semi-automated, ML enhanced algorithms for the generation of the BIM-Modell (only geometry)

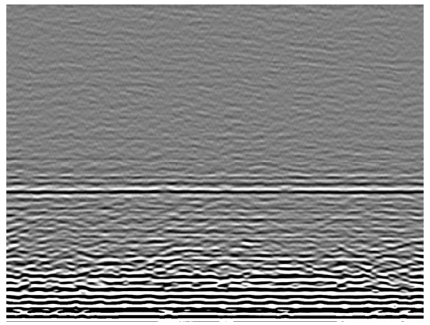


Semi-automated BIM-Model
(Points to BIM)

Methods for Data aquisition: GPR

- Laser scanning an established geometry acquisition method
- Use of the GPR for material massessment represents a novelty
- GPR uses an electromagnetic wave as a signal carrier, which is radiated into the wall by a transmitting antenna

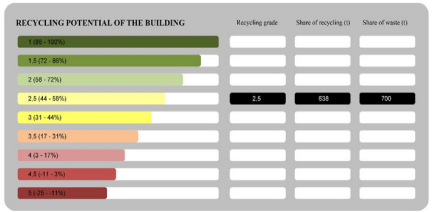
GRP scan of a wall

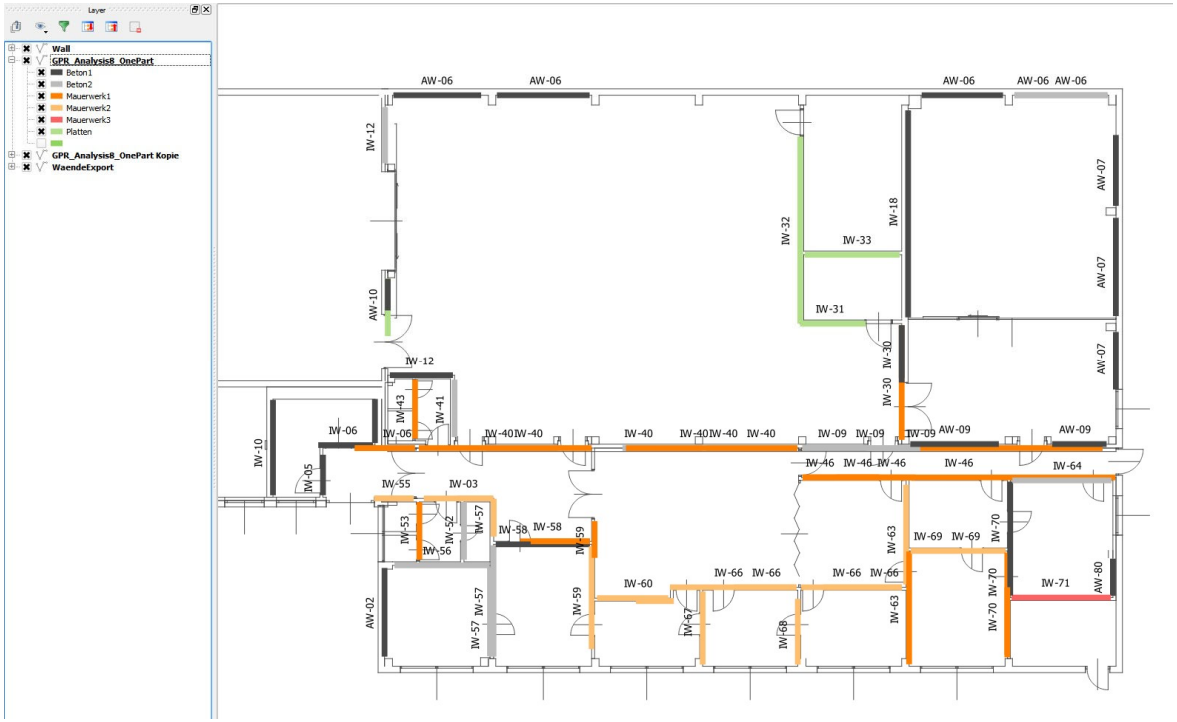


Methods for Data aquisition: GPR

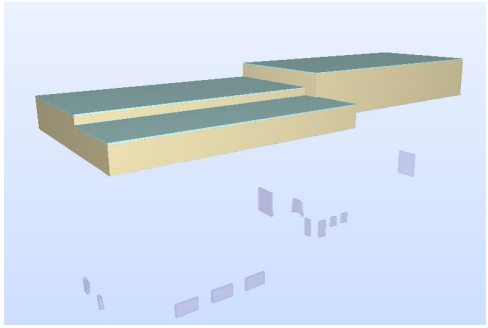
SCI_BIM

- Material determination through GPR

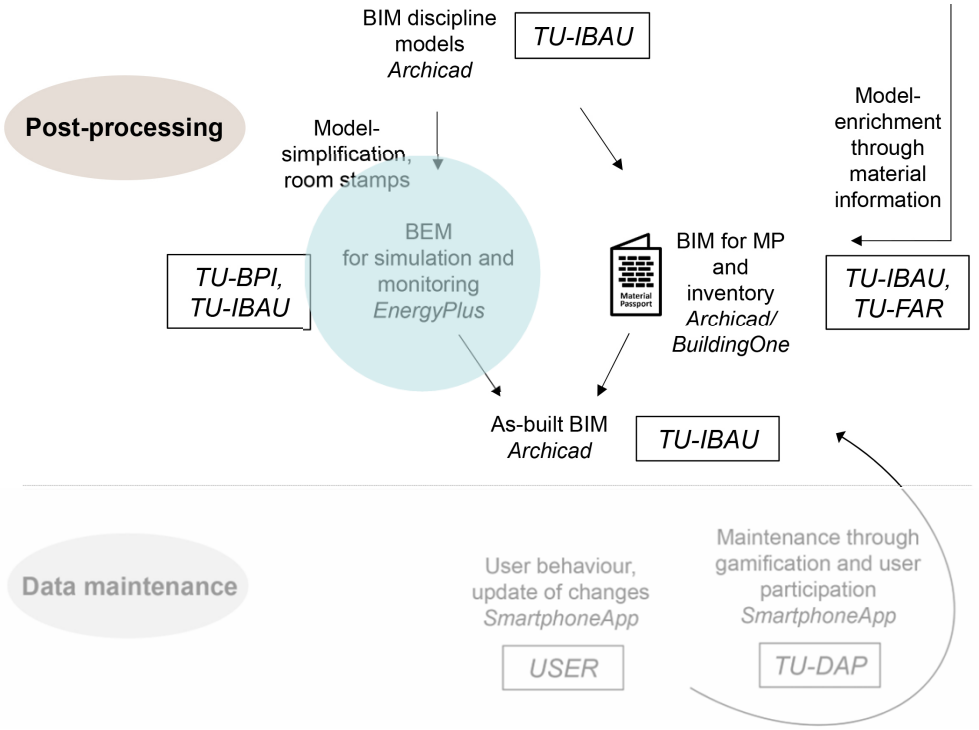




BIM to Building Energy Modelling



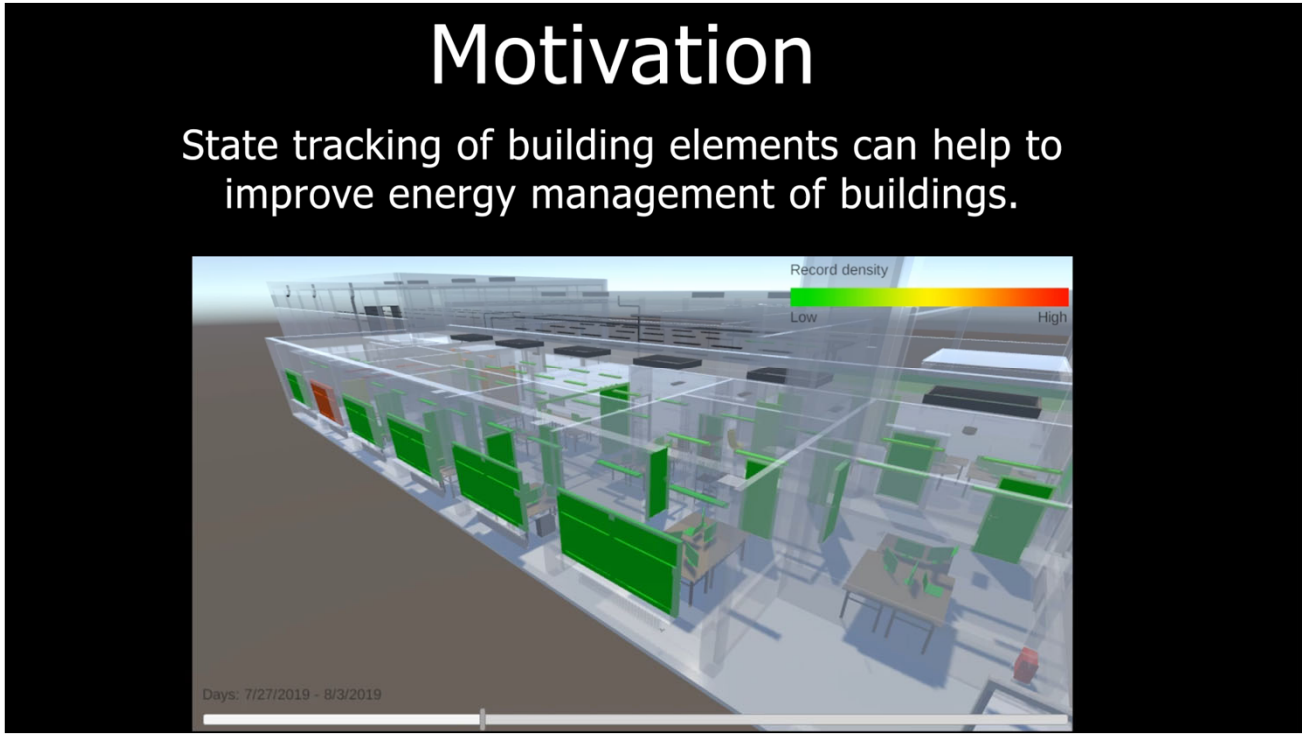
IFC model creation from point-cloud



SCI_BIM: Gamification for Model Update

SCI_BIM

- Resources management – tracking the material changes
- Energy management – comparison of termal simulation with actual consumption based on user behaviour

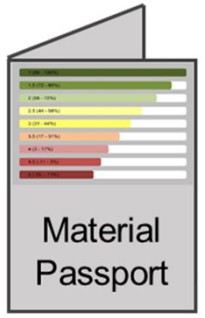


P. Ferschin, DAP and P. Kan, Interactive Media Systems, TU Wien

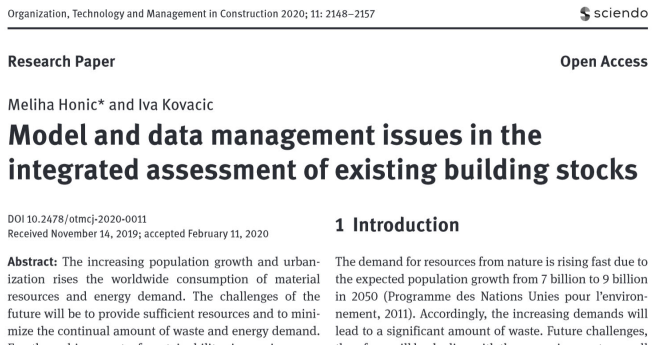
Results

- Data Assessment – Material assessment requires large effort (GPR and drilling)
- Load-bearing structure plays a crucial role for resources efficiency -> aim should be to use as light construction as possible and consider this in the design stage
- Materials with a long life-span and high recycling potential should be used

- Existing Stock represents the main challenge for achievement of sustainability aims



SCI_BIM



Organization, Technology and Management in Construction 2020; 11: 2148–2157

sciendo

Research Paper **Open Access**

Meliha Honic* and Iva Kovacic

Model and data management issues in the integrated assessment of existing building stocks

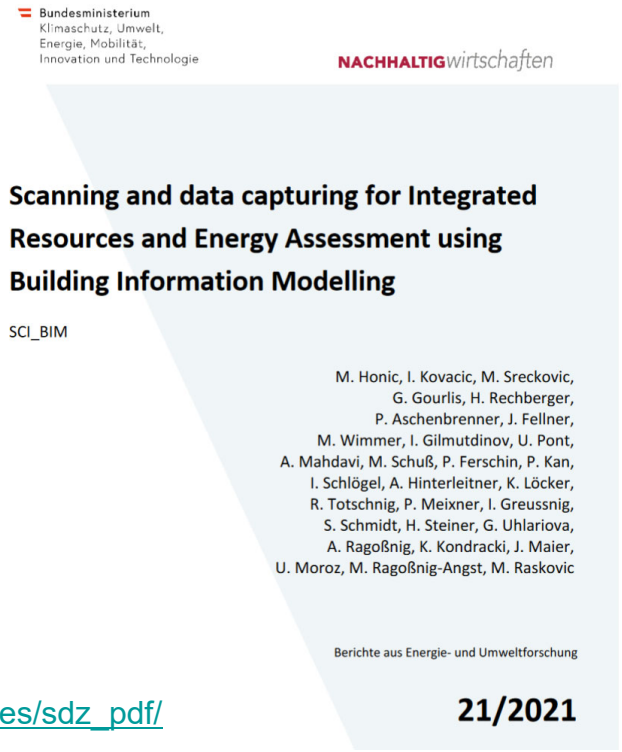
DOI 10.2478/otmcj-2020-0011
Received November 14, 2019; accepted February 11, 2020

Abstract: The increasing population growth and urbanization rises the worldwide consumption of material resources and energy demand. The challenges of the future will be to provide sufficient resources and to minimize the continual amount of waste and energy demand.

1 Introduction

The demand for resources from nature is rising fast due to the expected population growth from 7 billion to 9 billion in 2050 (Programme des Nations Unies pour l'environnement, 2011). Accordingly, the increasing demands will lead to a significant amount of waste. Future challenges,

DOI: 10.2478/otmcj-2020-0011



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Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

NACHHALTIGwirtschaften

Scanning and data capturing for Integrated Resources and Energy Assessment using Building Information Modelling

SCI_BIM

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Berichte aus Energie- und Umweltforschung

21/2021

https://nachhaltigwirtschaften.at/resources/sdz_pdf/schriftenreihe-2021-21_SCI_BIM.pdf