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Building Information Management Frameworks for Enabling Circular Economy within the Built Environment: A Systematic Literature Review

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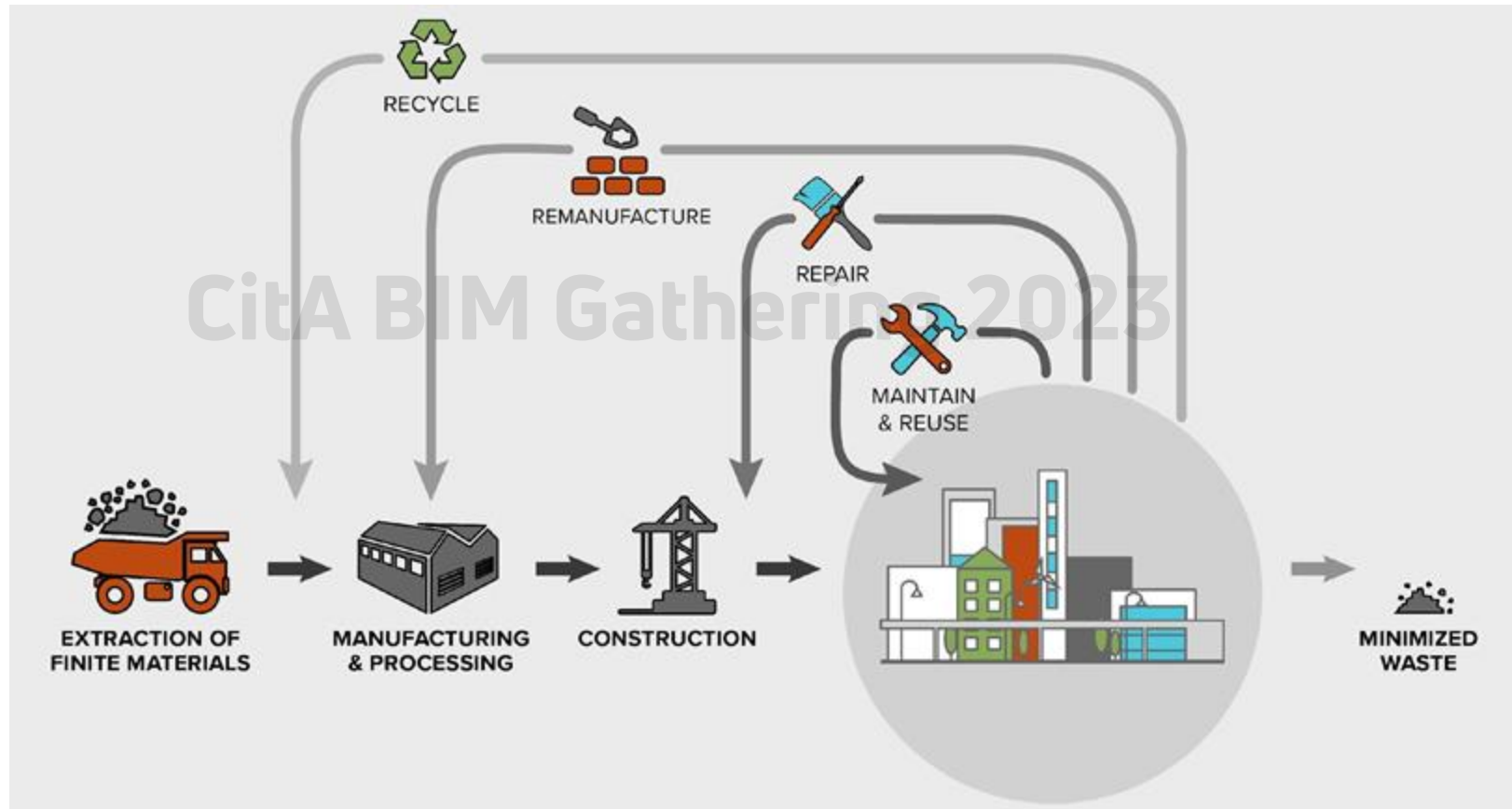
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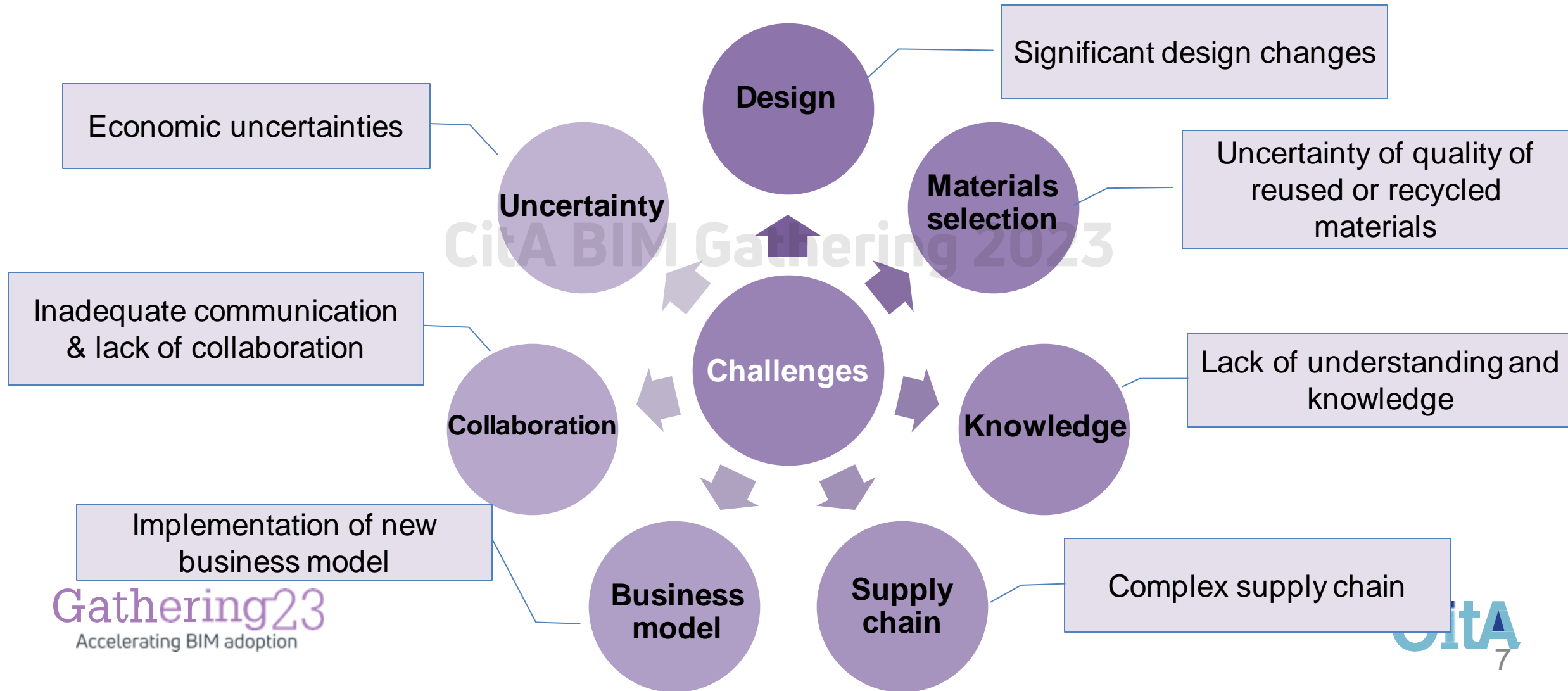
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Introduction

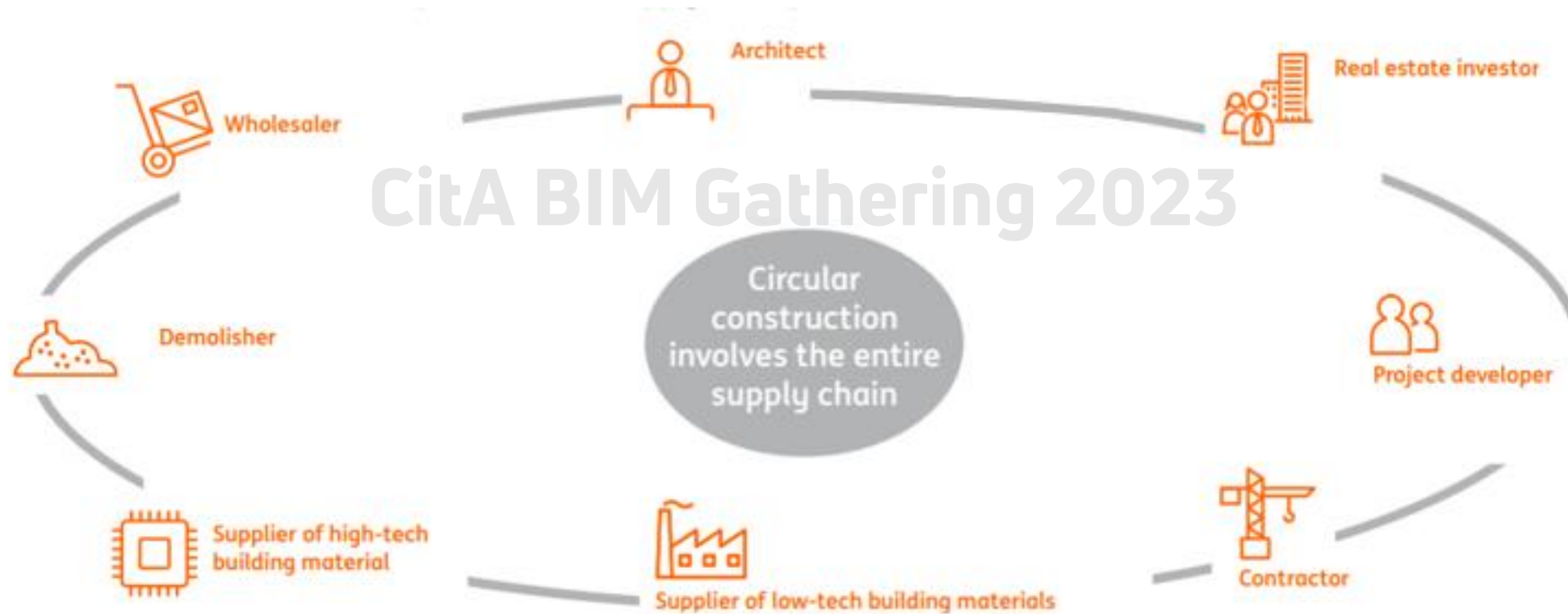
Circular economy (CE) principles have wide-spread application for the built environment



Implementation of CE in the built environment is hindered by various challenges



There is need for integration and collaboration among the whole supply chain to respond to challenges due to the fragmented nature of the industry



The transition to a CE requires integration of information systems, and the dominant information system in the construction industry is BIM

Providing information about materials and components

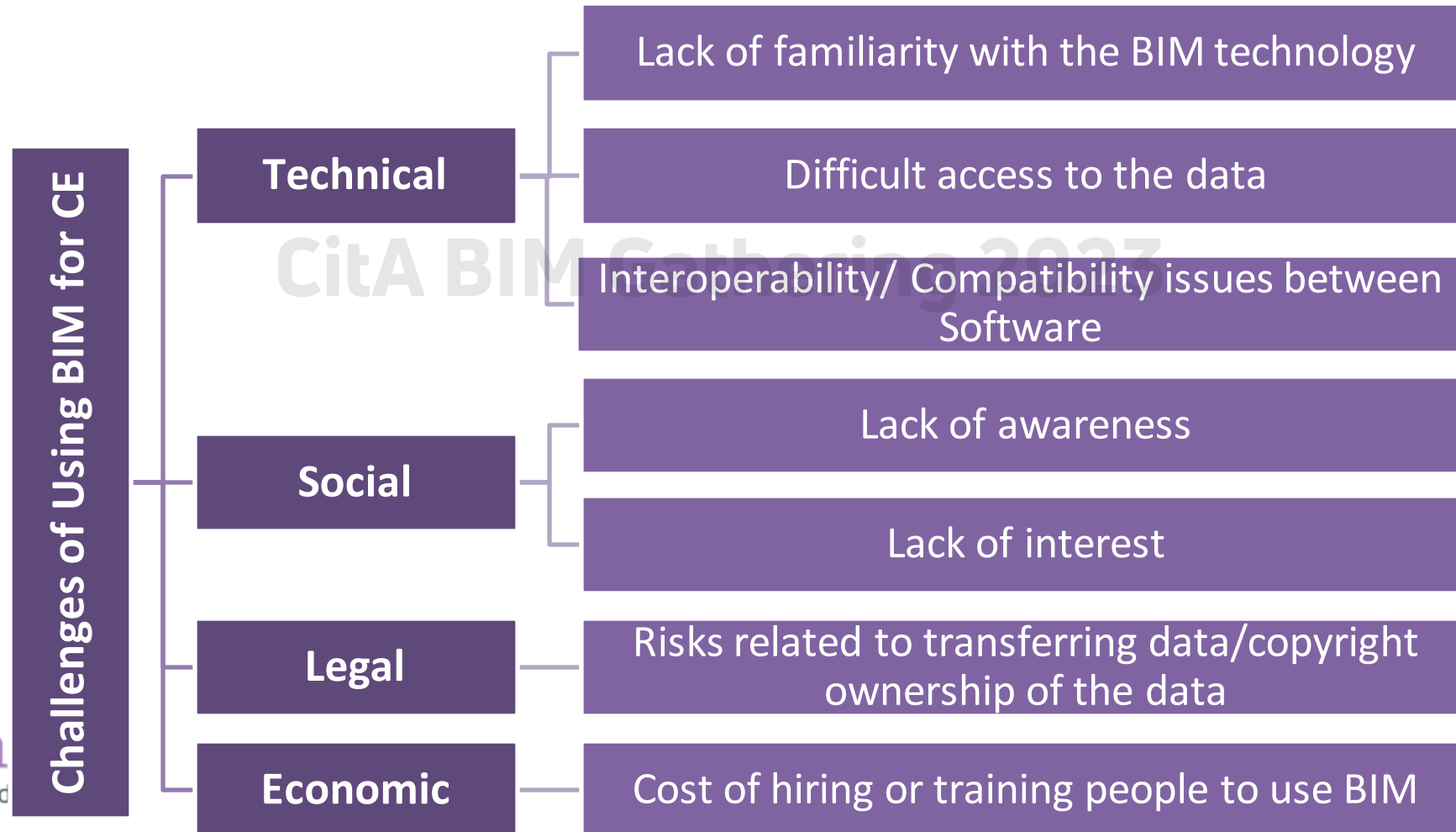
Waste Management

Integrating the supply chain

Improved collaboration among project stakeholders

Reduce the errors and uncertainties

Digital transformation of the construction industry and adoption of BIM has been slow due to numerous barriers



Problem Statement

Problem Statement

There is a need for effective information management throughout the entire supply chain for successful adoption of CE

Research Objective

Identification of BIM-based frameworks designed for information management for facilitating adoption of CE strategies in the built

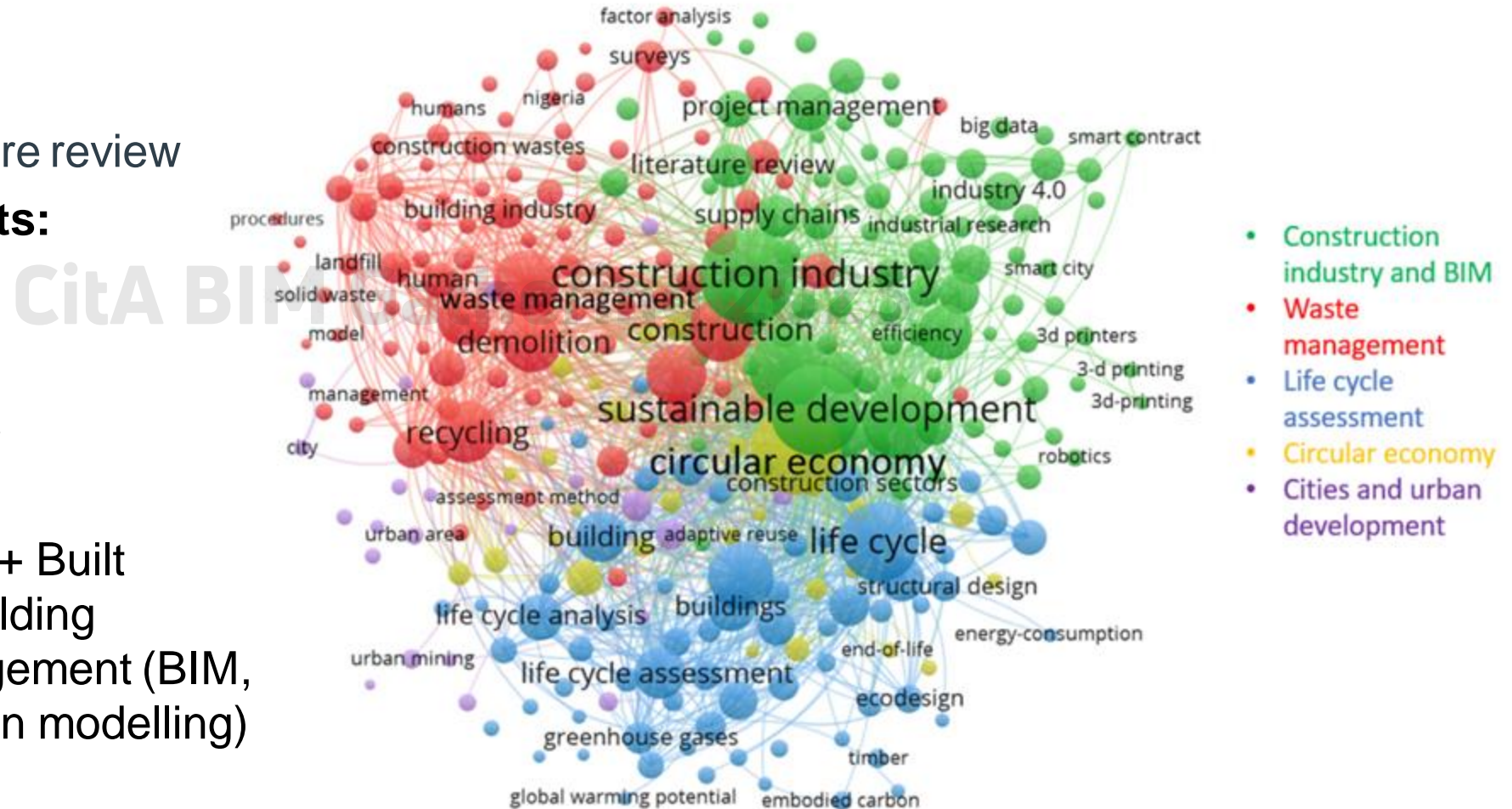
Research Objective

Identifying current gaps, challenges, and opportunities

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Literature links between info. management, construction industry and CE

- **Method:**
 - Systematic literature review
- **Number of documents:**
 - 662
- **Databases:**
 - WoS and Scopus
- **Scope:**
 - Circular Economy + Built Environment + Building Information Management (BIM, Building information modelling)



Identification of current efforts on information management for CE projects in the built environment

Type of literature review:

Systematic literature review

Scope:

Building Information Management and Circular Economy, Waste Management

Databases:

Scopus and WOS

Number of documents:

151

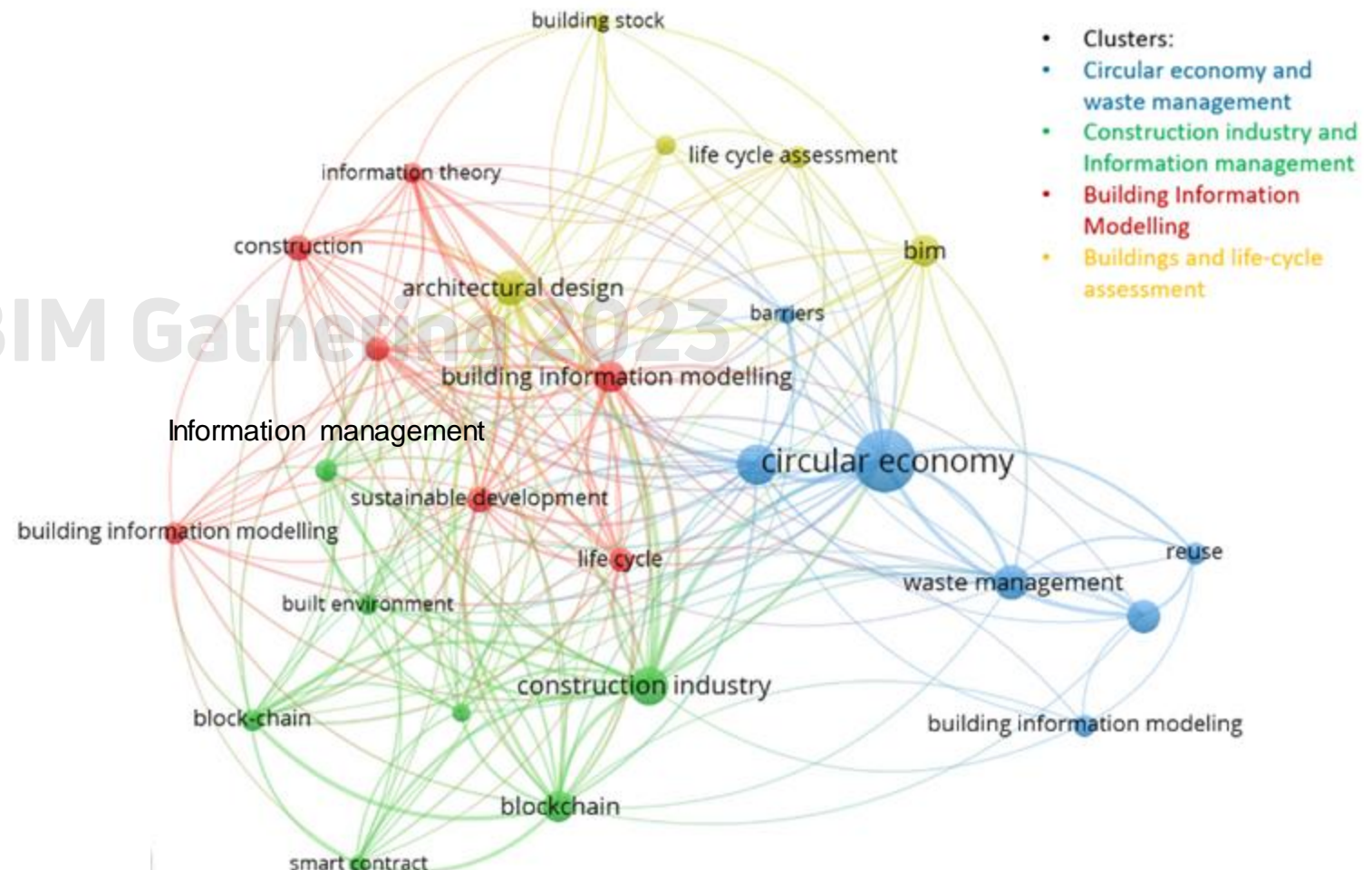


Fig. 4: Map of co-occurrence of the keywords related to the Building Information Management and CE in the built environment

Results and discussion

Studies on BIM-based frameworks for applying CE in the built environment

Studies	Technologies	Life-cycle phase	CE principles/strategies
(Çetin et al., 2021)	BIM & other technologies.	Pre-use phase, Use phase, next-use phase	Regenerate; Narrow; Slow; close
(Iyer-Raniga, 2019)	BIM, material banks, QR codes used in materials	3 case studies considered all stages of the building lifecycle	Regenerate, Share, Optimize, Loop, Virtualise, Exchange
(Succar and Poirier, 2020)	BIM, AI, digital twin	Whole life-cycle	Refurbishment, recycling, and reuse
(Abrishami & Martín-Durán, 2021)	BIM	whole lifecycle of assets	DfMA
(Fagnoli et al., 2019)	BIM	Maintenance	Repair and maintenance
(Atta et al., 2021)	MP and BIM	Whole life-cycle	deconstructability and recovery
(Quiñones et al., 2021)	BIM	Design phase	Reducing waste
(Sanchez et al., 2021)	BIM	Planning and design	Reuse
(Xing et al., 2020)	BIM	Whole life cycle	Reuse
(Guerra et al., 2020)	BIM	Planning and construction	Reuse and recycle
(Jayasinghe & Waldmann, 2020)	BIM	All phases	Recycle and reuse
(Akinade & Oyedele, 2019)	BIM	Design	Reducing construction waste
(Akanbi et al., 2018)	BIM	Whole life cycle	Reuse and recycle
(Liu et al., 2022)	BIM and Blockchain	End-of-life	Recycle

Findings

- Most studies investigated potentials, challenges and important role of BIM for facilitating the implementation of a circular economy
- Limited number of studies (only 14 papers) focused on development of frameworks for adoption of CE using BIM
- Only 2 frameworks incorporated all CE principles, whilst most research efforts focused on reusing and recycling
- 8 studies considered a whole life-cycle approach for developing their framework using BIM
- Limited number of case studies

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Conclusion

Recommendation and Future research

- Development of a common whole life-cycle information management framework
- Further investigation regarding higher circularity strategies including refuse, rethink and reduce
- Further studies on education and skill gaps regarding the adoption of BIM for CE
- Further case studies and demonstration projects to be used as a reference
- Further studies on opportunities for adoption of CE on infrastructure projects

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References

- Abrishami, S. Martín-Durán, R. (2021) 'Bim and dfma: A paradigm of new opportunities', *Sustainability (Switzerland)*.
- Akinade, OO. Oyedele, LO. (2019) 'Integrating construction supply chains within a circular economy: An ANFIS-based waste analytics system (A-WAS)', *Journal of Cleaner Production*, 229:863–873. <https://doi.org/10.1016/j.jclepro.2019.04.232>
- Atta, I. Bakhoun, ES. Marzouk, MM. (2021) 'Digitizing material passport for sustainable construction projects using BIM', *Journal of Building Engineering*, 43:103233. <https://doi.org/10.1016/j.jobbe.2021.103233>
- Cardellini. G. Mijndonckx, J. (2022) 'Synergies, energy efficiency and circularity in the renovation wave - bio-based products for the renovation wave'. Zenodo.
- Charef, R. Emmitt, S. (2021) 'Uses of building information modelling for overcoming barriers to a circular economy' *Journal of Cleaner Production*, 285:124854.
- Charef, R. (2022) 'The use of Building Information Modelling in the circular economy context: Several models and a new dimension of BIM (8D)', *Cleaner Engineering and Technology*, 7:100414.
- Criminale, A. Langar, S. (2017) Challenges with BIM Implementation: A Review of Literature. In 53rd ASC Annual International Conference Proceedings of the Associated Schools of Construction.
- Çetin, S., De Wolf, C. Bocken, N. (2021) 'Circular digital built environment: An emerging framework,' *Sustainability (Switzerland)*, vol. 13, no. 11, Art. no. 11.
- Fagnoli, M. Lleshaj, A. Lombardi, M. et al. (2019) 'A BIM-based PSS Approach for the Management of Maintenance Operations of Building Equipment', *Buildings*, 9:139.
- Guerra, BC. Leite, F. Faust, KM. (2020) '4D-BIM to enhance construction waste reuse and recycle planning: Case studies on concrete and drywall waste streams', *Waste Management*, 116:79–90.
- Han, D. Kalantari, M. Rajabifard, A. (2021) 'Building Information Modeling (BIM) for Construction and Demolition Waste Management in Australia: A Research Agenda', *Sustainability*, 13:12983.
- Jayasinghe, LB. Waldmann, D. (2020) 'Development of a BIM-Based Web Tool as a Material and Component Bank for a Sustainable Construction Industry', *Sustainability*, 12:1766.
- "Waste Less, Reuse More | Hickok Cole," Dec. 04, 2018. <https://hickokcole.com/ilab-microgrants/waste-less/> (accessed Feb. 14, 2023).
- Hossain, M.U., Ng, S.T., Antwi-Afari, P., Amor, B. (2020). Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. *Renewable and Sustainable Energy Reviews* 130.
- Liu, Z., Wu, T., Wang, F., Osmani, M., Demian, P. (2022). Blockchain Enhanced Construction Waste Information Management: A Conceptual Framework. *Sustainability* 14, 12145.
- Norouzi, M. Châfer, M. Cabeza, LF. Jiménez, L. Boer, D. (2021). 'Circular economy in the building and construction sector: A scientific evolution analysis,' *Journal of Building Engineering*, vol. 44.
- Quiñones, R. Llatas, C. Montes, MV. Cortés, I. (2021) 'A Multiplatform BIM-Integrated Construction Waste Quantification Model during Design Phase The Case of the Structural System in a Spanish Building', *Recycling*, 6:62. <https://doi.org/10.3390/recycling6030062>
- Rahla, KM. Mateus, R. Bragança, L. (2021) 'Implementing circular economy strategies in buildings—from theory to practice,' *Applied System Innovation*, vol. 4, no. 2, Art. no. 2.
- Sanchez, B. Rausch, C. Haas, C. Hartmann, T. (2021) 'A framework for BIM-based disassembly models to support reuse of building components' *Resources, Conservation and Recycling*, 175:105825.
- Succar, B. Poirier, E. (2020) 'Lifecycle information transformation and exchange for delivering and managing digital and physical assets', *Automation in Construction*.
- Iyer-Raniga, U. (2019) 'Using the ReSOLVE framework for circularity in the building and construction industry in emerging markets', *IOP Conference Series: Earth and Environmental Science*, 294:012002.
- Van Sante, M. (2017). Circular construction. Most opportunities for demolishers and wholesalers. ING Bank N. V. 22 p. Retrieved from https://www.ing.nl/media/ING_EBZ_Circular-construction_Opportunities-for-demolishers-and-wholesalers_juni2017_tcm162-127568.pdf
- Xing, K. Kim, KP. Ness, D. (2020) 'Cloud-BIM Enabled Cyber-Physical Data and Service Platforms for Building Component Reuse', *Sustainability*, 12:10329.

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