

# A BIM-based Theoretical Framework For the Integration of a sustainable EOL into the Asset Lifecycle

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## ❑ AEC industry waste production

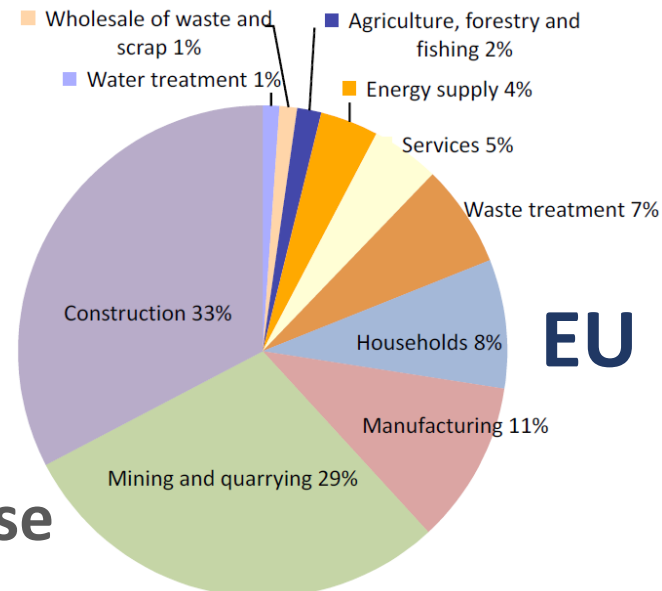
- C & D waste: 1/3 of the total waste
- 500 million tonnes/year (EU)

## ❑ AEC system: Fragmented

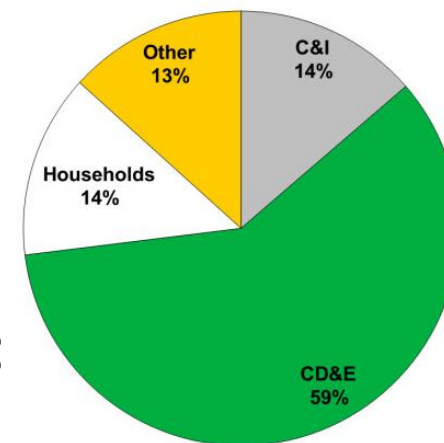
## ❑ Economy: Linear = Take, Make, Dispose

## ❑ Resource depletion

- AEC industry: biggest resources consumer: more than **50% of the global resources**
- Finite natural resources preservation: urgent need for **new strategies**



EU



UK

## □ Working methods

- **BIM adoption:** From silo working to collaborative work
- **Design with the end in mind:** Design for deconstruction

## □ Asset lifecycle reconsideration

- Asset Lifecycle = adding the **deconstruction phase**
- Asset lifecycle = **holistic system**

## □ From linear to circular Economy

- Reduce resource extraction: **Waste as a resource**
- **Material closed loop**



Problems

Solutions

**BIM**

Aim

Objectives

Results LR

Asset Lifecycle

New Asset Lifecycle

Sampling 1

Sampling 2

Barriers 1

Barriers 2

Conclusion

# Current use of BIM?

4 Levels

## Level 3

Full Integration

## Level 2

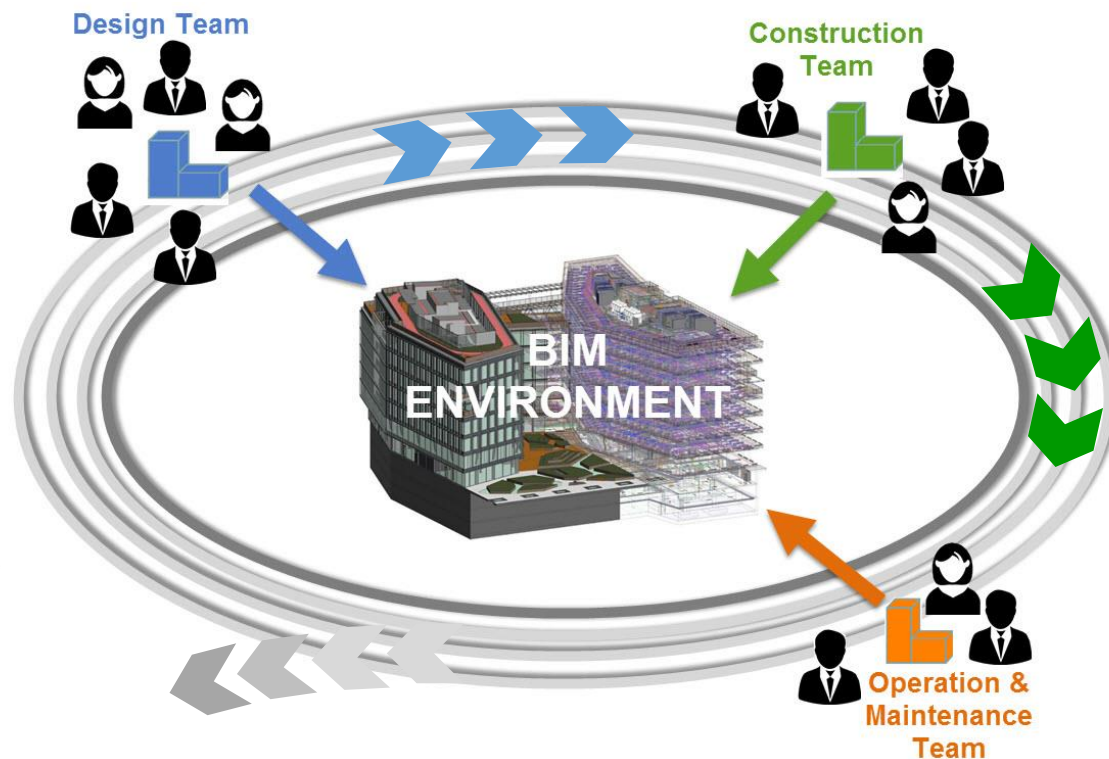
Full Collaboration

## Level 1

Partial Collaboration

## Level 0

Low Collaboration



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**Aim & Objectives**

## □ Aim

Reconsider **the asset lifecycle**: From design to the Asset End-of-Life

## □ Objectives

- To design a **Conceptual framework** integrating the asset EOL, based on the current Literature
- To **identify** the barriers for the integration of a sustainable EOL in the asset lifecycle



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# Results Literature Review

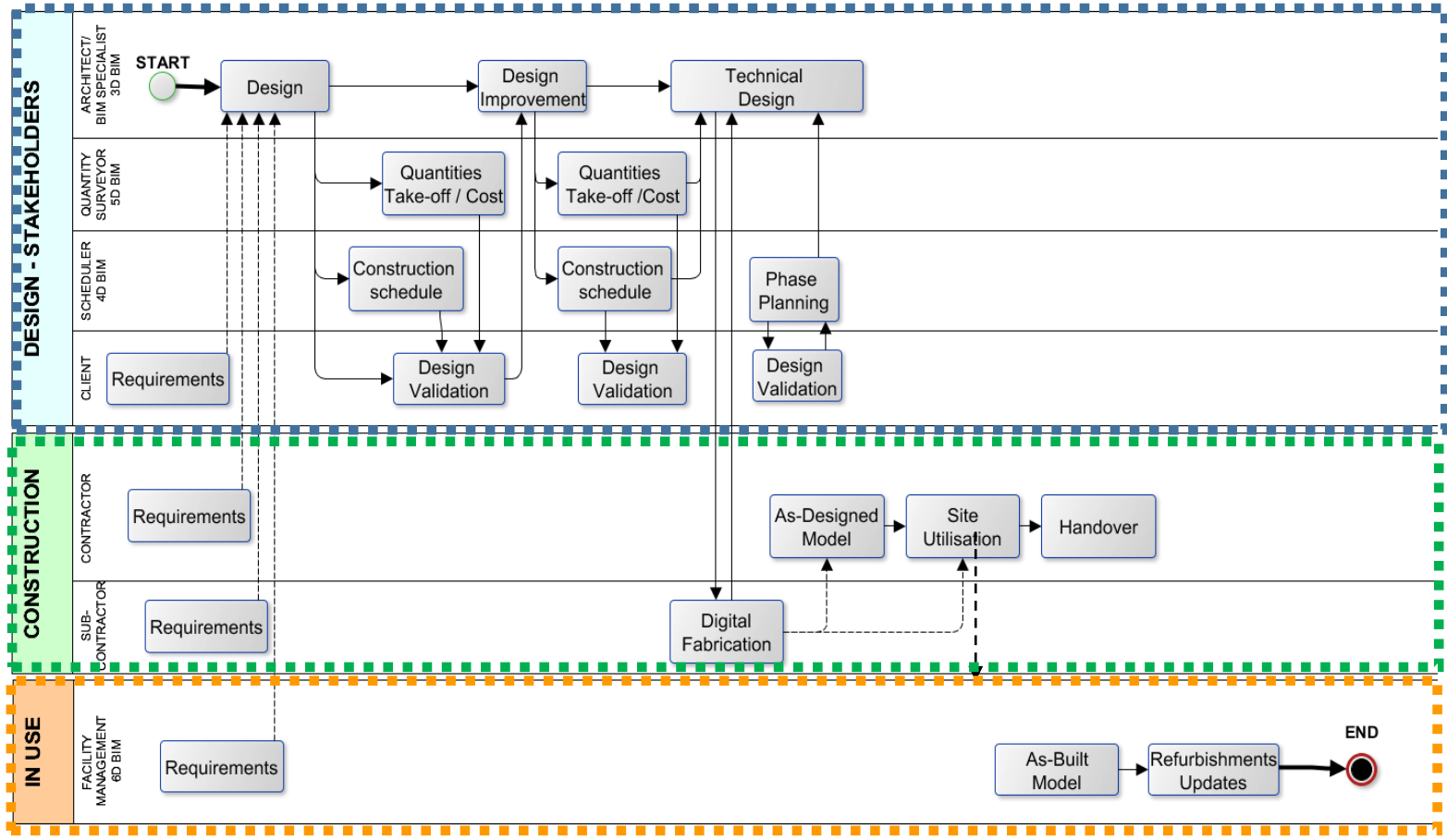
Categories	References
<b>Framework structure</b>	
Structure of the framework	CIOB (2014) ; RIBA (2013) ; Messner et al., (2012)
<b>Approach / changes</b>	
Hollistic view / Multidisciplinary approach	Crowther (2002) ; Sebastian (2010)
Contracts / Procurements changes	ISO 690 (2002) ; Sebastian (2010)
Things that should be done to begin a project in BIM	Sebastian (2010)
<b>Client</b>	
Client change & Poor communication	Liu et al., (2015)
Clients requirements	Bilal et al., (2016)
<b>Communication/ Coordination</b>	
Collaboration & Integrated approach	Akbarnezhad et al., (2014) ; Schultmann F (2008) ; Xanthopoulos et al., (2012)
Coordination & Communication	Bossink and Brouwers (1996) ; Osmani (2013) ; Osmani et al., (2008)
Communication between stakeholders	Kifokeris and Xenidis (2017) ; Sebastian (2010)
<b>Phases</b>	
Project All phases	Nawi et al. (2009) ; Saghatfroush et al. (2009)
Pre-project planning phase	Sanchez & Haas (2018)
Design phase	Inglis (2007) ; Bogenstätter (2000) ; Kovacic & Zoller (2015)
WMP incorporated during design stage	Couto & Couto (2010)
Planning phase	Knecht (2004)
In use phase changes	Van Reedt Dortland (2009)
EOL phase	Knecht (2004)
Supply chain management (phases)	Albaloushi & Skitmore (2008)
Link between phases	Kibert (2003) ; Akinade et al., (2017)
<b>Stakeholders importance</b>	
Importance of Architects/Engineers	Inglis (2007)
Designer role = essential	Gorgolewski (2008) ; Srour et al., (2010) ; EPA (2008) ; Pulaski et al., (2004) ; Knecht (2004) ; Srour et al., (2010) ; Chong & Hermreck (2009) ; Jaillon et al., (2009) ; Srour et al., (2012) ; EPA (2008)
Stakeholders involvement	Couto & Couto (2010) ; Bilal et al., (2016) ; Bossink and Brouwers (1996) ; Osmani (2013) ; Osmani et al., (2008) ; Kifokeris and Xenidis (2017) ; Sebastian (2010)
Stakeholders involvement design	Sebastian (2010) ; Kifokeris and Xenidis (2017) ; Sassi (2008) ; Pulaski et al., (2004) ; Gorgolewski (2008)
stakeholders challenges	Liu (2009) ; Dolan et al., (1999) ; Rios et al., (2015) ; EPA (2008)
<b>Data</b>	
BIM model / Data	Sebastian (2010) ; Akinade et al., (2016) ; Häkkinen & Belloni (2011)
Information management	Chen et al., (2015) ; Lu et al. (2017) ; Niu et al., (2016)
Deconstruction strategies to adopt	Akbarnezhad et al., (2012)



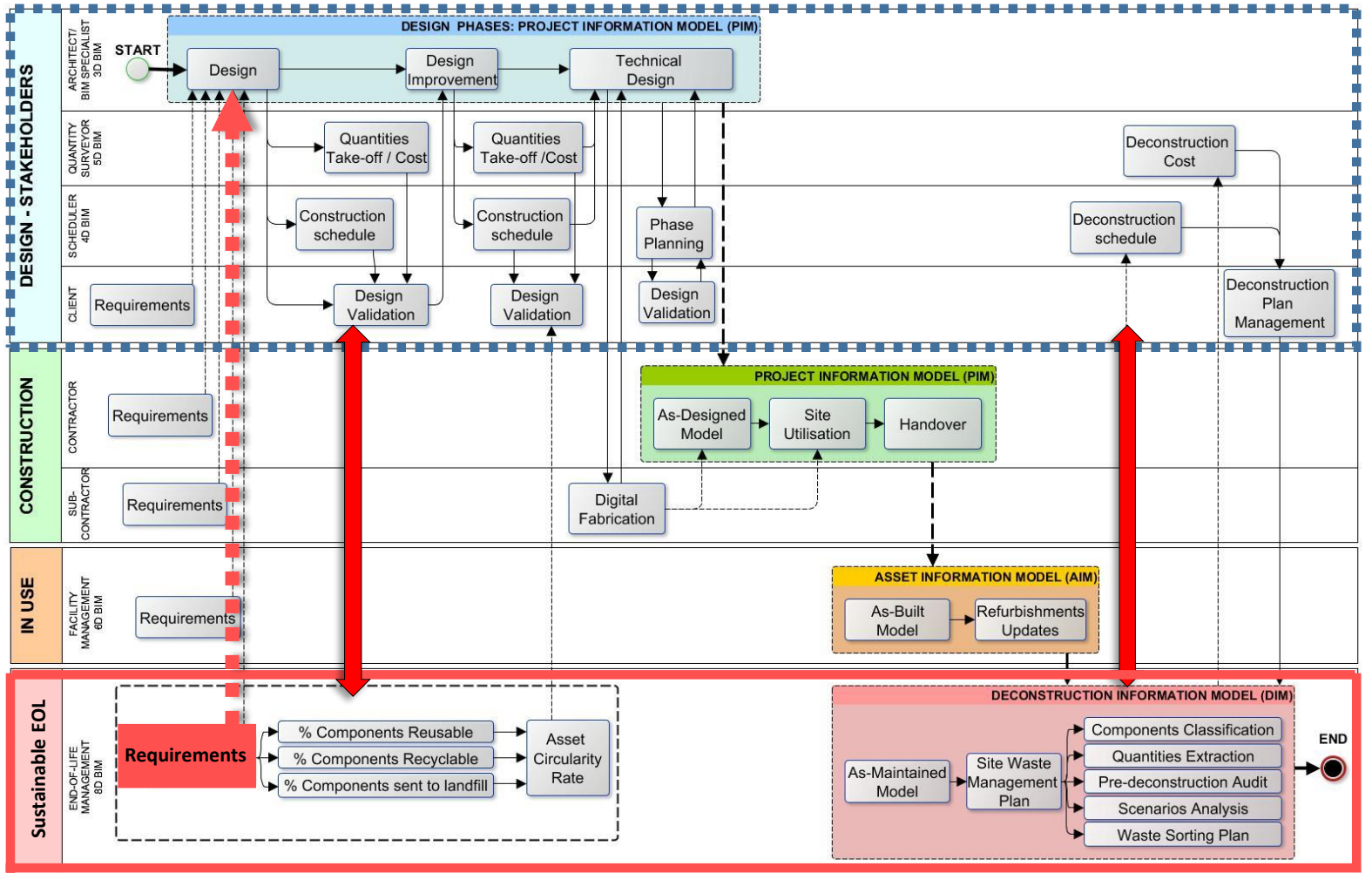
- Architects
- Engineers
- Quantity Surveyors
- Owners

- Contractors

- Facility Managers



- Architects
- Engineers
- Quantity Surveyors
- Owners
- Contractors
- Facility Managers
- Sustainable EOL



❑ **Method** Semi-Structured Interview : 20 questions

❑ **Scope** Construction stakeholders in France

❑ **Stakeholders (in total 11) roles**

- BIM Managers
- Engineers
- Designers
- Quantity Surveyor
- Control Officer

❑ **Stakeholders Experience**

- 8 – 10 years : **3**
- 15 – 20 years : **4**
- + 30 years : **4**



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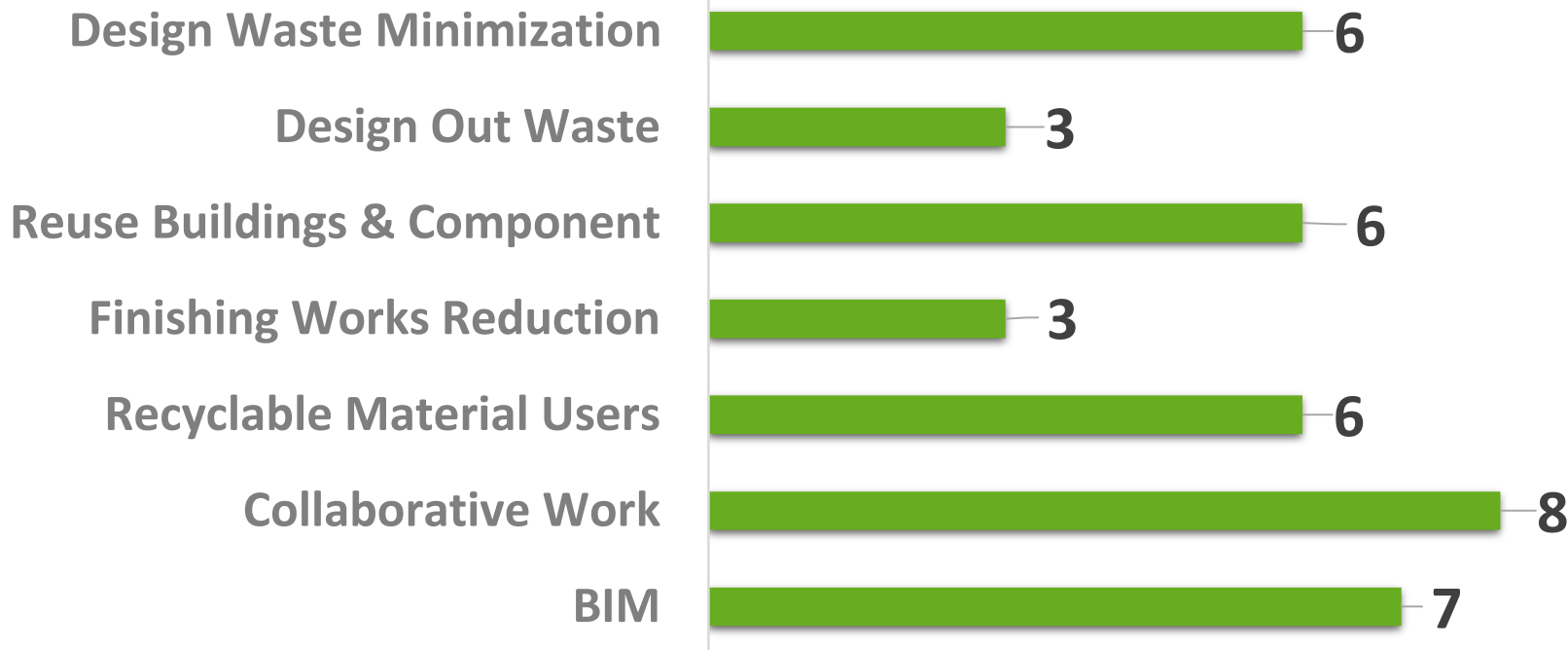
Sampling 2

Barriers 1

Barriers 2

Conclusion

Interview sampling



## □ Stakeholders approaches



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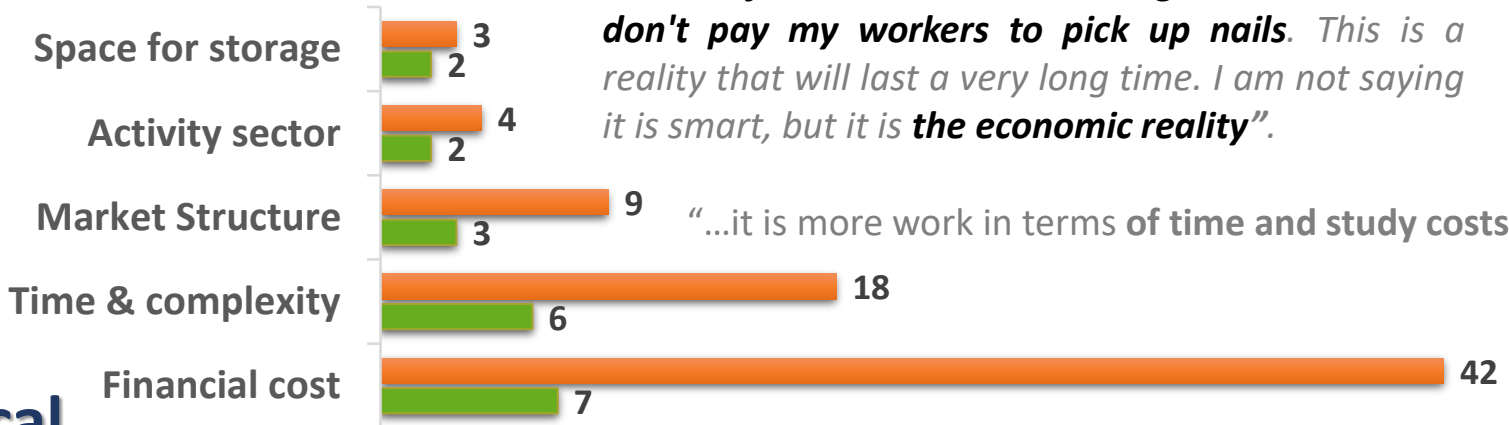
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# What are the barriers?

## Economical

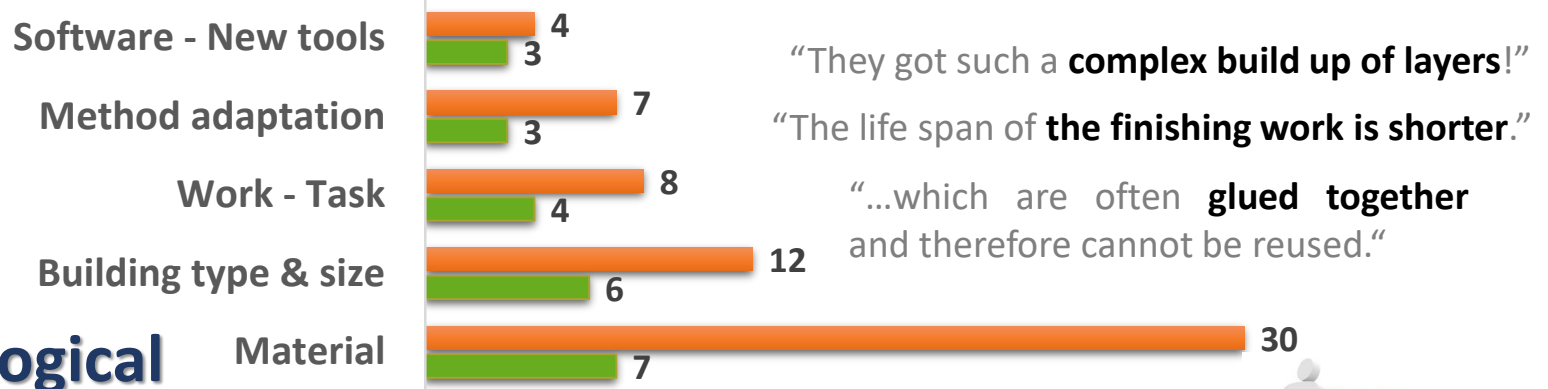


*"Most of the cost in the building is labour time. I don't pay my workers to pick up nails. This is a reality that will last a very long time. I am not saying it is smart, but it is **the economic reality**".*

*"...it is more work in terms of time and study costs"*

■ Number of Interviewees  
■ Number of Citations

## Technological



*"They got such a **complex build up of layers!**"*

*"The life span of **the finishing work is shorter.**"*

*"...which are often **glued together** and therefore cannot be reused."*



# What are the barriers?

## Political

Incentives for reclaimed materials



Contracts - Tender



Insurance



Regulations



Aesthetic trend



Lack of understanding - interest



Lack of information



Unrealistic approach



Construction durability



Awareness



Responsibilities



Training - Skills



Human behaviour



Number of Interviewees (Green)  
Number of Citations (Orange)

*"It's **not standardized yet**. I put wax on it and you have no maintenance".*

*"...we need the same system as in Switzerland, there is **no ten-year insurance...**"*

*"The main barriers are **related to humans**".*

*"Change is hard".*

*"...it will be very difficult because the **construction industry is so conservative**".*

## Sociological



**Theoretical framework:** based on Literature Review

**Assessment through interviews**

- **Economic barrier:** Financial cost, time & complexity
- **Technological barriers:** Material, building type & size
- **Political barriers:** regulations
- **Sociological barriers:** human behaviour

**Next step**

- Increase the number of interviewees
- Improve the theoretical framework based on the Interviewees comments



# Thank you

Publications related to the ongoing PhD:

**Charef, R., Alaka, H., & Emmitt, S. (2018).** Beyond the third dimension of BIM: A systematic review of literature and assessment of professional views. *Journal of Building Engineering*, 19, 242-257.

**Charef, R., Emmitt, S., Alaka, H., Fouchal, F. (2019).** Building Information Modelling Adoption in the European Union: An Overview . *Journal of Building Engineering*, (Accepted)

