
# Why is Product Modularity underdeveloped in Construction?

Cecilia G. da Rocha and Lauri Koskela

# Introduction

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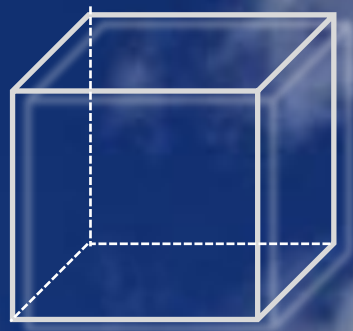
- Product Modularity (modularization) is not new in construction
- Unclear understanding of Product Modularity in this context
  - Non-consideration of peculiarities (one-off product, spatial voids, etc)
- Examine product modularity in two projects
  - What are modules? What are interfaces?
  - High-rise apartment building (cast in place reinforced concrete)
  - Low-income housing (pre-fabricated timber framed panels)

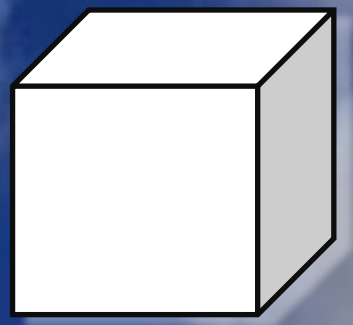
# What is a module?



- Spatial-oriented perspective
  - Primary functions (work, read, sleep, etc.) performed by people in the spatial voids
- Component-oriented perspective
  - Secondary functions (shield from the weather, noise, etc.) performed by physical components

(Rocha et al. 2015)





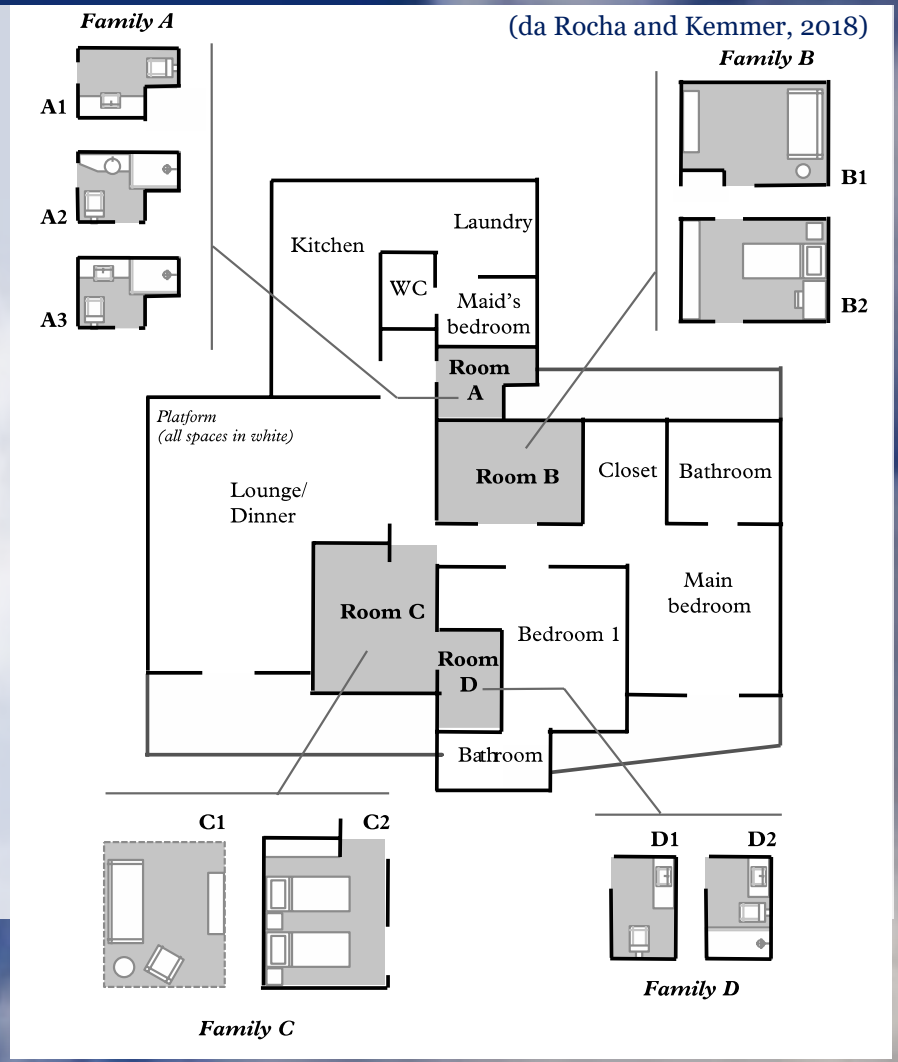
# What is a module?



- Spatial-oriented perspective

(Gravina da Rocha et al., 2019)


(da Rocha and Kemmer, 2018)



# What is an interface?



# Problems in interfaces

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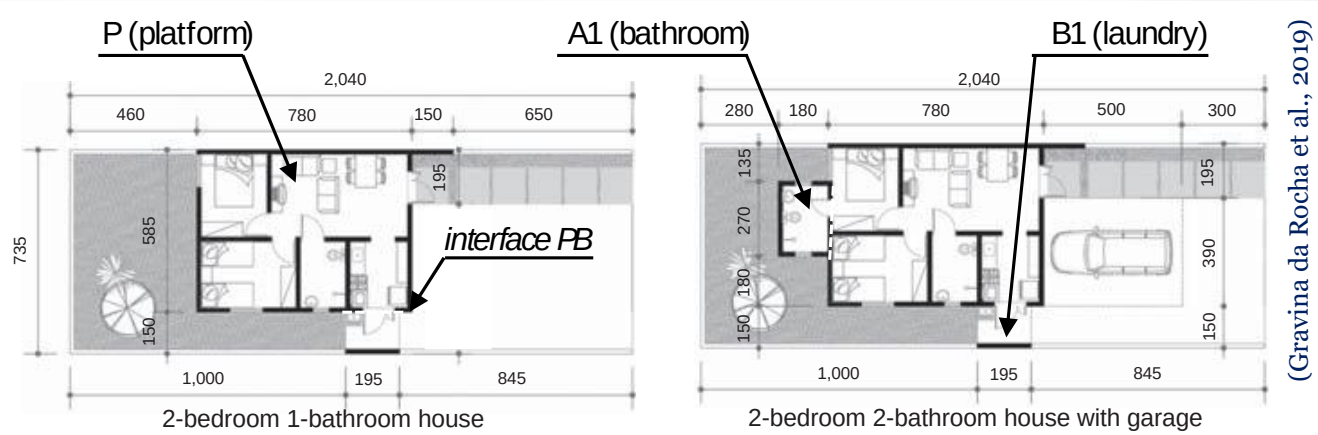
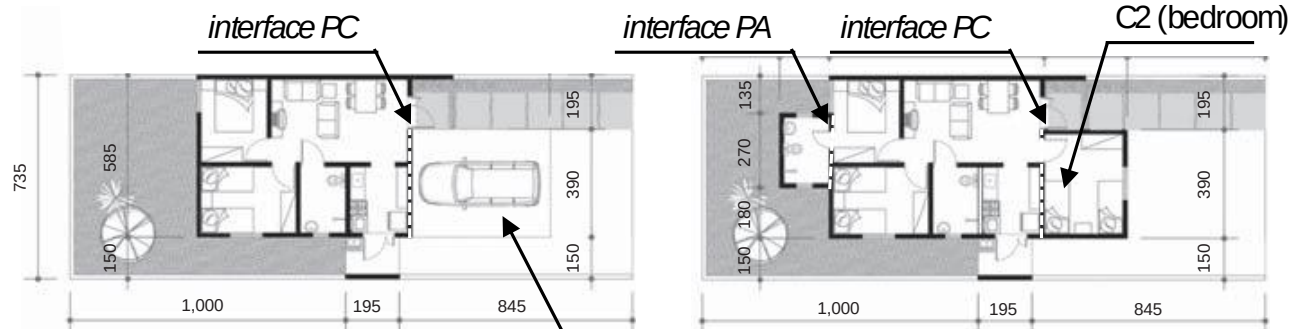
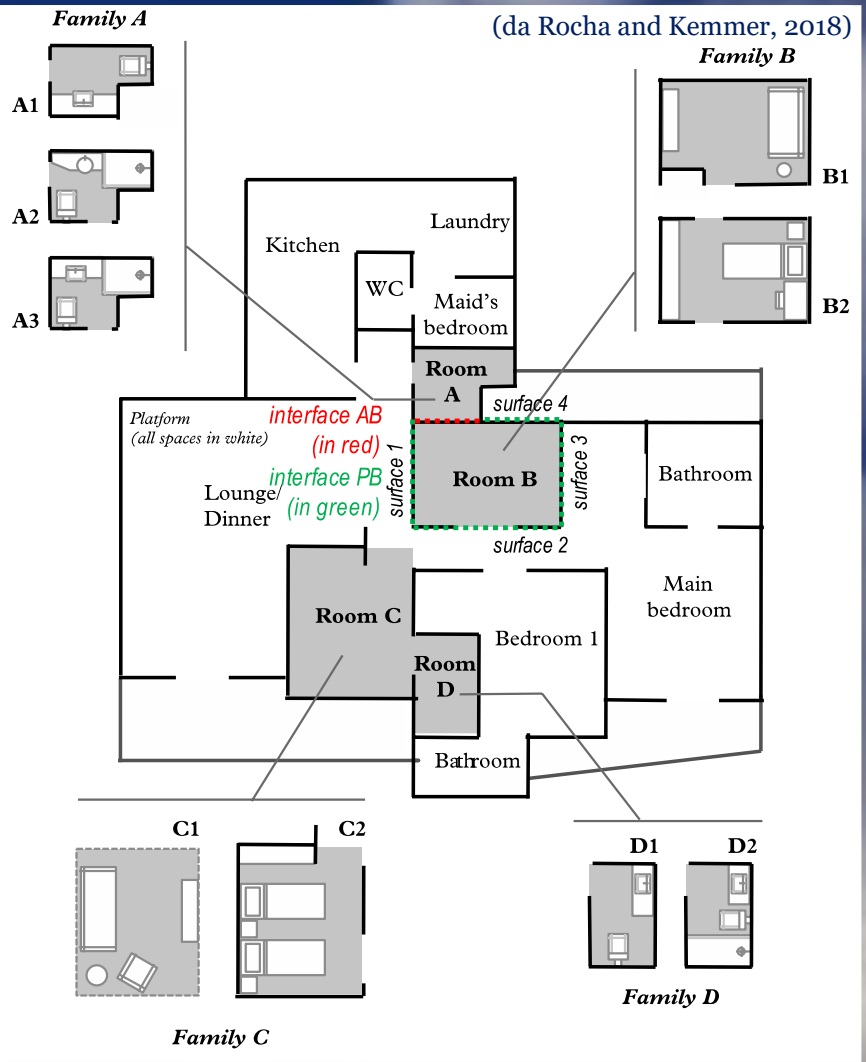
- Ambiguous interface
  - Modules that change across combinations
  - Unclear boundaries between modules




(Gravina da Rocha et al., 2019)




(da Rocha and Kemmer, 2018)



# Problems in interfaces

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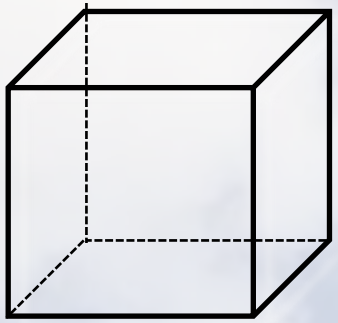
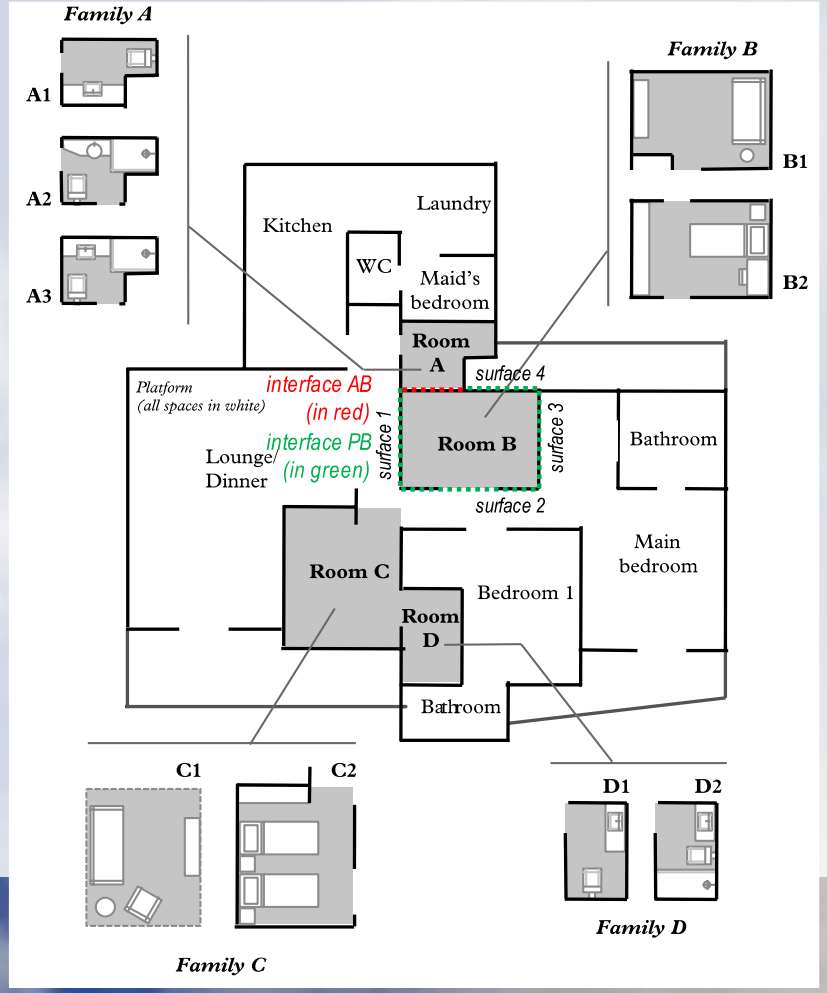
- Complexity of interfaces
  - Surfaces vs interfaces


*Manufacturing*

*Construction*



(da Rocha and Kemmer, 2018)



# Conclusions

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- Spatial-oriented perspective is more adequate
  - Spaces align with the *raison d'être* of buildings
  - Spaces align with client requirements and value
  - Global optimization (looking at the building and its comprising spaces)
    - Component-oriented perspective (e.g. MEP system) can lead to local optimization
  - Produces benefits even in traditional construction (da Rocha and Kemmer 2013)
    - Completing Platform prior to modules postponed the DP in 42 weeks
    - 30% of time (42/138 weeks) shielded from variability due to variety
  - Product Modularity is not applicable only to off-site construction

# Conclusions

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- Why is Product Modularity underdeveloped in Construction?
  - One-off nature of construction projects: multiple meaning of modules
  - Spatial voids/"cuboids" modules: ambiguous interfaces

  - Two conceptual considerations missing for a proper understanding

- Future studies
  - Acknowledge the multiple meanings of module in construction
    - What is a module in this study? Images, drawings, diagrams, etc.
  - Engage with design teams adopting a spatial-oriented perspective
    - Challenges of resolving the ambiguous interfaces/having truly invariant modules

# Thank you!


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