RMIT UNIVERSITY

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Operational Research Driven by Software Engineering Principles

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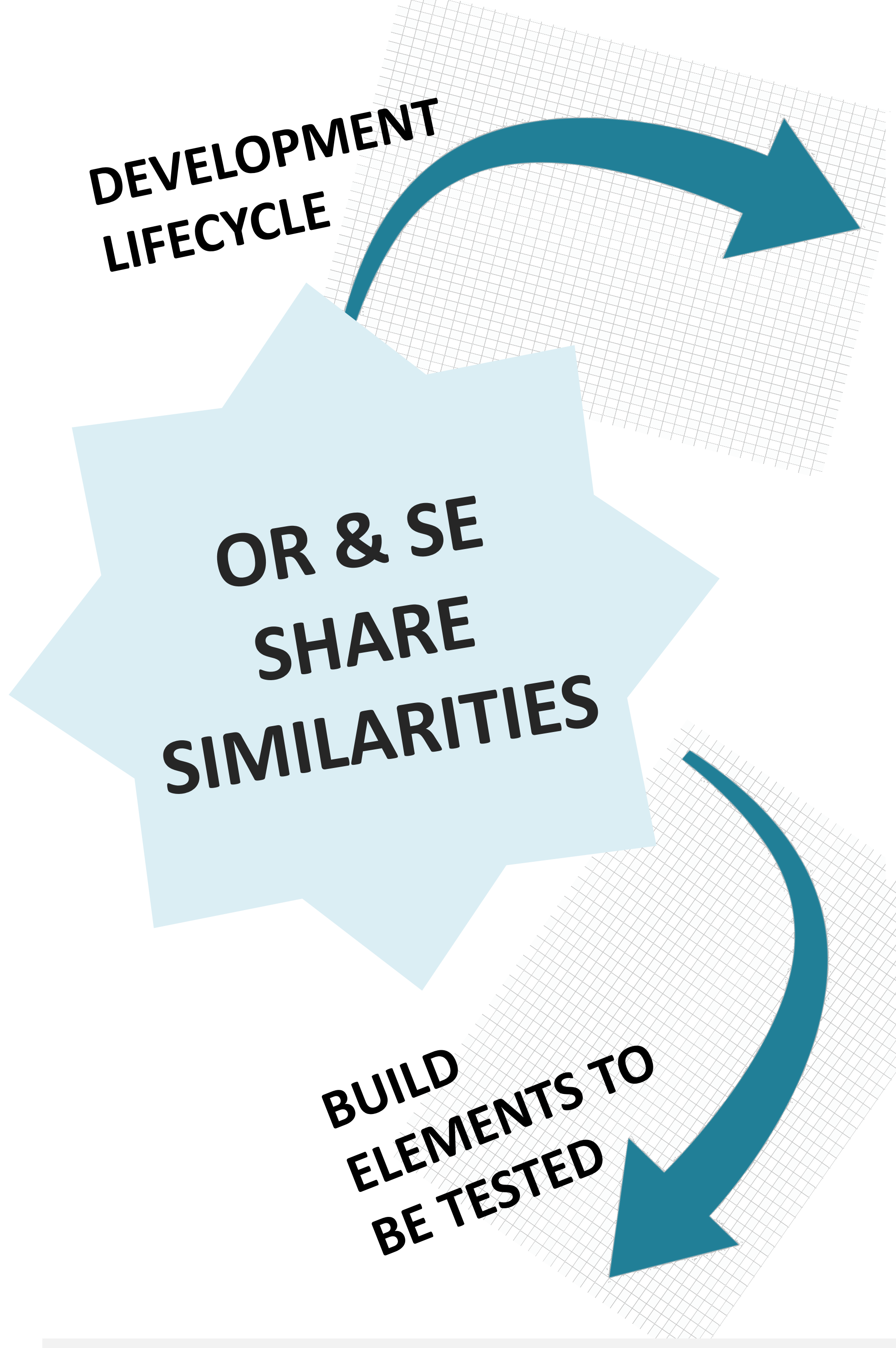
Introduction

PROBLEM

- Operations Research (OR) struggle with “wicked problems”: changeable environments, with conflicting requirements and confusing information.
- The lack of a methodology guiding OR projects complicates the introduction of changes in the model due to alterations on the requirements.
- Similar issues have already been acknowledged and approached in Software Engineering (SE), but this is not applied in OR models development.

PROPOSAL

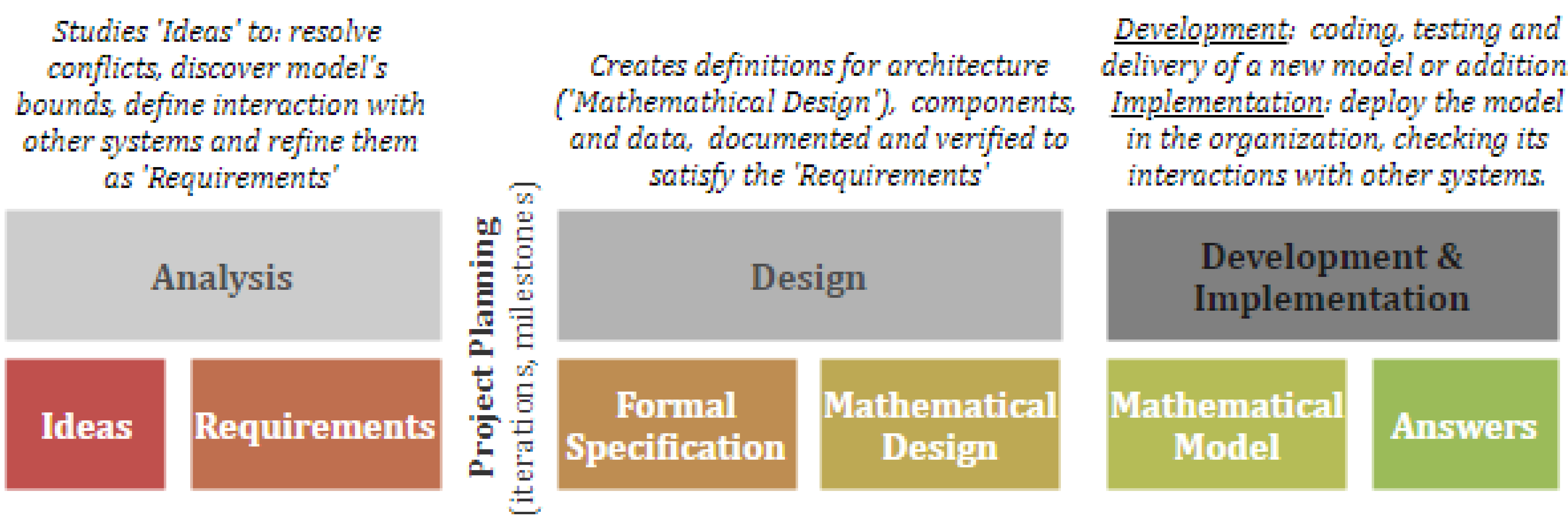
- To use the experience obtained in SE practices regarding agility and project management, and applies it in OR projects.
- Apply agile methodologies concepts in OR projects management, to simplify its adoption and integration with SE practices and systems.
- Define concepts for some agile techniques, such as unit testing, to provide a conceptual base for SE-driven OR.



DEVELOPMENT LIFECYCLE

OR & SE SHARE SIMILARITIES

BUILD ELEMENTS TO BE TESTED


Studies 'Ideas' to: resolve conflicts, discover model's bounds, define interaction with other systems and refine them as 'Requirements'
Creates definitions for architecture ('Mathemathical Design'), components, and data, documented and verified to satisfy the 'Requirements'
Development: coding, testing and delivery of a new model or addition. Implementation: deploy the model in the organization, checking its interactions with other systems.
Analysis
Project Planning
(iterations, milestones)
Design
Development & Implementation
Ideas
Requirements
Formal Specification
Mathematical Design
Mathematical Model
Answers

OR Units for Testing

Input Data	Variables
Constraints (Feasibility Region)	Objectives

→ **Individually:** searches for compound errors (a constraint works well on its own).

→ **Grouping:** studies how constraints interact.

→ **Groups Combinations:** evaluates levels of integration.

WHAT IS DONE SO FAR:

- Guidelines for selecting an agile methodology for OR projects.
- Reverse Engineering of two (2) real-world interventions, that developed an OR optimisation model each.
- Empirically test existing Scrum tools for OR project management.
- Identification that Quality Attributes can be defined for OR mathematical models.

CONCLUSIONS

SE-driven OR implies a change of paradigm and working practices, but improves the dynamics between both disciplines.

OR becomes easier to implement.

This applies existing, tried-and-true, SE techniques into OR. Validating “Agile OR” requires multiple implementations and case studies.

SE-driven OR is a newborn discipline with extensive potential.

FUTURE WORKS

What are “functional requirements” in OR? How can we elicit and represent them? Can we use Scrum’s User Stories for this purpose?

Can we automate the use of unit testing in OR?

Because OR models are software, what is the “architecture” of OR models? How do we design and represent it?

1. Vidoni, Cúnico, Vecchietti. “Towards an Agile Lifecycle in Operational Research Projects”, in 20th International Conference on Enterprise Information Systems (ICEIS). Vol 1, pp432-440. 2018.
2. Vidoni, Cúnico, Vecchietti. “An Empirical Framework to Applying Unit Testing in Operational Research”, in “48th Computers and Industrial Engineering (CIE). Vol 1, 2019.
3. Vidoni, Cúnico, Vecchietti. “Agile Operational Research”, in Journal of Operational Research Society. *Accepted, entering publication schedule.*