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The structural coherence of problem-based projects

Roundtable discussion

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DTU

The structural coherence of problem-based projects

Roundtable discussion

Wednesday, september 19, 10:30-12:30

Hosts: John Clausen, Per Valentin Bigum, and Samuel Brüning Larsen
Center for Bachelor of Engineering Studies, DTU

Hosts

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Agenda

The *problem* in problem-based projects

The problem-based project: proces and characteristics

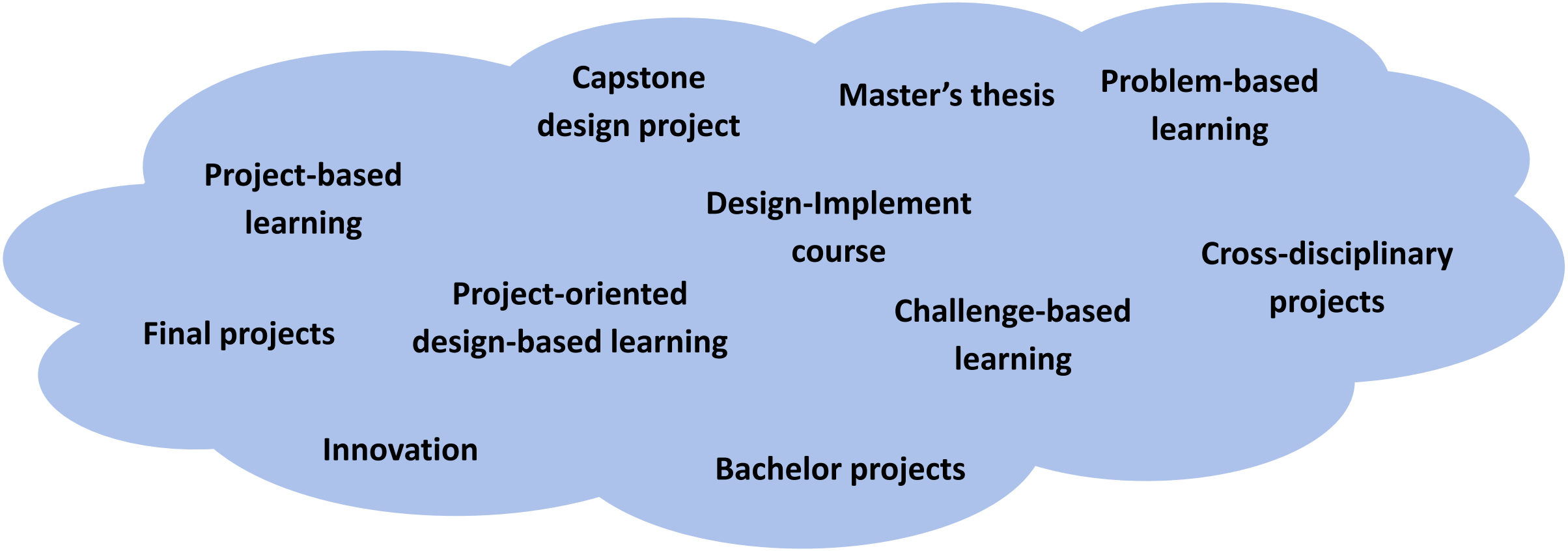
The relationship between problem and methodology

The relationship between problem and analysis

The relationship between analysis and solution design

The relationship between solution design and implementation

The problem-based project has many names



What is a *problem* in a problem-based project? (1/3)

1

ROUNDTABLE DISCUSSION

The structural coherence of problem-based projects

Background

The *problem-based project* is a much-applied method for facilitating learning experiences that mirror engineering practice. Problem-based projects have many names. Examples are problem-based learning, challenge-based learning, design-implement experience, and capstone design project. Using problem-based projects as learning method supports active learning where students construct internal knowledge about a topic throughout the project.

In problem-based projects, teams of students design solutions to problems. These problems often reside with an 'industrial partner', i.e. a firm with which the student team cooperates. Examples of industrial partners are manufacturers, public utilities, software developers, contractors, and entrepreneurs.

In engineering, problem-solving projects usually either improve an existing entity or design a new entity from scratch. Improving an existing entity is e.g. lengthening a machine's durability. The project team develops a solution, which might be a combination of a new material and an improved machine maintenance policy. Designing a new entity is e.g. a project that designs a building. In this project, the solution is constituted by the drawings of the building and perhaps a small-scale building model.

The perhaps most prevalent and yet most vaguely defined terms for a great problem-based project is 'structural coherence'. Synonyms for the concept are 'project flow', 'red line' or 'red thread', and 'inherent logic'. In the spoken language, an often used *antonym* for structural coherence is "apples and oranges".

The structural coherence of a project refers to how the elements of the project fit together. These elements are often (1) problem statement, (2) methodology, (3) analysis, (4) solution design, and (5) implementation.

What is a *problem* in a problem-based project? (2/3)

An existing entity is not performning adeqautely

Examples:

- *Low durability of a machine*
- *Low performance of an engine*
- *High failure rate of a production line*

Someone has a need for a new entity

Examples:

- *A new building*
- *A new chemical compound*
- *A new machine*
- *A new procedure or planning process*

An unanswered, traditional research questions

Examples:

- *Why does metal X corrodes faster than metal Y?*
- *Do clouds reflect more sunlight than ice?*

What is a *problem* in a problem-based project? (3/3)

Designing a solution to a problem is not the same as conducting research (that answers an unanswered question and perhaps is publishable in a journal)!

Do you agree?

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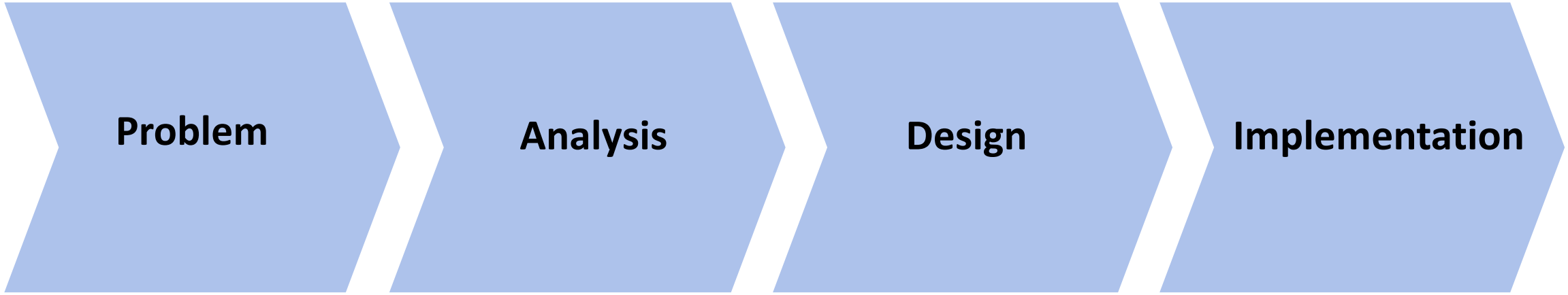
The problem-based project (2/4)



The problem-based project – The characteristics

1. Projects in engineering education concern the use of theory and methods in *real-life* or *close-to-real-life* situations
2. The objective is to design solutions to current, specific problems
3. Problems in engineering projects can be technical in nature or a combination of technical and social, i.e. involving changed human behavior
4. The problem that engineering projects solve often exists with an industrial partner. The problem must solved within the industrial partner's specific context
5. The solution that the project group designs must be implementable with the industrial partner
6. Projects are often conducted by project groups of two to six persons
7. Project have a minimum of two stakeholders (the university and the industrial partner). Therefore, the project has two sets of target groups each with their own set of demands

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The relationship between problem statement and methodology

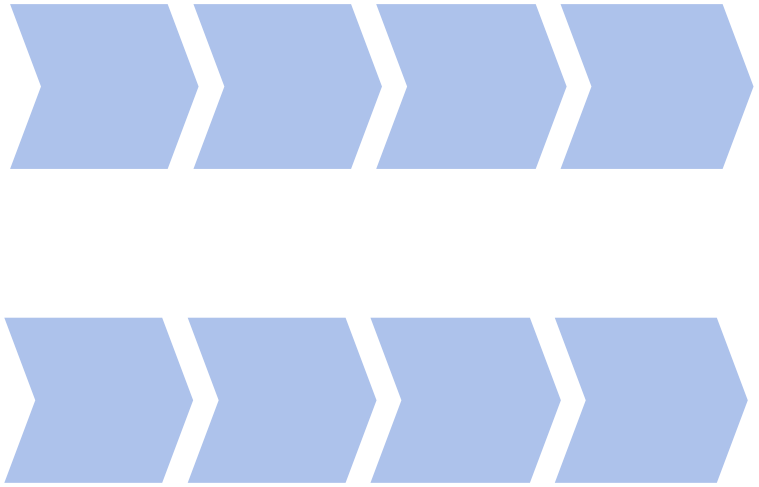
2

Problem

A need for a new entity

Underperformance of an existing entity

What is the right methodology?



- What are the generic elements in the sequence of steps that constitutes a project's methodology?
- Differences between engineering disciplines? Examples?
- When do we (as examiners) know whether a project's problem and methodology are coherent?

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The relationship between problem and analysis

2

Problem	The right analysis
A need for a new entity	- Objective? - Deliverables?
Underperformance of an existing entity	- Objective? - Deliverables?

- What are the objectives and deliverables of a project's analysis?
- Differences between engineering disciplines? Examples?
- When do we (as examiners) know whether a project's problem and analysis are coherent?

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The relationship between analysis and solution

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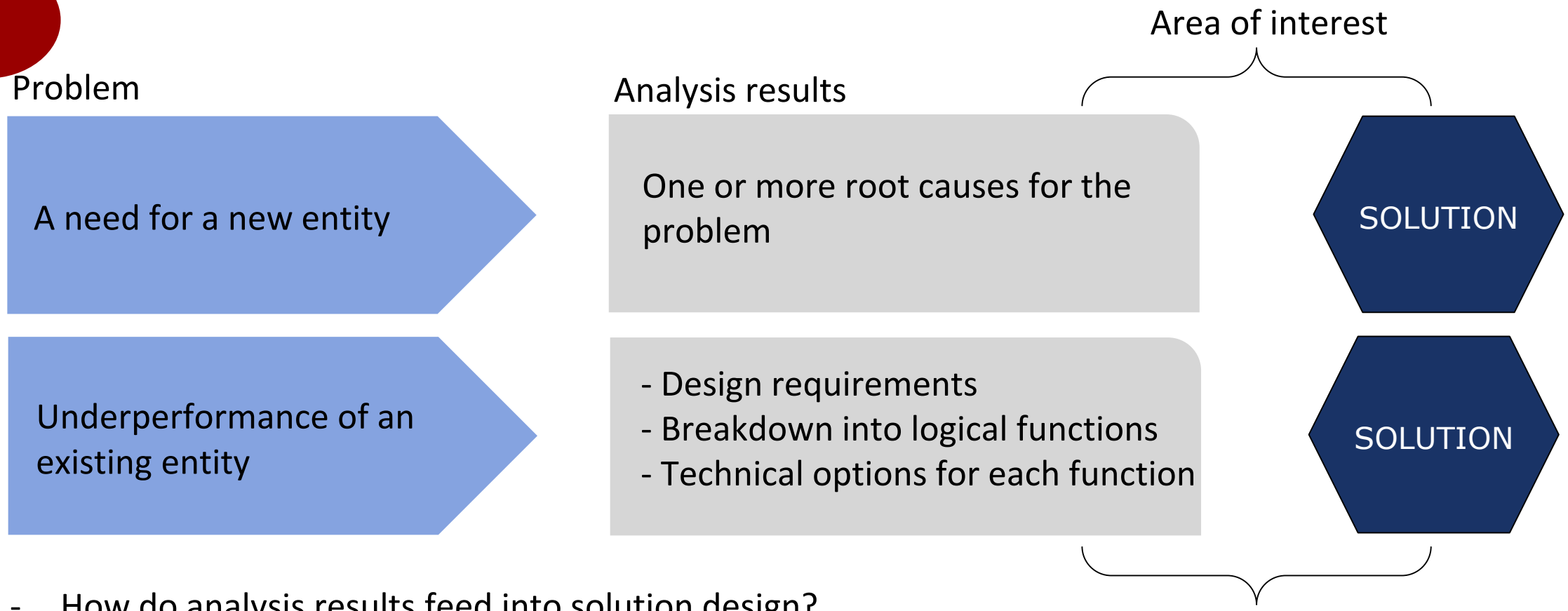

- How do analysis results feed into solution design?
- Differences between engineering disciplines?
- When do we know whether a project's analysis and solution are coherent?

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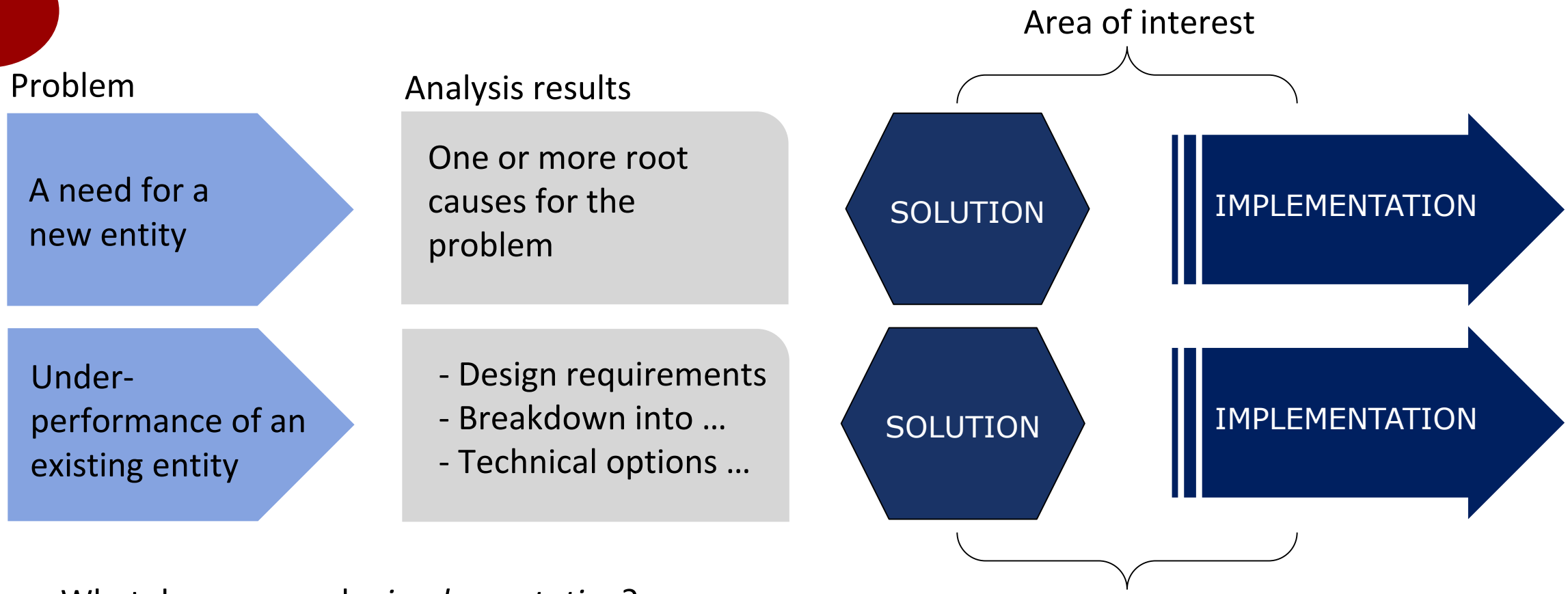

- What do we mean by *implementation*?
- Differences between engineering disciplines?
- When do we know whether a project's solution and implementation (plan) are coherent?

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