EMEA Workshop 2019

Utrecht, the Netherlands
10-11 October 2019

Elena Gallego, The REUSE Company

Boosting Reuse and Quality of legacy assets in the engineering process

Reuse of our legacy assets

We must ensure that the assets that we maintain in our Product Lines fulfil with the Quality priorities defined by the Organization.

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◈ *It is precisely the idea of* *knowledge reuse* *what will help to overcome the challenges that organizations face to* *build better systems* *or* *deliver better services**, in less time, with less money and more efficiency.*

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The European automotive sector differed greatly in the level of variety they offered to customers, although variety had little relation to unitary sales.

	Bodies	Power trains	Total number of variations	European units sales in 2002
Mercedes E-Class	**30**	**15**	**3,347,807,348,000,000,000,000,000**	**157,584**
BMW 3-Series	**10**	**20**	**64,081,043,660,000,000**	**350,723**
Peugeot 206	**5**	**24**	**1,739**	**596,531**

Source: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.2061&rep=rep1&type=pdf

The challenges in Product Lines Engineering

◈ Customer-Oriented products development

◈ Sophisticated components interactions

◈ Old Product Lines vs. New Product Lines

Technology limits how we do Product Lines Engineering - PLE, as manufacturing complexity limits how we manage our Product Lines.

Knowledge Reuse Purpose

◈ A few goals of the Knowledge Based PLE are:

- ◆ To ensure that the Product or Services development main <u>documents are Complete, Consistent and Correct</u>

- ◆ To support the <u>quality analysis of requirements</u>, models, and even unstructured information

- ◆ To reuse the Organizational or <u>Domain information</u> among several projects

- ◆ To share knowledge between the <u>different stakeholders</u> in the process

- ◆ To infer behavioral patterns from <u>legacy assets</u>

PLE: Product Line Engineering

Knowledge Based System: Infers and Uses a Knowledge Base to solve complex problems

Product Oriented　　　　　　　　　　　　　　　**Services Oriented**

Knowledge Organization

Product Oriented

- Product Breakdown Structures

- Architectures

- Thesaurus

- Patterns

- Controlled Vocabulary

Services Oriented

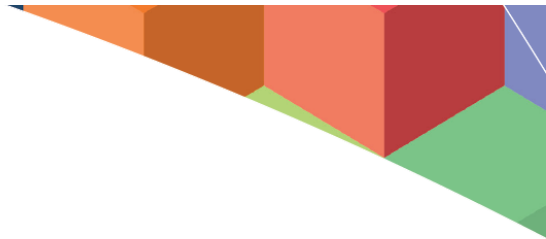- Unstructured documentation

- Unknown inputs of information

- Thesaurus

- Controlled Vocabulary

The need from Industry

Industrial Needs — Extraction: 51, Modelling: 44, Integration: 28, Co-Evolution: 11, Verification: 8

Technology Coverage — Extraction: 14, Modelling: 4, Integration: 20, Co-Evolution: 4, Verification: 13
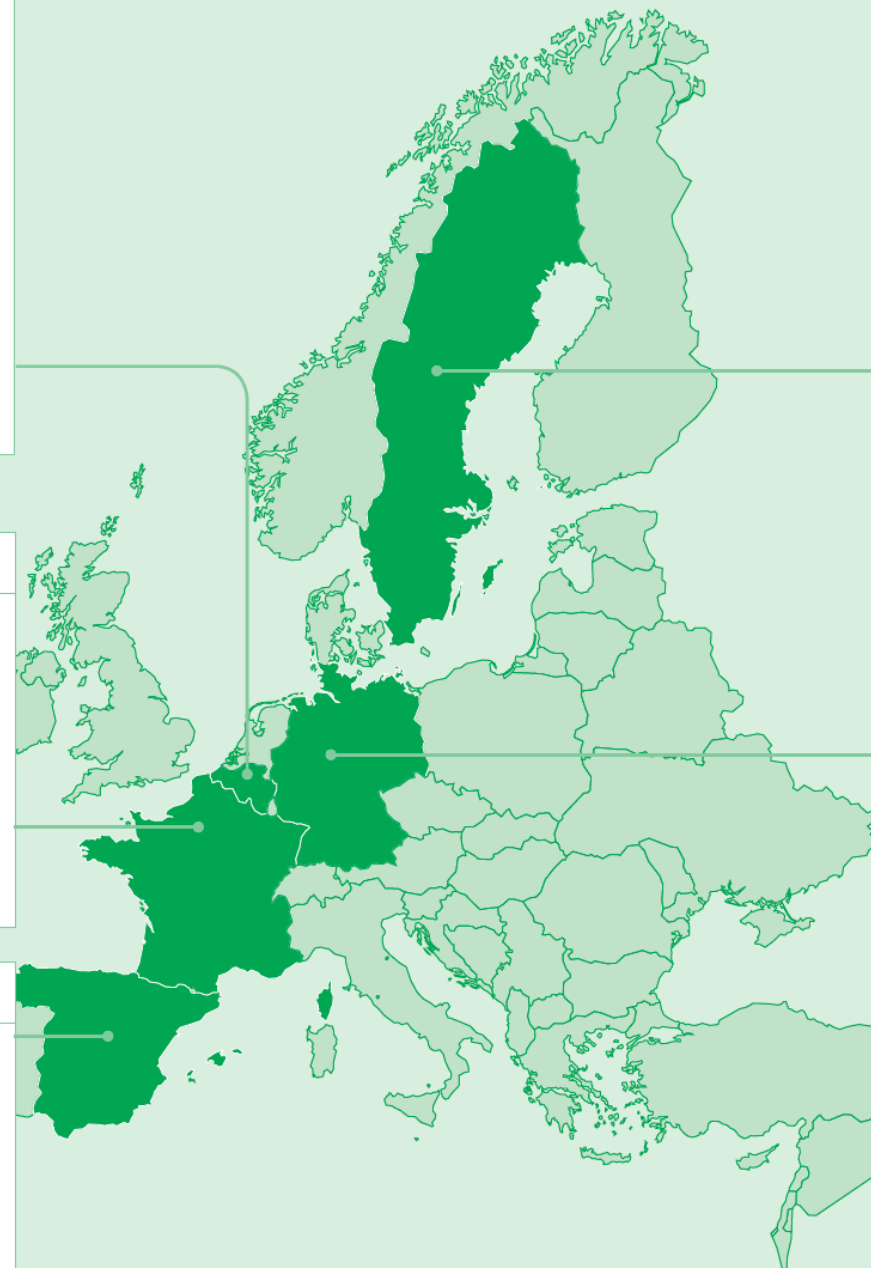
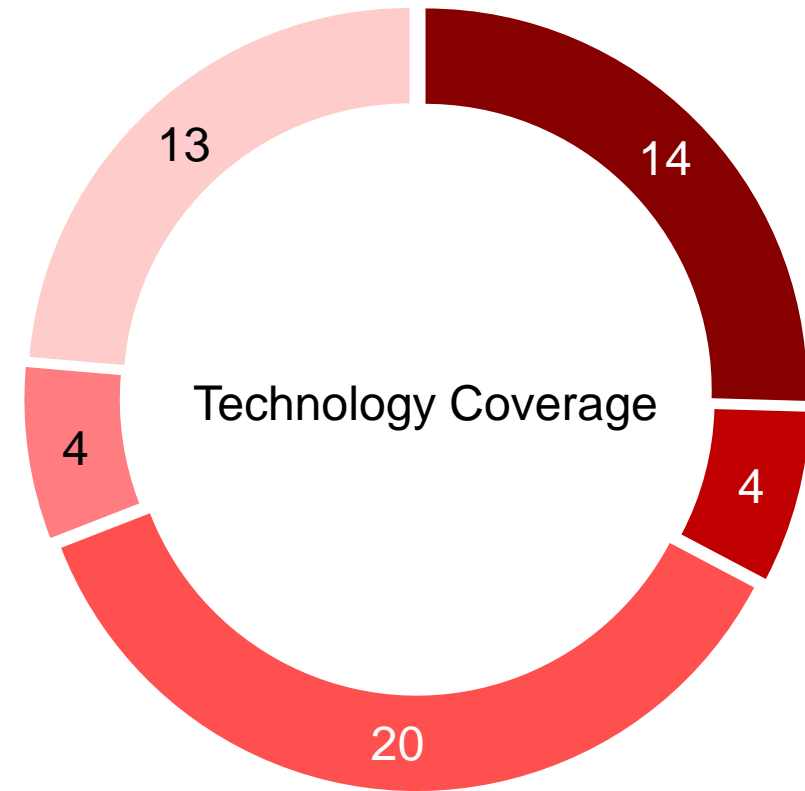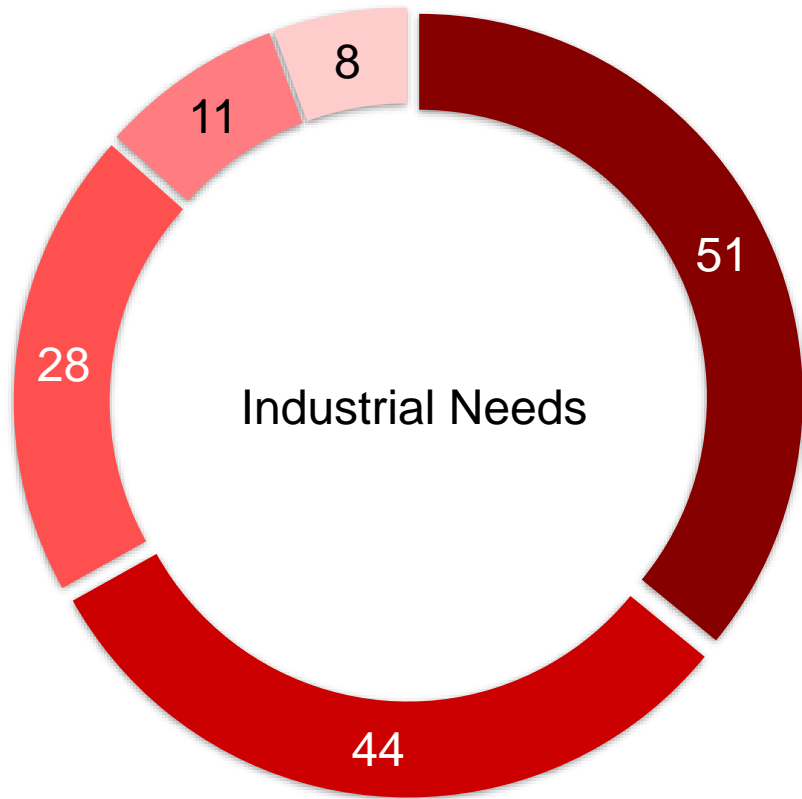Legend: ■ Extraction ■ Modelling ■ Integration ■ Co-Evolution ■ Verification

*Number of requirements covering each characteristic*

The REUSE Company (TRC)

◈ Specialized in the application of <mark>Semantic Analysis Technologies</mark> to a wide range of industries, such as Aerospace, Defense, Automotive, Railway or Energy

◈ Focus: System/Software <mark>Reuse, Traceability and Quality</mark>. Integration of tools and technology from <mark>The REUSE Company</mark> facilitates the representation, analysis and exploitation of knowledge and enables a knowledge-centric systems engineering approach

◈ Mission: promoting system/software and knowledge reuse within any organization, by offering processes, methods, tools and services. Technology fully integrated within the organization production chain

The Product Line Knowledge Base is formed by all types of Knowledge

Figure 1. Vehicle model structure.
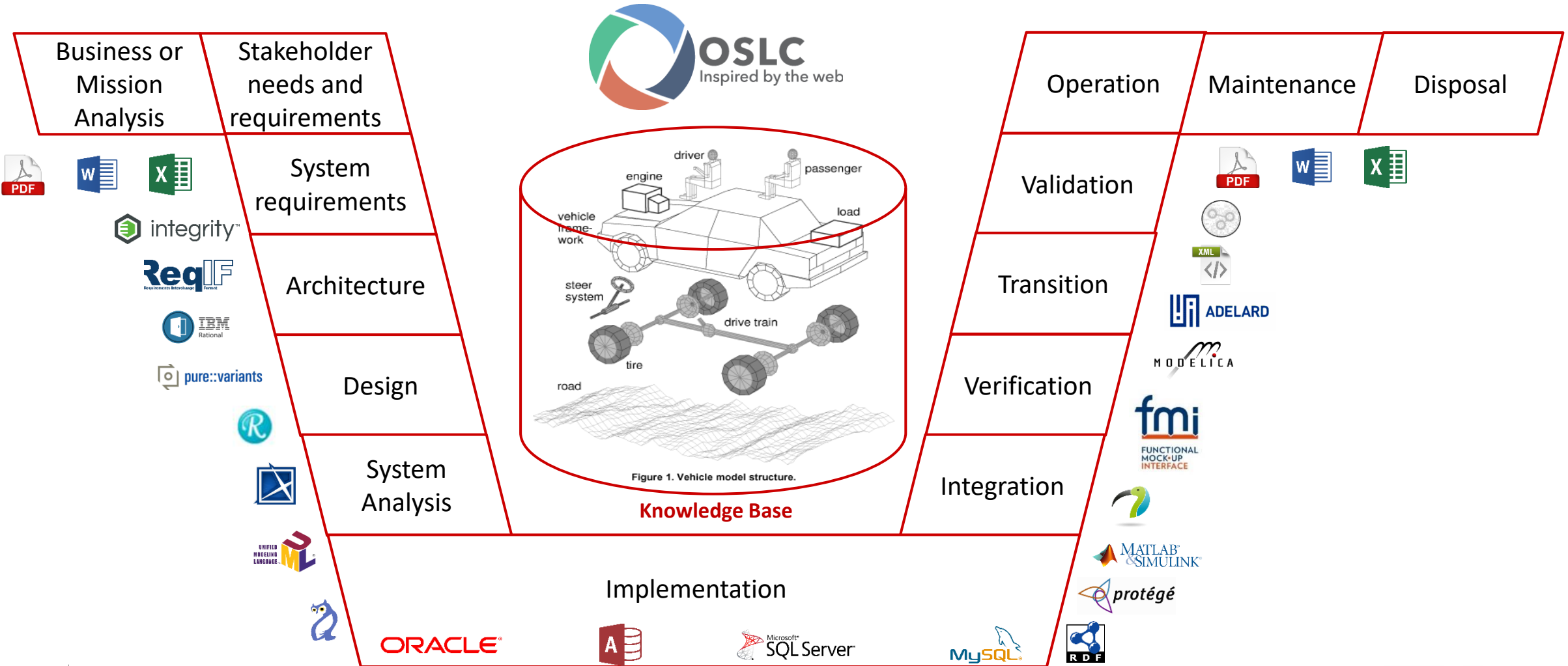
Knowledge Base

Knowledge-Based Engineering Objectives

- ◈ Extraction of requirements from the product-line assets
  - ◆ Automatic allocation of assets from the solution space to requirements document

- ◈ Identification of the variant features in the requirements
  - ◆ Patterns and Thesaurus to cover commonality and variability

- ◈ Coverage of the specific system features
  - ◆ Knowledge interfaces with Product Lifecycle Management software tools

"

The goal of this process is to automatically generate the right set of patterns to formalize the features of the products, and the different semantics and values from the natural language, into SRL to later use their corresponding formalization and generate the variability model based on the captured features.

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A simple example of a pattern matching, and relationships generation

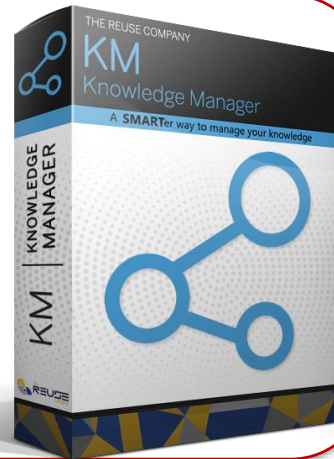When switched on, the Cab radio shall operate within a temperature range of -20°C to +70°C

When [TRIGGER] and [PRECONDITION], the [ACTOR] shall [ACTION] [OBJECT]
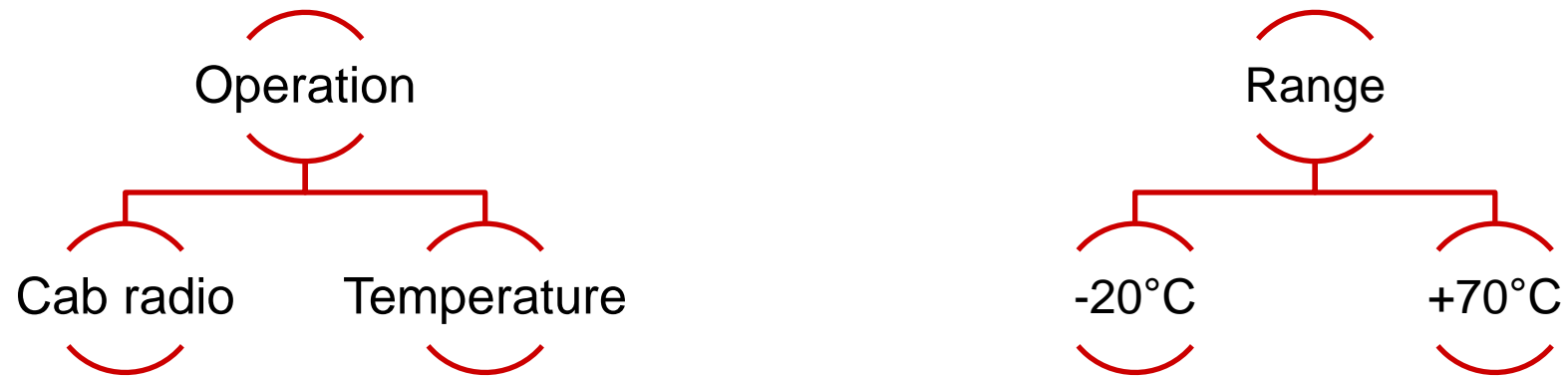
KM - Knowledge Management

Capture, creation, **representation**, and **exchange of knowledge** across targeted groups of **stakeholders**

Traceability

Support the **integration** among assets through semantic **interoperability** to ensure the **traces** between similar elements
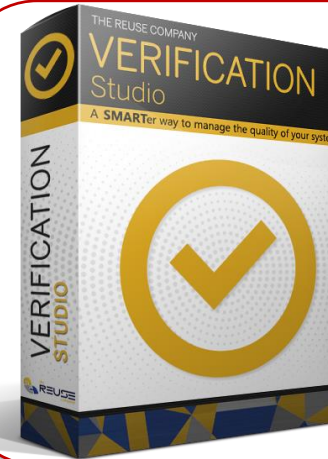
RAT - Requirements

Enhance Requirements **writing** engineering skills and ensure **CCC** based on the organizational **know-how**

RQA - Quality Management

Define, implement and perform **measures** to meet the **quality priorities** that satisfy the **verification** of any engineering element

CCC: Correctness, Completeness and Consistency

And all this to conclude…

Define the right round-trip strategy to optimize PLE

Knowledge Based Systems to solve complex problems

Knowledge Digitalization to improve the way we do engineering

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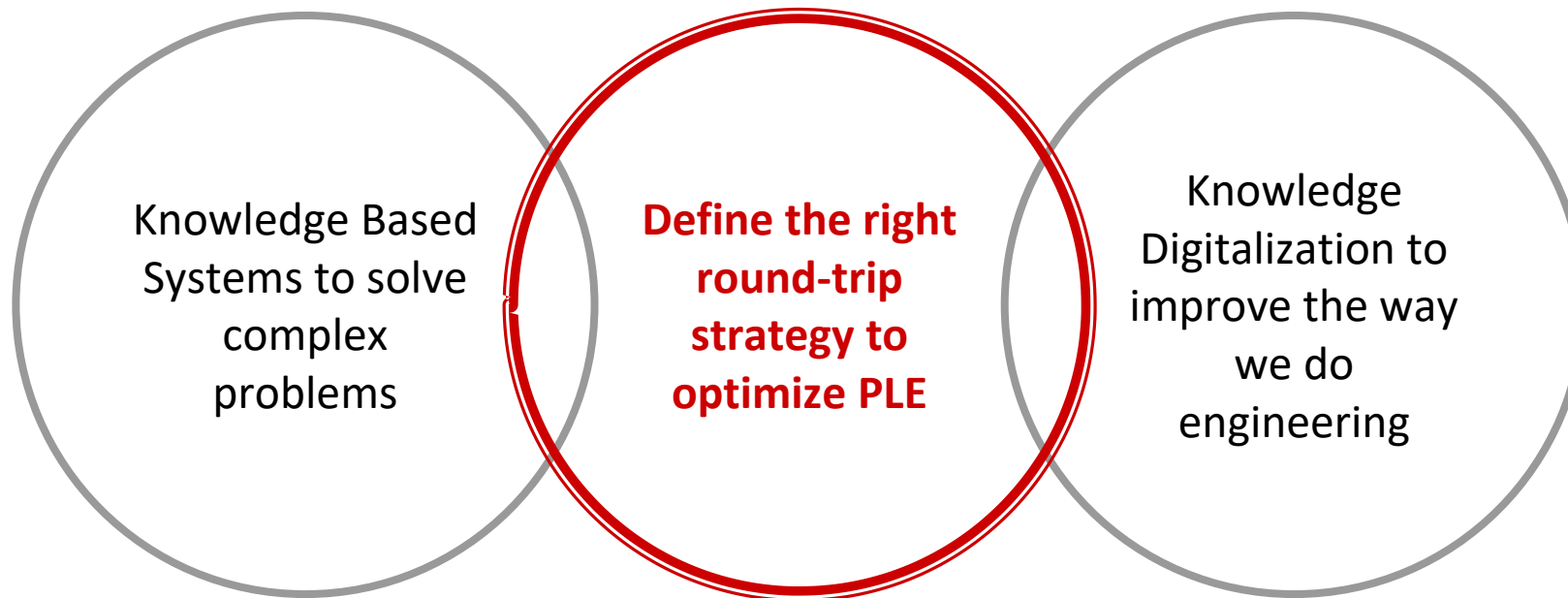
Thank you!

Any questions?

You can reach me at elena.gallego@reusecompany.com

How would you apply a REUSE strategy to fit into your environment?

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