Structure and design of Business Analysis and Requirements Engineering methods

Ivan Jureta
Senior Researcher, Fonds de la Recherche Scientifique - FNRS
Associate Professor, Louvain School of Management, Université de Namur
Belgium
ivan.jureta@fundp.ac.be

Overview

What is the purpose of Business Analysis and Requirements Engineering methods?

Who uses BA & RE methods?

What are the structure and components of BA & RE methods?

How do we design, evaluate, and validate BA & RE methods?

How do BA & RE methods relate to formal methods in SE?

How are BA & RE used in business?

About me

- Academia:
  - Senior researcher at Fonds de la Recherche Scientifique – FNRS, Brussels, Belgium
  - Associate professor – Dept. Management Science, University of Namur, Belgium

- Business:
  - Founding partner of JTT, a boutique consultancy

Previously:

- Université catholique de Louvain, London School of Economics, Université de Namur, Carnegie Mellon University, University of Toronto, University of Trento
- Product design for online services, in various startups (Europe)

Preamble

Since 2007, research in progress with:

-John Mylopoulos, University of Trento
-Alexander Borgida, Rutgers University
-Neil Ernst, Software Engineering Institute, Carnegie Mellon University

Academic use of results:

-Lucretius project team, University of Trento (5-year ERC grant)
-University of Trento, Dept Info. Eng. and Comp. Sci.
-Université de Namur, Comp. Sci. Dept. & Management Sci. Dept.
-University of Toronto, Comp. Sci. Dept.

Business use of results:

-ADMA (Advice and Decision-Making Automation) spin-off
-JTT, a boutique consultancy
-Two technology start-ups in Europe (Denmark and Italy)

What is the purpose of Business Analysis and Requirements Engineering methods?

What is a method?

A way of doing something, especially a systematic way; implies an orderly logical arrangement (usually in steps).

Source: WordNet.

What is the purpose of Business Analysis and Requirements Engineering methods?

What is Business Analysis?

Business analysis is the discipline of identifying business needs and determining solutions to business problems.

Solutions often include a systems development component, but may also consist of process improvement, organizational change or strategic planning and policy development.

The person who carries out this task is called a Business Analyst (BA).

Sources: Wikipedia.

What is the purpose of Business Analysis and Requirements Engineering methods?

What is Requirements Engineering?

Requirements engineering (RE) is a systems and software engineering process which covers all of the activities involved in discovering, documenting and maintaining a set of requirements for a computer-based system.

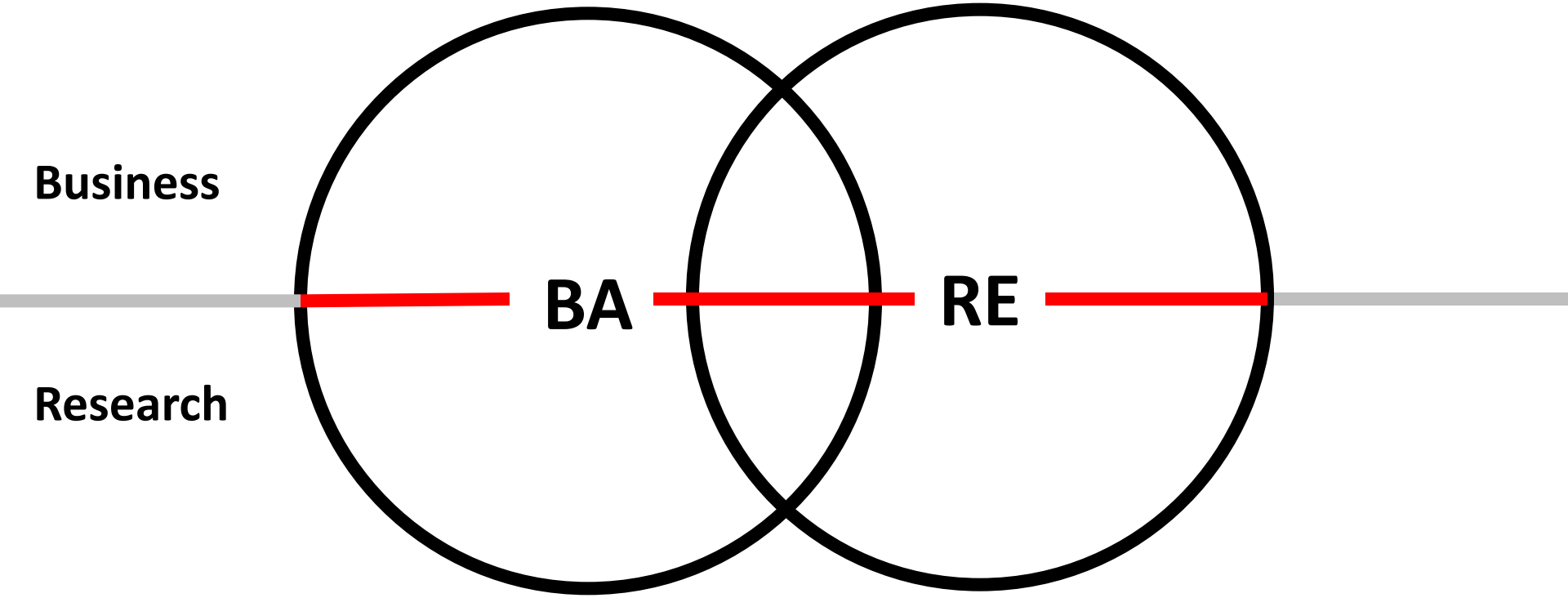
Source: Kotonya G. and Sommerville, I. Requirements Engineering: Processes and Techniques. Chichester, UK: John Wiley & Sons.

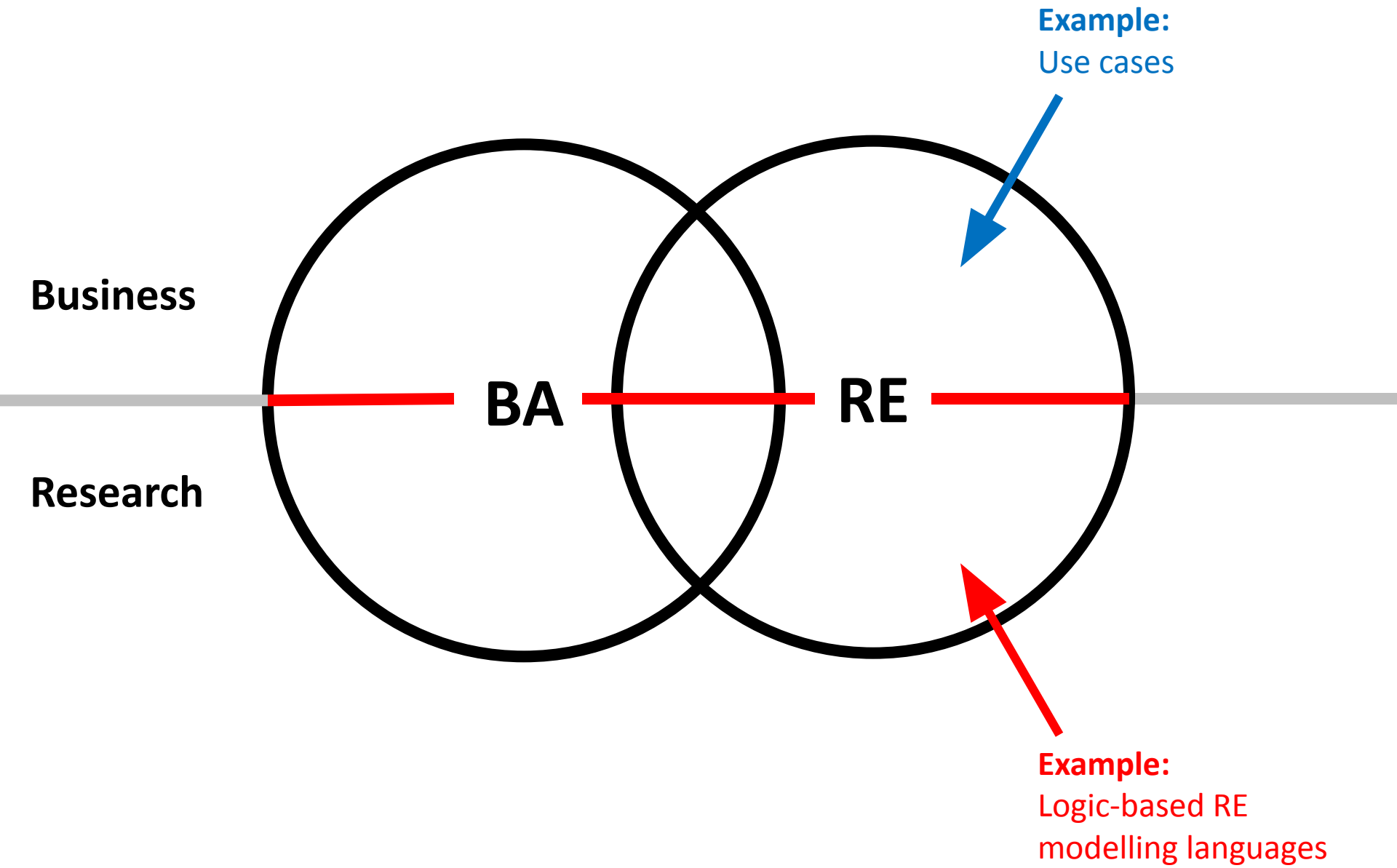
What is the purpose of Business Analysis and Requirements Engineering methods?

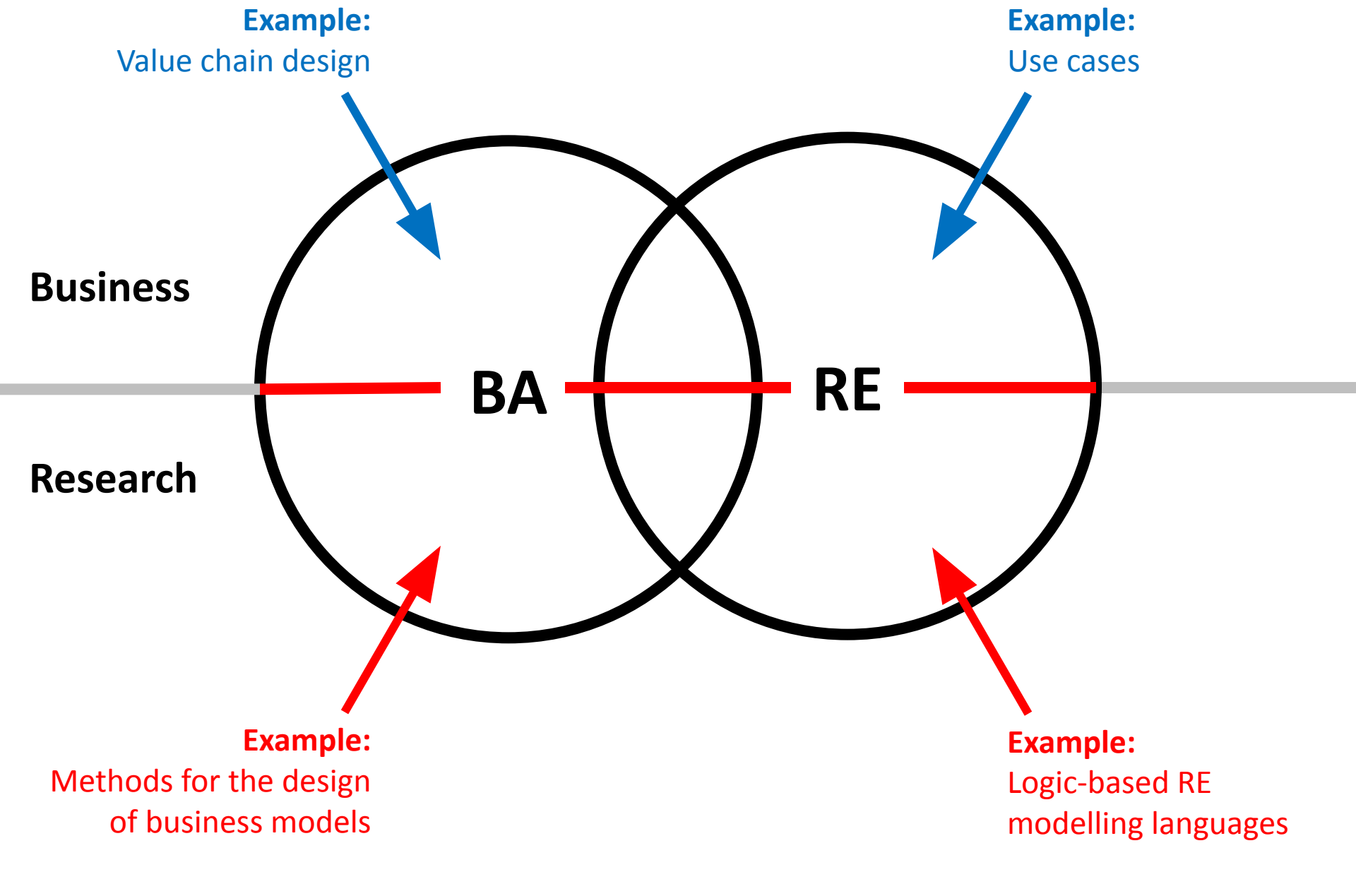
Why work on both BA and RE methods?

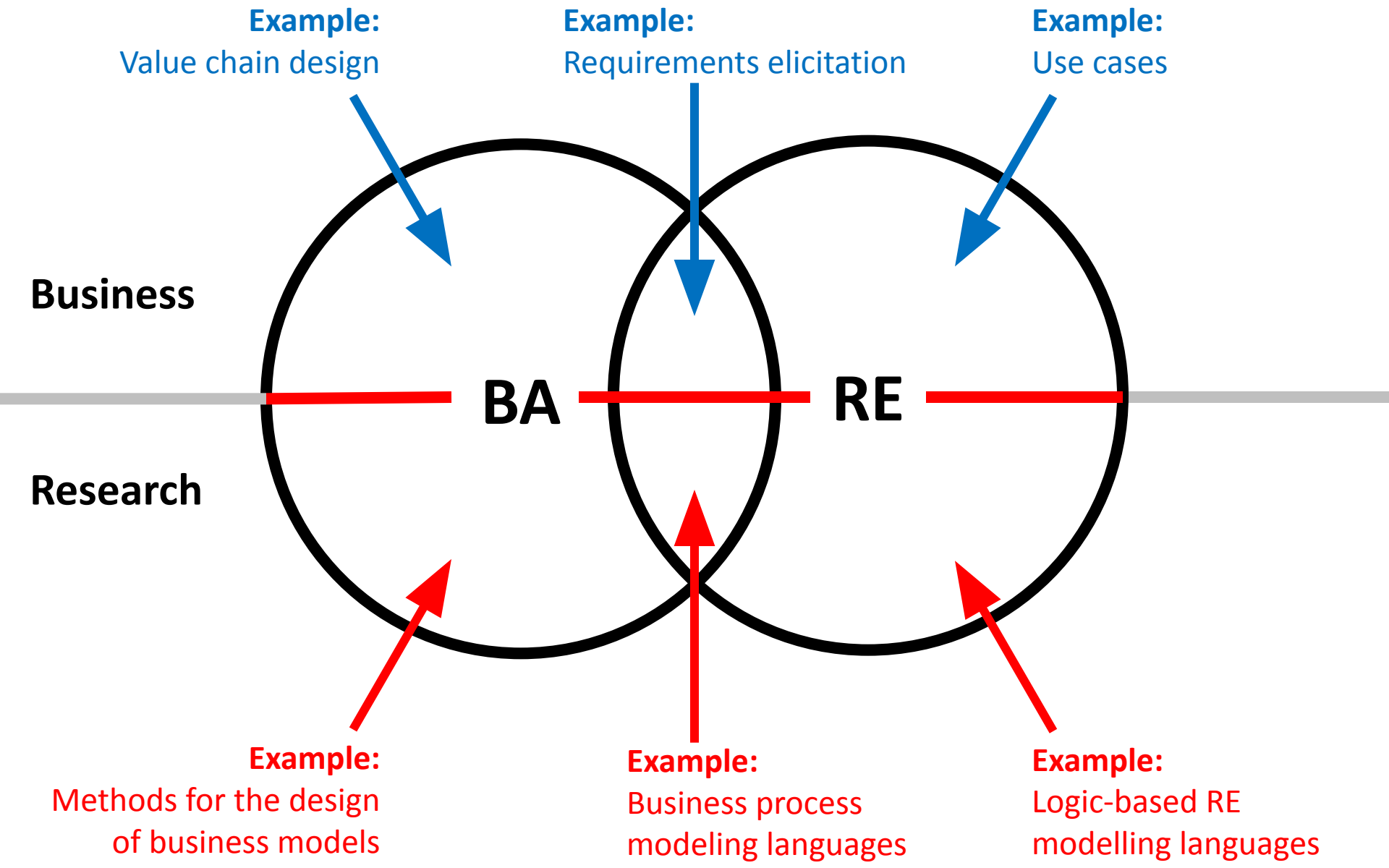
Both seek answers to same questions:

1. What are business problems?
2. What are business solutions?
3. How to **identify** a business problem?
4. How to **structure** the problem space?
5. How to **find** solutions?
6. How to **evaluate** solutions?
7. How to **choose** solutions?
8. How to **represent** problems and solutions? For whom?
9. How to **coordinate** people to work jointly on problems and solutions?


Business
BA
RE
Research


Example:
Use cases
Business
BA
RE
Research
Example:
Logic-based RE
modelling languages


Example:
Value chain design
Example:
Use cases
Business
BA
RE
Research
Example:
Methods for the design
of business models
Example:
Logic-based RE
modelling languages


Example:
Value chain design
Example:
Requirements elicitation
Example:
Use cases
Business
BA
RE
Research
Example:
Methods for the design of business models
Example:
Business process modeling languages
Example:
Logic-based RE modelling languages

Who uses BA & RE methods?

Responsibilities of a Business Analyst, according to HP:

-Identify and understand the **business problem** and the impact of the proposed **solution** on the **organization's operations;**

-Document **project scope, objectives, added value or benefit expectations**, using an integrated set of analysis and modeling techniques;

-Translate business objectives into system requirements using powerful analysis and modeling tools;

-Evaluate customer business needs, thus contributing to strategic planning of information systems and technology directions;

-Assist in determining the **strategic direction** of the organization;

-Liaise with major **customers** during **preliminary** installation and testing of new products and services;

-Design and develop high quality business solutions.

Source: Hewlett-Packard. The business analyst: The pivotal IT role of the future. 2007.

Who uses BA & RE methods?

Example of a recurrent problem in a company
Inefficient process of acquiring a new Client, at a software engineering company.

Rough process steps:

1. Preliminary Client meetings;
2. Allocation of resources to the Client (before a contract is signed);
3. Project aims and scope clarification with Client;
4. Preliminary technical proposal drafted;
5. Client confirms preliminary proposal;
6. Company board decides go/no-go;
7. Allocation of resources to prepare final proposal to Client;
8. Requirements specification;
9. Project plan definition;
10. Financial proposal definition;
11. Proposal submitted.

Process involves 5+ positions, 8+ people, 2-3 months, 10+ meetings, 100s of pages of documentation. **What can a Business Analyst do about this?**

Who uses BA & RE methods?

Observe that a Business Analyst's responsibilities are broad, since almost any problem a business faces can be called a business problem.

Hence the question: Are there universal BA & RE methods that a Business Analyst could learn and apply?

No, because of the variety of business problems.

Consequently, it is useful to think of a Business Analyst not as a position, but as a role to take when there is need to:

-Design rules, processes, positions for solving problems in an organization (or group of organizations);

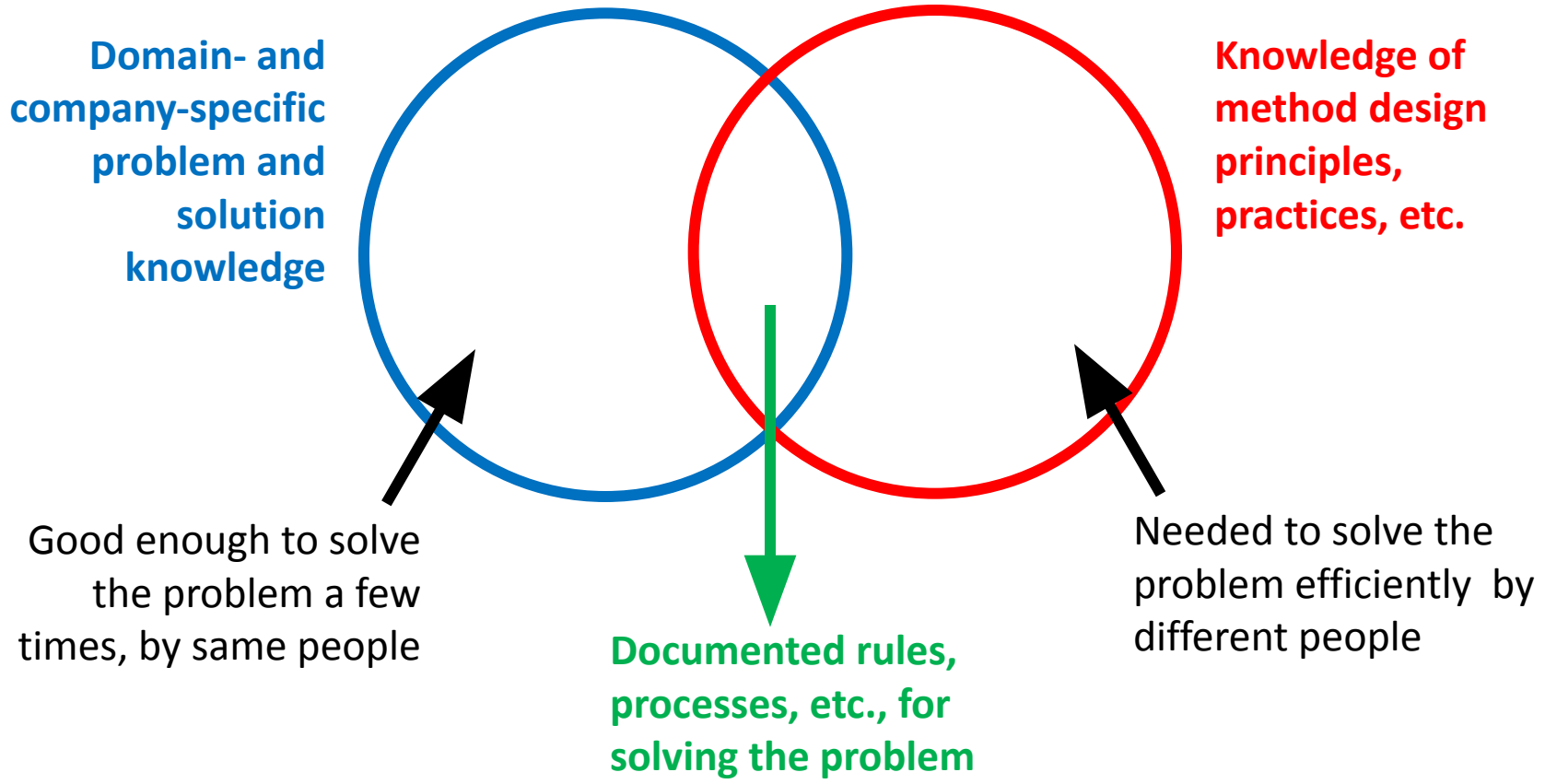
-Diagnose problems in the organization;

-Document how to solve some recurring problem in the organization;

-Improve some existing way of solving a problem in the organization.

Who uses BA & RE methods?

Design of domain- and company-specific BA & RE methods requires at least two kinds of knowledge:



What are the structure and components of BA & RE methods?

To identify knowledge on how to make methods in RE and BA, we went back to understand what counts as a method in RE.

Zave & Jackson

"Four dark corners of requirements engineering"

ACM TOSEM 6(1), 1997

Synthetic requirements problem statement:

Given R and K, find S such that $\mathbf{K}, \mathbf{S} \vdash \mathbf{R}$

Conveys the following key ideas:

1. **Types** There are R, K and S formulas
2. **Consistency** If R is consistent, K and S must be consistent
3. **Achievement** Deduce every R formula from K and S

What are the structure and components of BA & RE methods?

Ingredients:

1. Three types
    1. R: Requirements (what is desired)
    2. K: Domain assumptions (what is true)
    3. S: Specification (what to do)
2. A logic

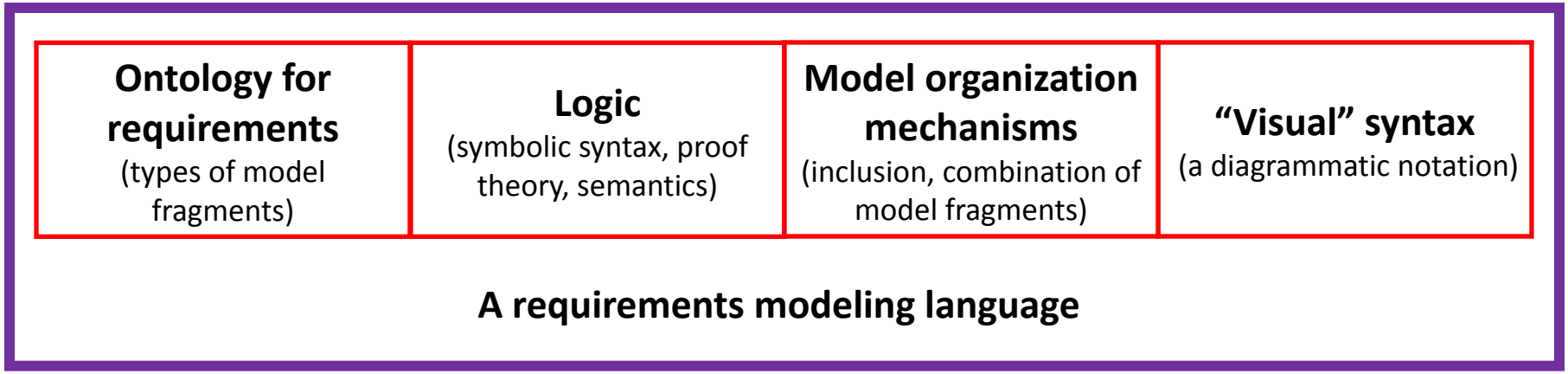
Rough steps to make a formalism for representation and reasoning in Requirements Engineering (RE)

1. Choose types
2. Choose a logic
3. Write methodology on how to convert natural language requirements statements into typed formulas, and what to do with them

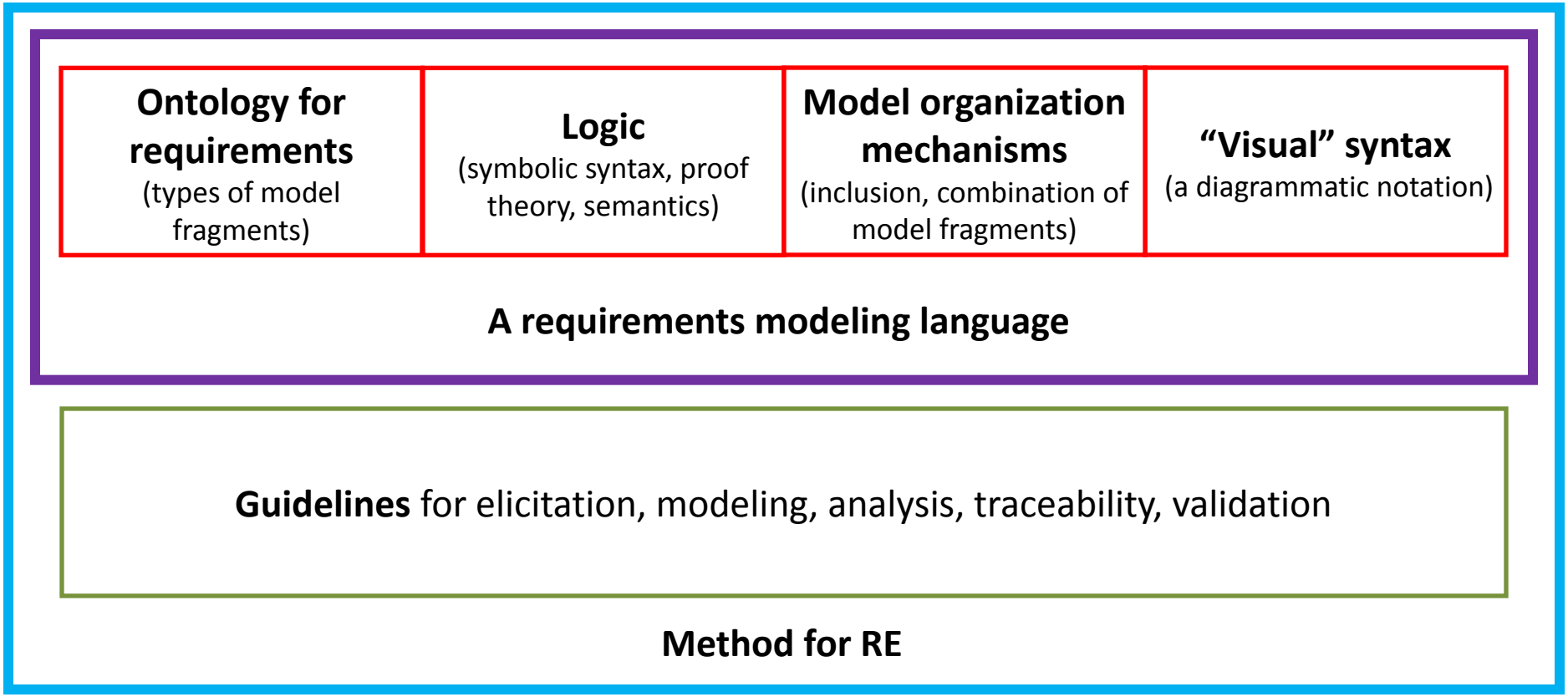
What are the structure and components of BA & RE methods?

Ontology for requirements (types of model fragments)	**Logic** (symbolic syntax, proof theory, semantics)	**Model organization mechanisms** (inclusion, combination of model fragments)	**“Visual” syntax** (a diagrammatic notation)

What are the structure and components of BA & RE methods?



What are the structure and components of BA & RE methods?



What are the structure and components of BA & RE methods?

Examples:

- **“Original” RML**

  Greenspan, Borgida, Mylopoulos. *Info. Sys.*, 11(1), 1986.

- **ERAE**

  Dubois, Hagelstein, Rifaut. *Philips J. of Res.*, 43(3-4), 1988.

- **KAOS**

  Dardenne, van Lamsweerde, Fickas. *Sci. Comp. Prog.*, 20(1-2), 1993.

- **i-star**

  Yu, Mylopoulos. *ICSE*, 1994.

- **Tropos**

  Castro, Kolp, Mylopoulos. *Info. Sys.*, 27(6), 2002.

- **Formal Tropos**

  Fuxman, Liu, Mylopoulos, Roveri, Traverso. *Req. Eng.*, 9(2), 2004.

What are the structure and components of BA & RE methods?

Quick overview: Components of **i-star**

Ontology for requirements (Eric Yu's PhD thesis)	**Logic** (no formal logic)	**Model organization mechanisms** (actor boundaries)	**"Visual" syntax** (i-star diagrams)

A requirements modeling language

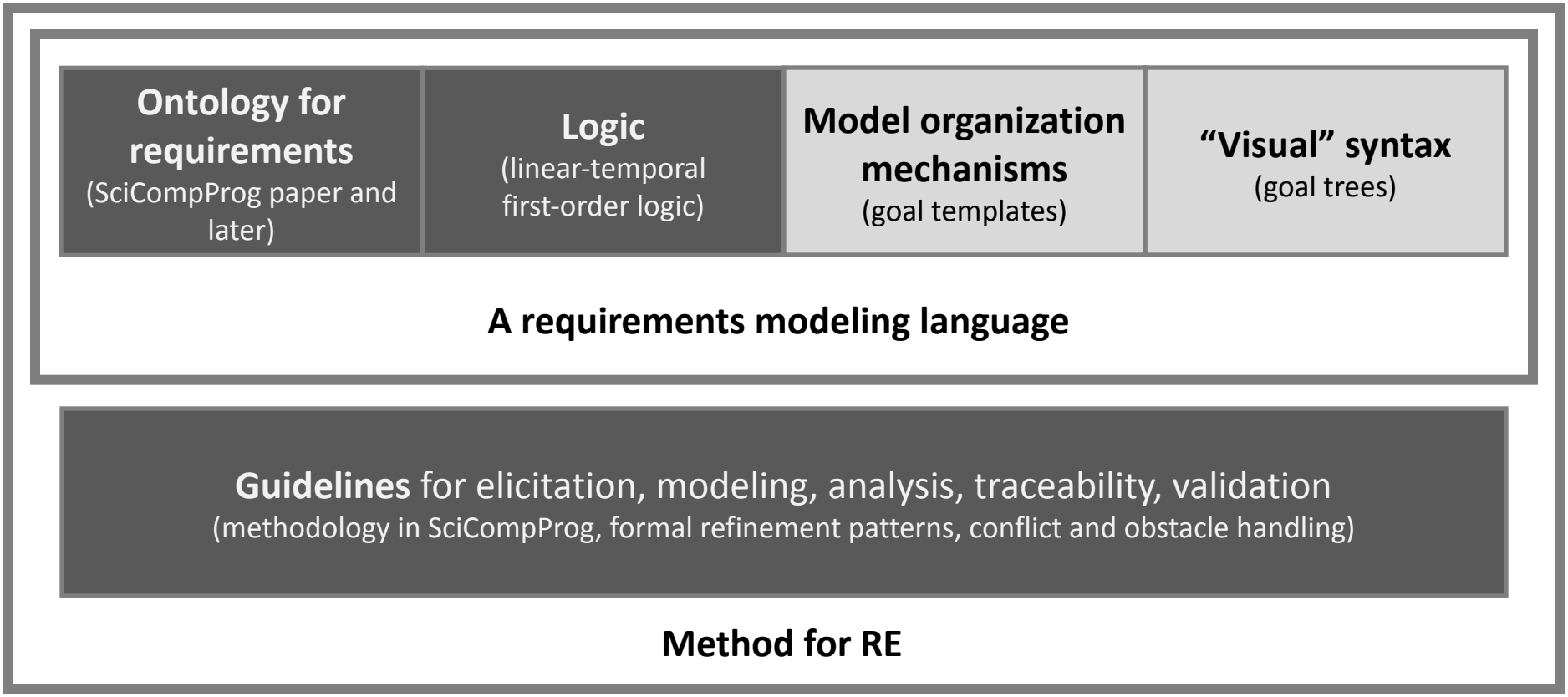
Guidelines for elicitation, modeling, analysis, traceability, validation
(many papers that followed Yu & Mylopoulos' initial work)

Method for RE

Color intensity: the darker the color, the more the formalism seems to be advanced in the colored component

What are the structure and components of BA & RE methods?

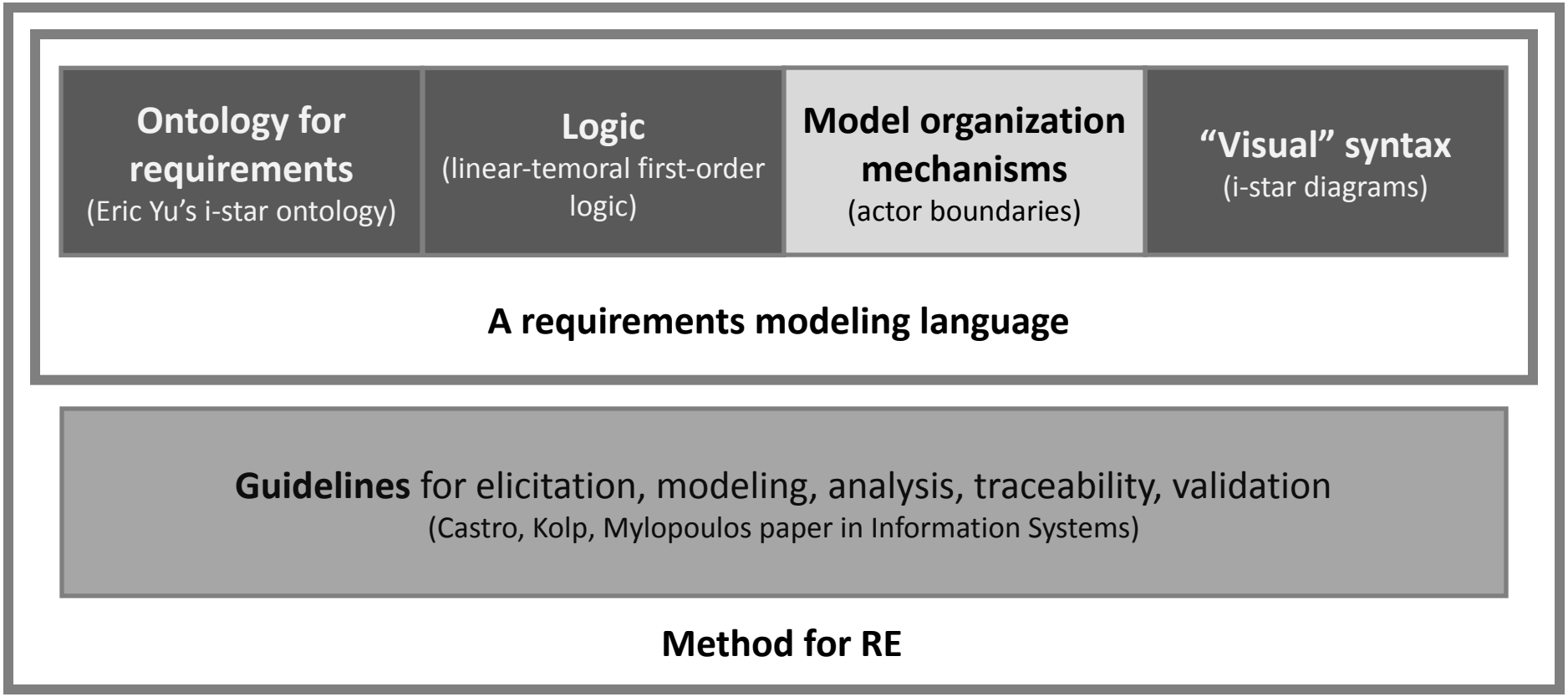
Quick overview: Components of **KAOS**



Color intensity: the darker the color, the more the formalism seems to be advanced in the colored component

What are the structure and components of BA & RE methods?

Quick overview: Components of **Formal Tropos**



Color intensity: the darker the color, the more the formalism seems to be advanced in the colored component

What are the structure and components of BA & RE methods?

In our research, we adopted an integrated structure:

Guidelines for elicitation, modeling, analysis, traceability, validation

Ontology for requirements (types of model fragments)	**Logic** (symbolic syntax, proof theory, semantics)	**Model organization mechanisms** (inclusion, combination of model fragments)	**"Visual" syntax** (a diagrammatic notation)

Rather than:

Ontology for requirements (types of model fragments)	**Logic** (symbolic syntax, proof theory, semantics)	**Model organization mechanisms** (inclusion, combination of model fragments)	**"Visual" syntax** (a diagrammatic notation)
Guidelines for elicitation, modeling, analysis, traceability, validation			

What are the structure and components of BA & RE methods?

And we asked the following questions:

1. Is there always one requirments problem statement?
2. Is there always one solution to a problem statement?
3. If not, does the statement say anything about the comparison of solutions?
4. Does the statement say anything about the quality of a solution?
5. Where are requirements which can only be partially satisfied?
6. Do we have to satisfy all requirements in R and maintain all domain assumptions in K?
7. If not, how do we choose which R and K to drop, and which to keep?
8. Is R always consistent?
9. Are K and S always consistent?
10. If not, what does the problem statement say when K, S, or R are inconsistent?

What are the structure and components of BA & RE methods?

This led us to a different statement of the requirements problem, that the method should help us solve:

Given the elicited
- domain assumptions
- goals
- quality constraints
- softgoals
- tasks

Find
- **tasks & domain assumptions** which
  - **satisfy all mandatory goals and quality constraints**, *and if feasible,* satisfy many preferred requirements and many optional requirements.

What are the structure and components of BA & RE methods?

This led to the original Techne.

Our goal was to make the simplest RML which would:

1. Include all types of formulas from the restated requirements problem
2. Allow the definition of the restated problem and solution concepts

Types in Techne:

-g: Goal

-s: Softgoal

-q: Quality constraint

-t: Task

-k: Domain assumption

- **Refinement** formulas
- **Operationalization** formulas
- **Conflict** formulas

Syntax:

$$
\begin{aligned}
pl ::= \quad & \mathbf{k}(p) \mid \mathbf{g}(p) \mid \mathbf{q}(p) \mid \mathbf{s}(p) \mid \mathbf{t}(p) \\
\phi ::= \quad & \bigwedge_{i=1}^{n} pl_i \rightarrow pl \mid \bigwedge_{i=1}^{n} pl_i \rightarrow \bot \\
sn ::= \quad & pl \mid \mathbf{k}(\phi)
\end{aligned}
$$

Consequence relation

Reflexive and paraconsistent **consequence relation** which lets the implication consequent through when antecedents can be deduced.

How do we design, evaluate, and validate BA & RE methods?

What should we teach, when we want to teach RE & BA method design?

Two complementary answers – teach:

1. Methods for RE and BA, including:
    1. Ontologies
    2. Representation and analysis formalisms
    3. Rules
2. How to make methods for RE and BA:
    1. Ontology engineering
    2. Formalism engineering
    3. Process engineering

How do we design, evaluate, and validate BA & RE methods?

What should we teach, when we want to teach RE & BA method design?

Two complementary answers – teach:

1. Methods for RE and BA, including:
    1. Ontologies
    2. Representation and analysis formalisms
    3. Rules

Reasons for this should be obvious.

2. How to make methods for RE and BA:
    1. Ontology engineering
    2. Formalism engineering
    3. Process engineering

How do we design, evaluate, and validate BA & RE methods?

What should we teach, when we want to teach RE & BA method design?

Two complementary answers – teach:

1. Methods for RE and BA, including:
    1. Ontologies
    2. Representation and analysis formalisms
    3. Rules
2. How to make methods for RE and BA:
    1. Ontology engineering
    2. Formalism design
    3. Process engineering

Some reasons for this:

1. **Concrete methods may be too general;**
2. **Organizations need local methods;**
3. **Method design excellence is in rules for method design, not concrete methods.**

How do we design, evaluate, and validate BA & RE methods?

How do we evaluate and validate BA & RE methods?

I have no general answer.

My approach is:

1. Design BA & RE methods for use in companies;
2. Observe BA & RE method use in companies;
3. Collect qualitative data, to see what worked (or not) and why.

This required:

- Making a consultancy;
- Making a spinoff;
- Getting involved in startups.

How do BA & RE methods relate to formal methods in SE?

Differences from formal methods (Z, VDM, Larch, temporal logic, etc.):

-Ontology, logic, and guidelines in a formal method are not specific to either RE or BA;

-Formal methods are for the specification of system designs, not for the representation and analysis of the requirements problem and alternative solutions to it.

How are BA & RE methods used in business?

Again, I have no general answer.

My own experience comes from a limited number of SMEs and startups only.

1. After being given examples, such companies see the value in having custom BA & RE methods;

2. After being given examples, such companies are willing to pay to document their internal rules, processes, etc. as their own internal methods;

3. One startup uses BA & RE methods to elicit and document expert knowledge, automate it in proprietary software, expose it via APIs, and sell access to APIs.

Thank you :-)

Thank you :-)