Guidelines for the Specification and Design of Large-Scale Semantic Applications

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How can I **specify** the **semantic** functionalities of my **application**?

How can I carry out the **development process** of my **semantic application**?
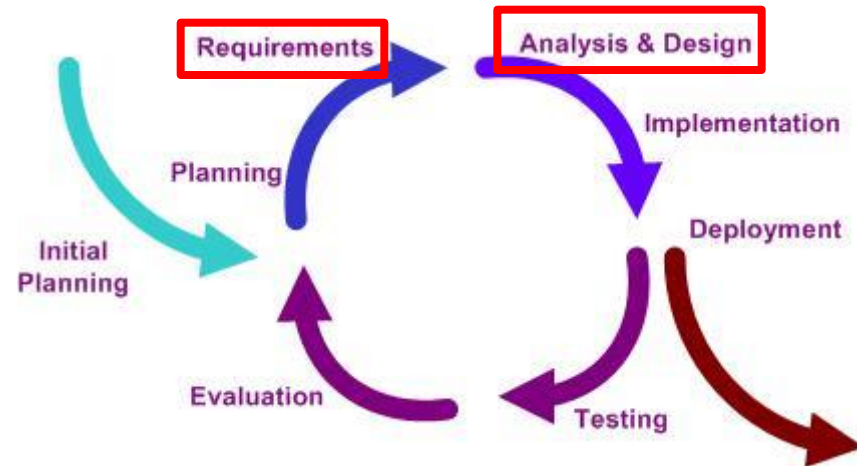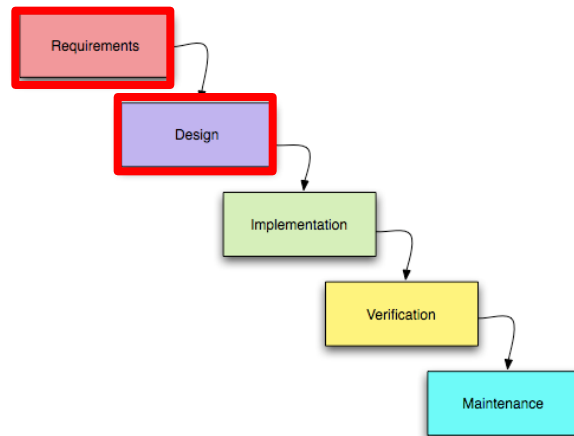
Non-expert Software Engineer

Semantic applications require different software development techniques.
- They manipulate huge quantities of heterogeneous decentralized information.
- They integrate semantic and non-semantic data.
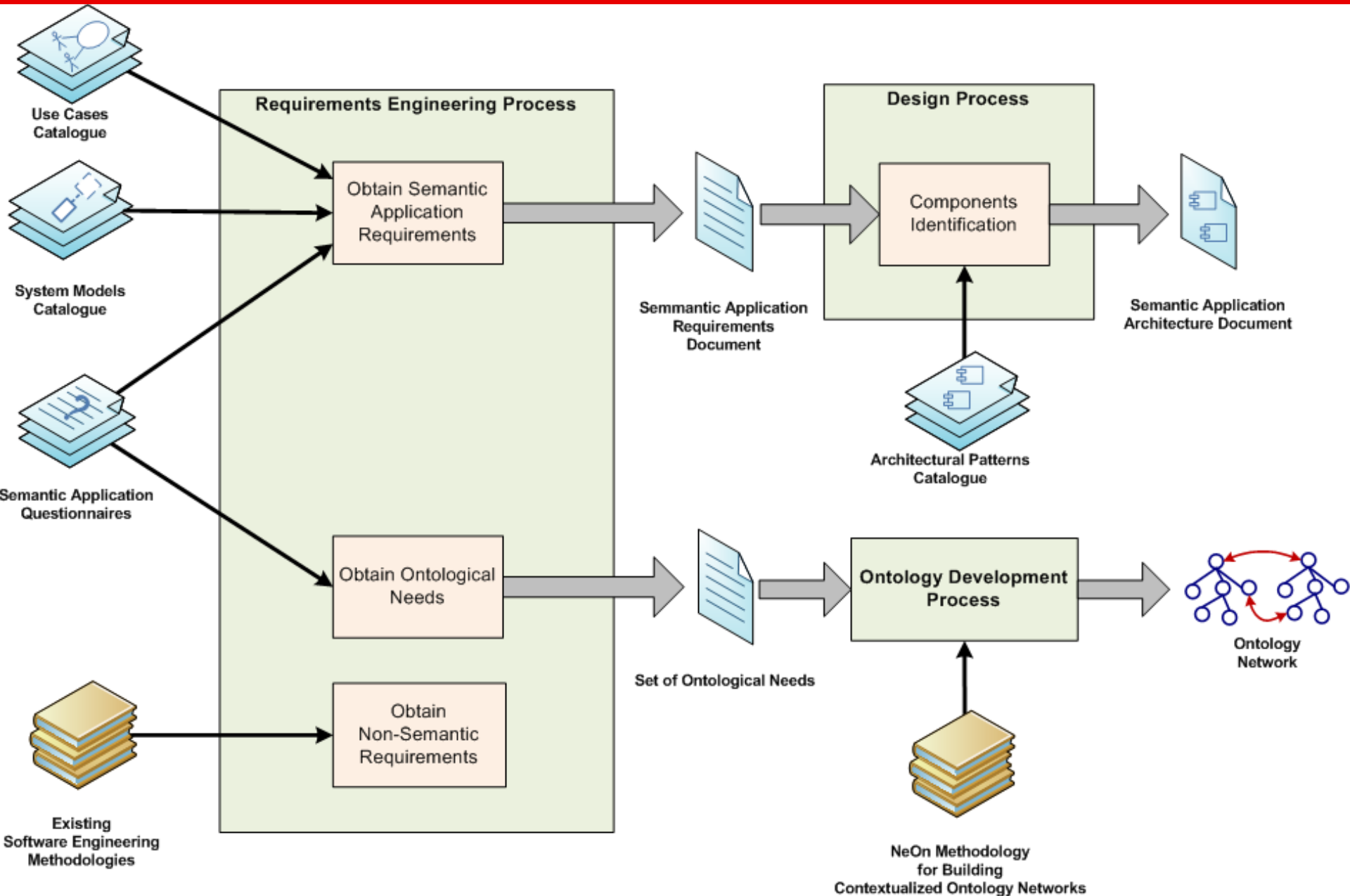- They explore different sources at run-time.

Need **guidelines** that can be easily adapted and **integrated** in the software **development process**
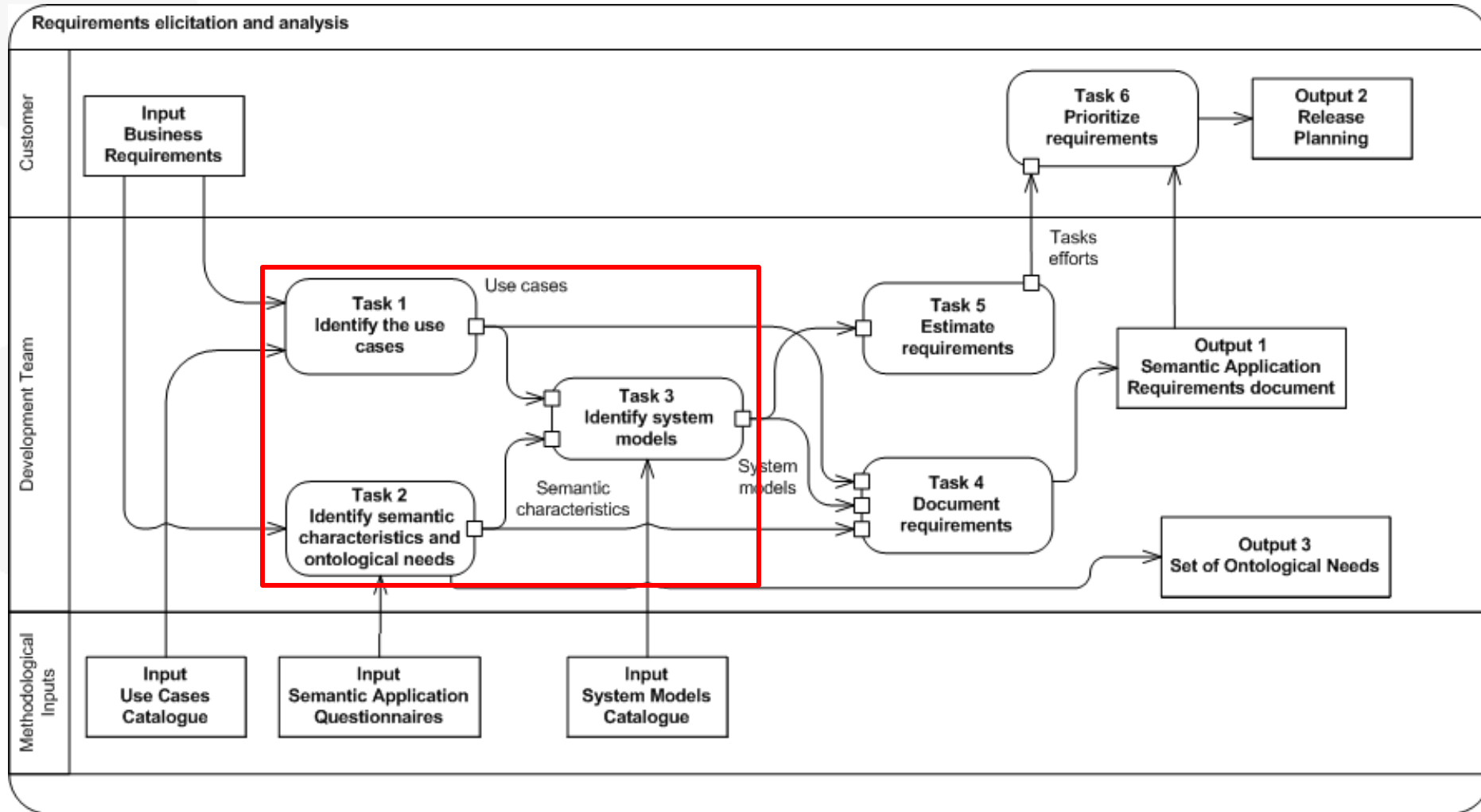
1st stage: **Requirements Engineering** of Semantic Applications
2st stage: **Design** of Semantic Applications

Use Cases Catalogue

System Models Catalogue

Semantic Application Questionnaires

Existing Software Engineering Methodologies

Requirements Engineering Process

Obtain Semantic Application Requirements

Obtain Ontological Needs

Obtain Non-Semantic Requirements

Semmantic Application Requirements Document

Set of Ontological Needs

Design Process

Components Identification

Architectural Patterns Catalogue

Semantic Application Architecture Document

Ontology Development Process

Ontology Network

NeOn Methodology for Building Contextualized Ontology Networks

Objective

To gather information about the application from the business requirements and to distil scenarios from this information

Technique

To select and adapt semantic-related scenarios from a catalogue of 5 use cases

Use Cases Catalogue

- Query Information

  To obtain integrated information from several resources given a query

- Search Resources

  To obtain resources (annotated with the corresponding metadata) related to a given query

- Browse Resources

  To navigate through categorised resources utilizing ontologies as indexes

- Extract Information

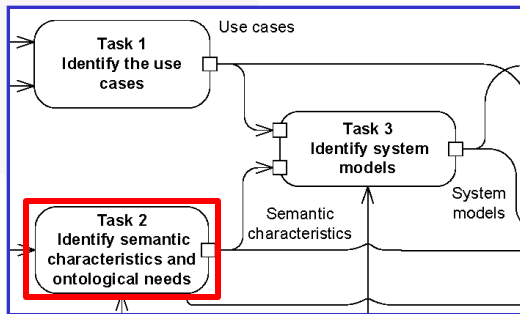 To extract meaningful information from a set of resources obtaining after performing a search

- Manage Knowledge

  To collaboratively construct and evolve shared knowledge by

  - Managing classes, properties, instances, mappings, annotations...
  - Learning or populating an ontology, ...

Use cases

Task 1
Identify the use cases

Task 3
Identify system models
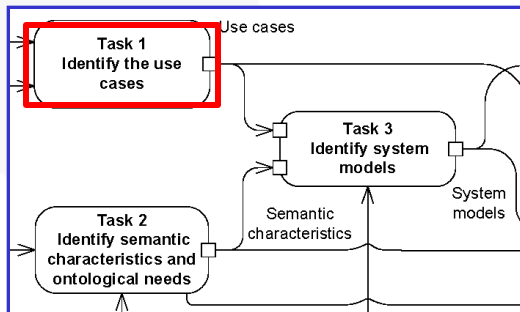
Task 2
Identify semantic characteristics and ontological needs

Semantic characteristics

System models

Objective

To collect semantic application requirements and ontological needs

Technique

To apply 4 questionnaires oriented to obtain the values of 32 characteristics and ontological needs

Characteristics

Ontologies

(1) Use of a single ontology or a network of ontologies
(2) Design-time or run-time ontology selection
(3) Use of generic or domain-specific ontologies
(4) Generation of new ontologies
(5) Use of internal or external ontologies
(6) Ontologies reuse and reengineering
(7) Non-ontological resources reengineering
(8) Ontologies dynamicity
(9) Centralization or distribution of ontologies
(10) Scalabitlity regarding the number of ontologies
(11) Scalability regarding the number of ontology elements
(12) Ontologies encoding heterogeneity
(13) Ability to resolve conceptual heterogeneity in ontologies

Data

(14) Data domain dependence
(15) Data Generation
(16) Use of internal or external data sources
(17) Use of linked data
(18) Data distribution
(19) Data dynamicity
(20) Design-time or run-time data selection
(21) Data scalability
(22) Use of non-semantic data
(23) Data encoding heterogeneity

Reasoning

(24) Kind of semantic reasoning
(25) Sound reasoning
(26) Complete reasoning
(27) Hybrid reasoning
(28) Reasoning with contradictory data
(29) Reasoning with incomplete data
(30) Reasoning with uncertainty
(31) Distributed reasoning

Non-functional

(32) Interoperability with other applications

Objective

To preliminary specify the application from

- An external perspective
  - Systems involved and their limits
- A structural perspective
  - By modelling the structure of the information processed

Technique

To build system model using a set of templates taking into account

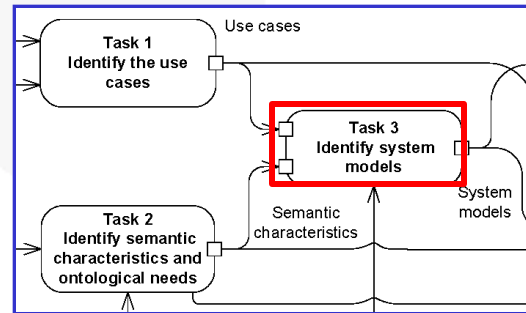- Identified use cases
- Application characteristics
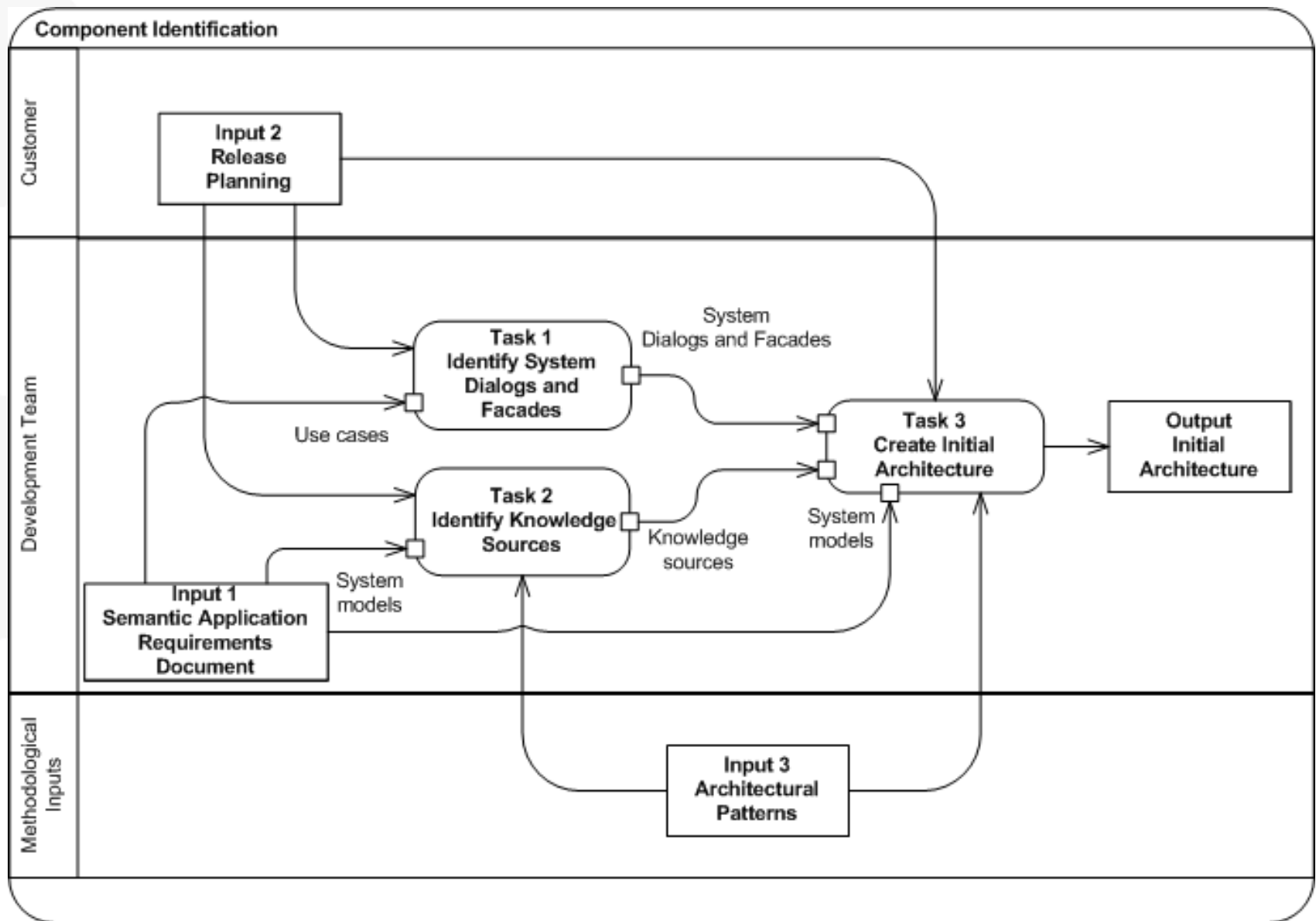
Basic Symbols

Relationships

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System Models Templates Catalogue
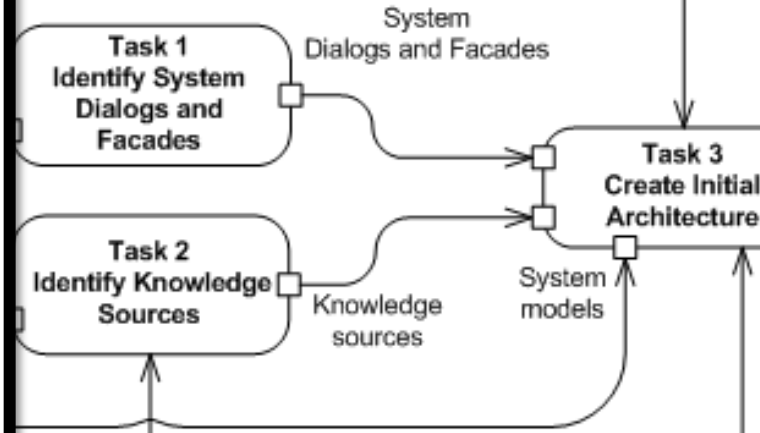
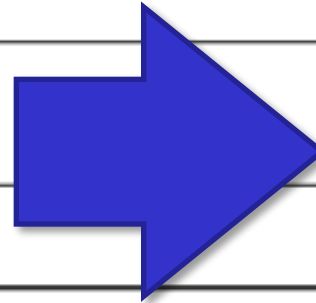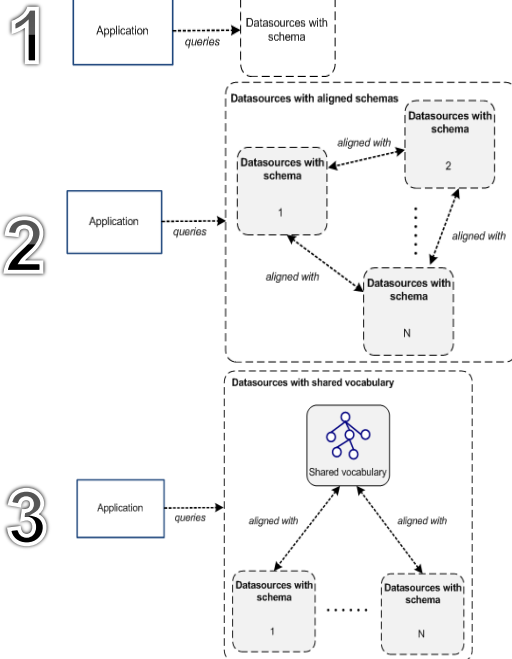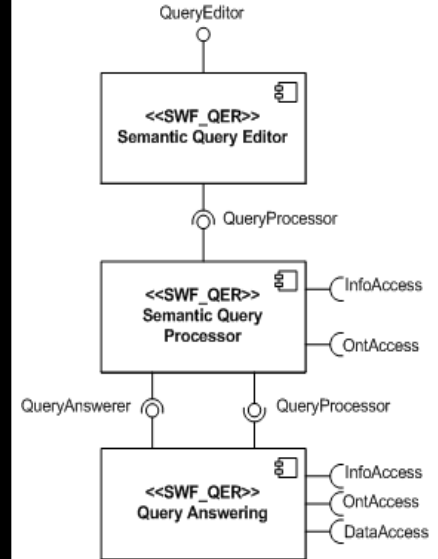- Includes 11 system models templates

Component Identification

System Model Templates

Pattern

Task 1
Identify System Dialogs and Facades

System Dialogs and Facades

Task 2
Identify Knowledge Sources

Knowledge sources

Task 3
Create Initial Architecture

System models

Objective

To draw the application architecture that form an idea of how the components might fit together

Technique

To draw the architecture by applying 28 architectural patterns associated to the previously identified System Models

- Our main goal is to facilitate the development of semantic applications for non-expert software engineers.

    - Adapting the Requirements Engineering and Design processes from SE.

    - Allowing to design the architecture of SA from scratch and to include semantic components into traditional information systems.

- The techniques described are novel and specially oriented to the specification and design of the semantic functionalities of an application.

- The semantic **characteristics** of an application will influence the whole development process.

- The **use cases** are useful to start analysing the application from concrete functional user needs.

- The **system models** are graphical representations of the macro-structure and environment of the application. We have provided **architectural patterns** that aim to facilitate the Architectural Design of the Semantic Application.

    - These architectural patterns are not bound to a particular implementation.