SE-210

Software System Requirements

II. Requirements Engineering Processes

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Objectives

- To introduce the notion of processes and process models for requirements engineering
- To explain the critical role of people in requirements engineering processes
- To explain why process improvements is important and to suggest a process improvement model for requirements engineering

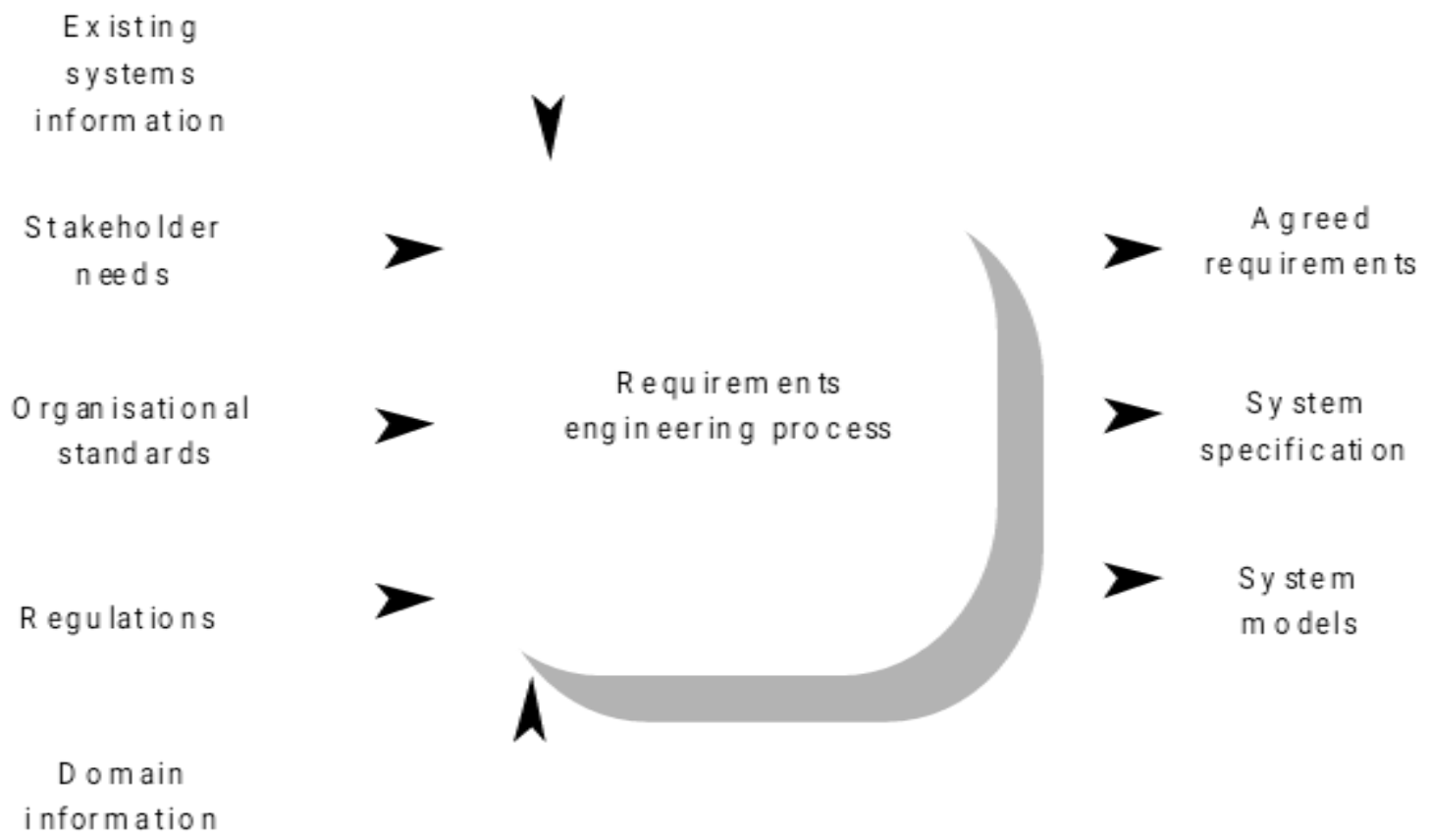
Processes

- A process is an organized set of activities which transforms inputs to outputs
- Process descriptions encapsulate knowledge and allow it to be reused
- Examples of process descriptions
  - Instruction manual for a dishwasher
  - Cookery book
  - Procedures manual for a bank
  - Quality manual for software development

Design processes

- Processes which involve creativity, interactions between a wide range of different people, engineering judgment and background knowledge and experience
- Examples of design processes
  - Writing a book
  - Organizing a conference
  - Designing a processor chip
  - Requirements engineering

RE process - inputs and outputs



Input/output description

Input or output	Type	Description
Existing system information	Input	Information about the functionality of systems to be replaced or other systems which interact with the system being specified
Stakeholder needs	Input	Descriptions of what system stakeholders need from the system to support their work
Organisational standards	Input	Standards used in an organisation regarding system development practice, quality management, etc.
Regulations	Input	External regulations such as health and safety regulations which apply to the system.
Domain information	Input	General information about the application domain of the system
Agreed requirements	Output	A description of the system requirements which is understandable by stakeholders and which has been agreed by them
System specification	Output	This is a more detailed specification of the system functionality which may be produced in some cases
System models	Output	A set of models such as a data-flow model. an object model, a process model, etc. which describes the system from different perspectives

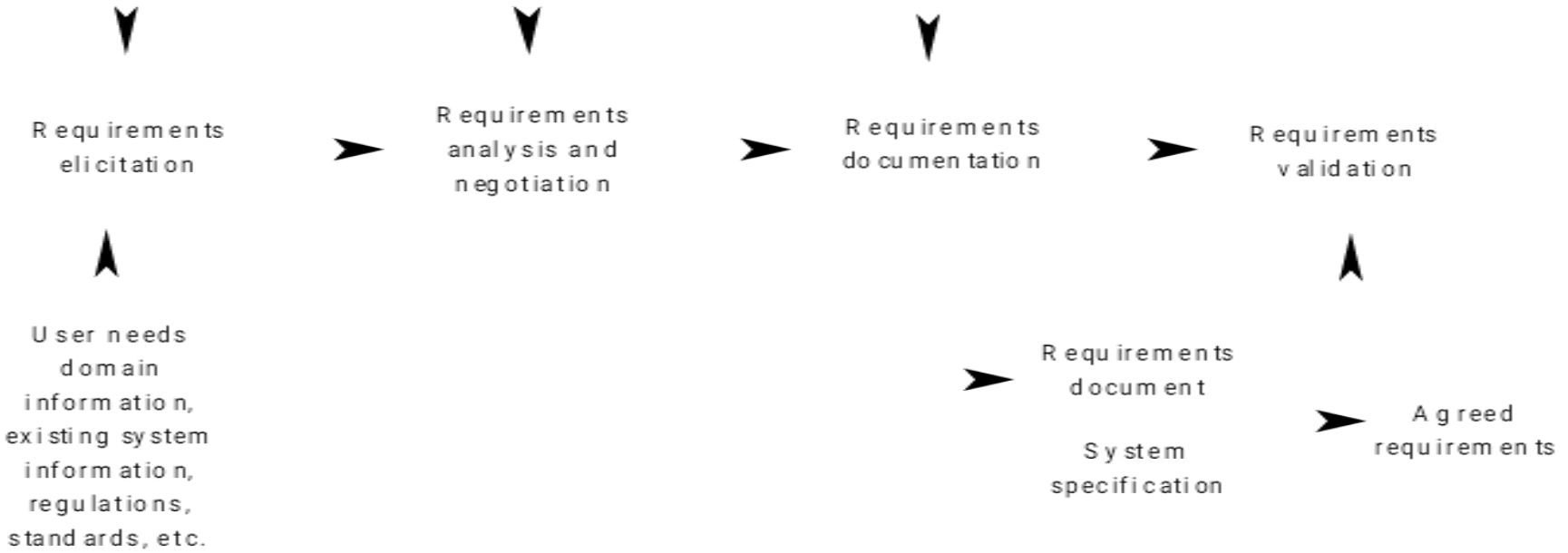
RE process variability

- RE processes vary radically from one organization to another
- Factors contributing to this variability include
  - Technical maturity
  - Disciplinary involvement
  - Organizational culture
  - Application domain
- There is therefore no ‘ideal’ requirements engineering process

Process models

- A process model is a simplified description of a process presented from a particular perspective
- Types of process model include:
  - Coarse-grain activity models
  - Fine-grain activity models
  - Role-action models
  - Entity-relation models

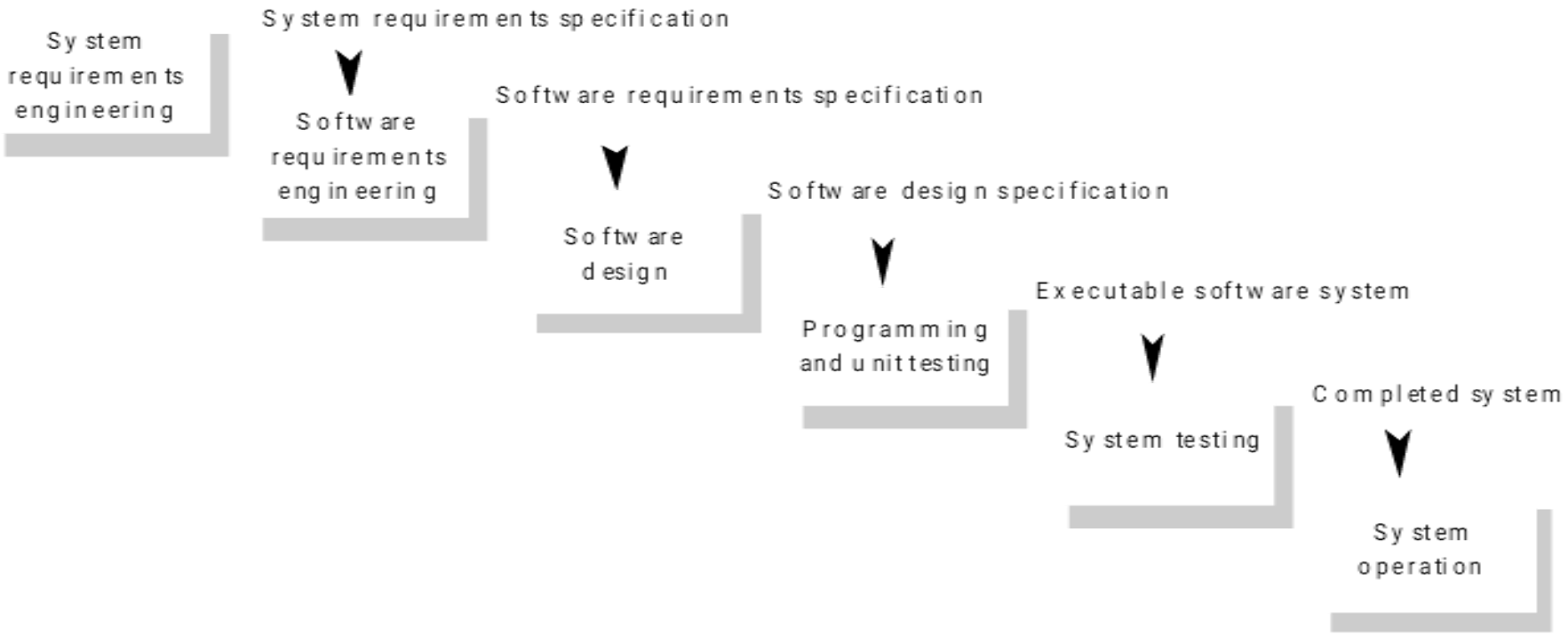
Coarse-grain activity model of RE



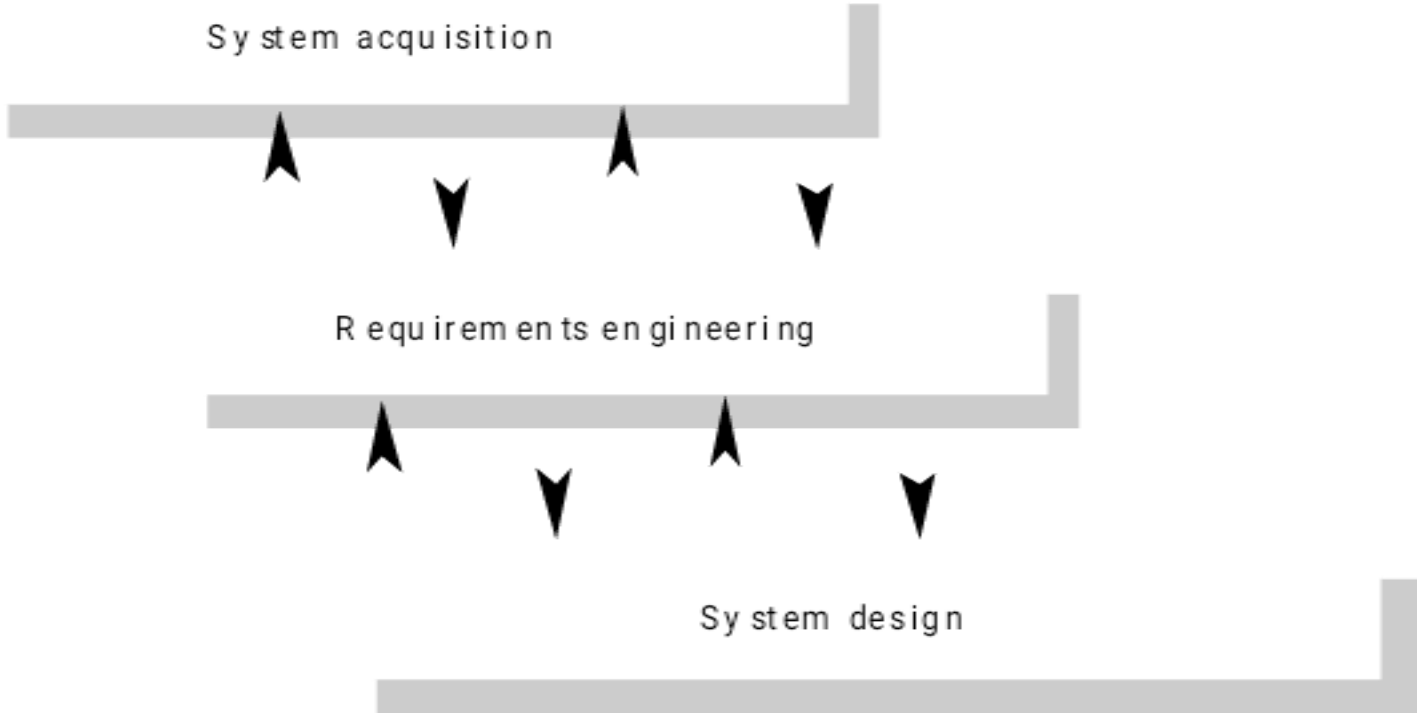
RE process activities

- Requirements elicitation
  - Requirements discovered through consultation with stakeholders
- Requirements analysis and negotiation
  - Requirements are analyzed and conflicts resolved through negotiation
- Requirements documentation
  - A requirements document is produced
- Requirements validation
  - The requirements document is checked for consistency and completeness

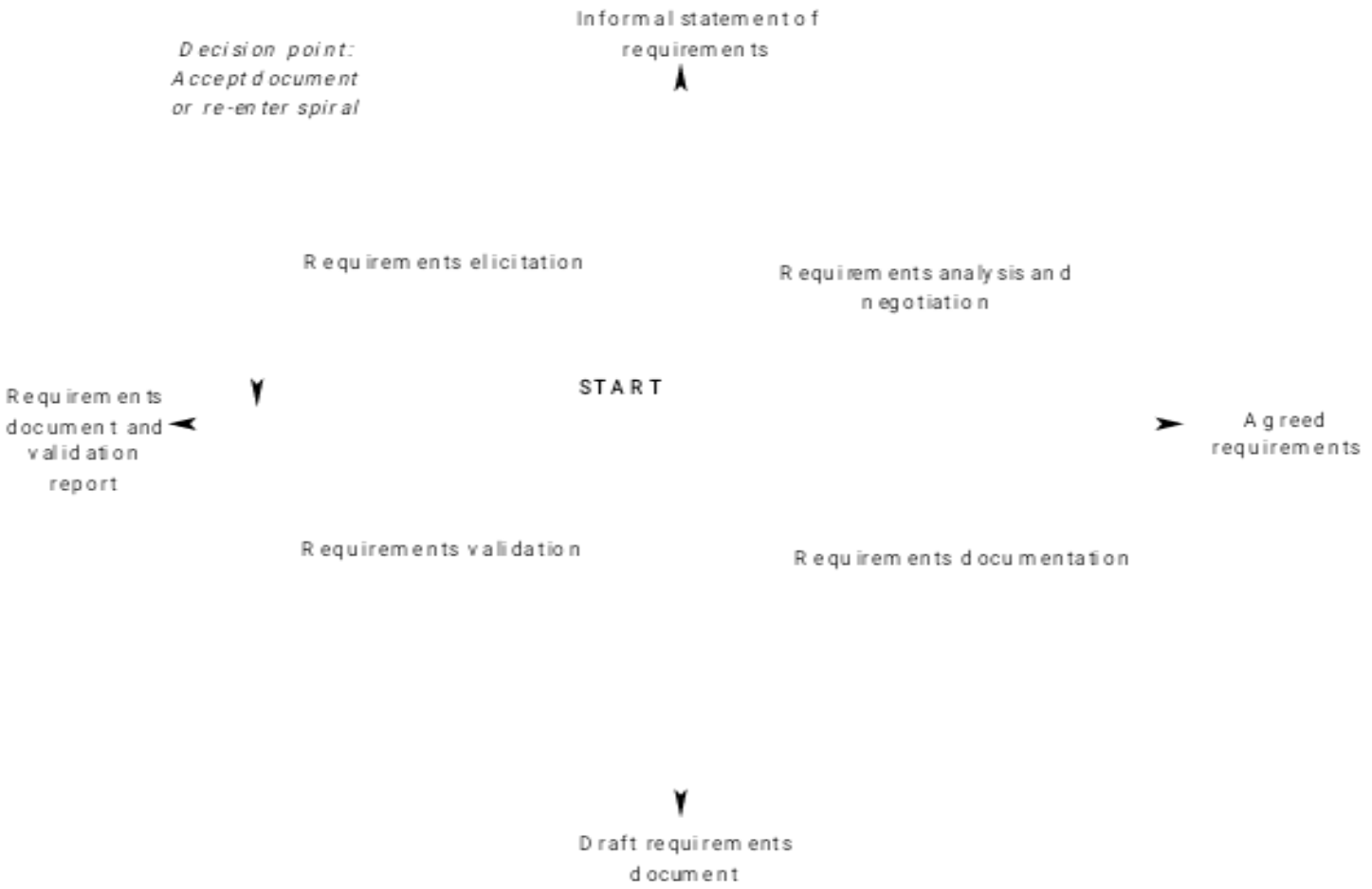
Waterfall model of the software process



Context of the RE process



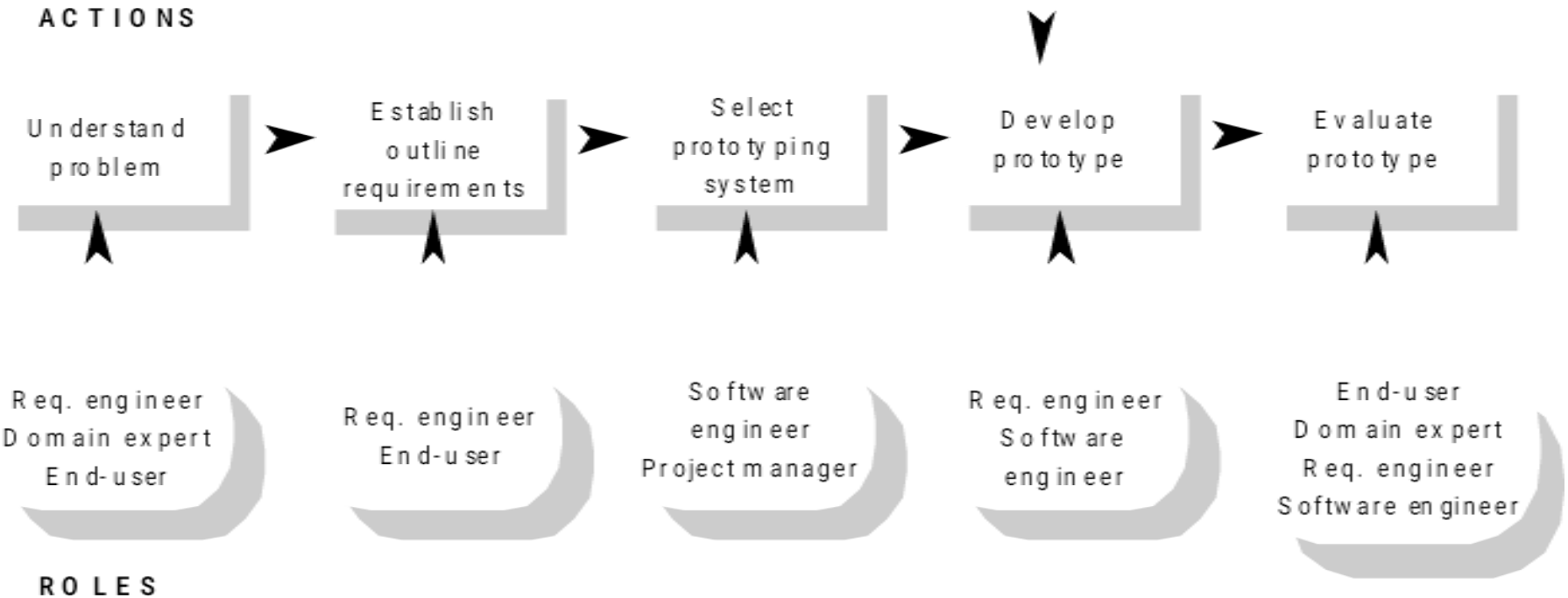
Spiral model of the RE process



Actors in the RE process

- Actors in a process are the people involved in the execution of that process
- Actors are normally identified by their roles rather than individually
- Requirements engineering involves actors who are primarily interested in the problem to be solved (end-users, etc) as well actors interested in the solution (system designers, etc.)
- Role-action diagrams document which actors are involved in different activities

RAD for software prototyping



Role descriptions

Role	Description
Domain expert	Responsible for providing information about the application domain and the specific problem in that domain which is to be solved.
System end-user	Responsible for using the system after delivery
Requirements engineer	Responsible for eliciting and specifying the system requirements
Software engineer	Responsible for developing the prototype software system
Project manager	Responsible for planning and estimating the prototyping project

Human and social factors

- Requirements engineering processes are dominated by human, social and organizational factors because they always involve a range of stakeholders from different backgrounds and with different individual and organizational goals.
- System stakeholders may come from a range of technical and non-technical background and from different disciplines

Types of stakeholder

- Software engineers responsible for system development
- System end-users who will use the system after it has been delivered
- Managers of system end-users who are responsible for their work
- External regulators who check that the system meets its legal requirements
- Domain experts who give essential background information about the system application domain

Factors influencing requirements

- Personality and status of stakeholders
- The personal goals of individuals within an organization
- The degree of political influence of stakeholders within an organization

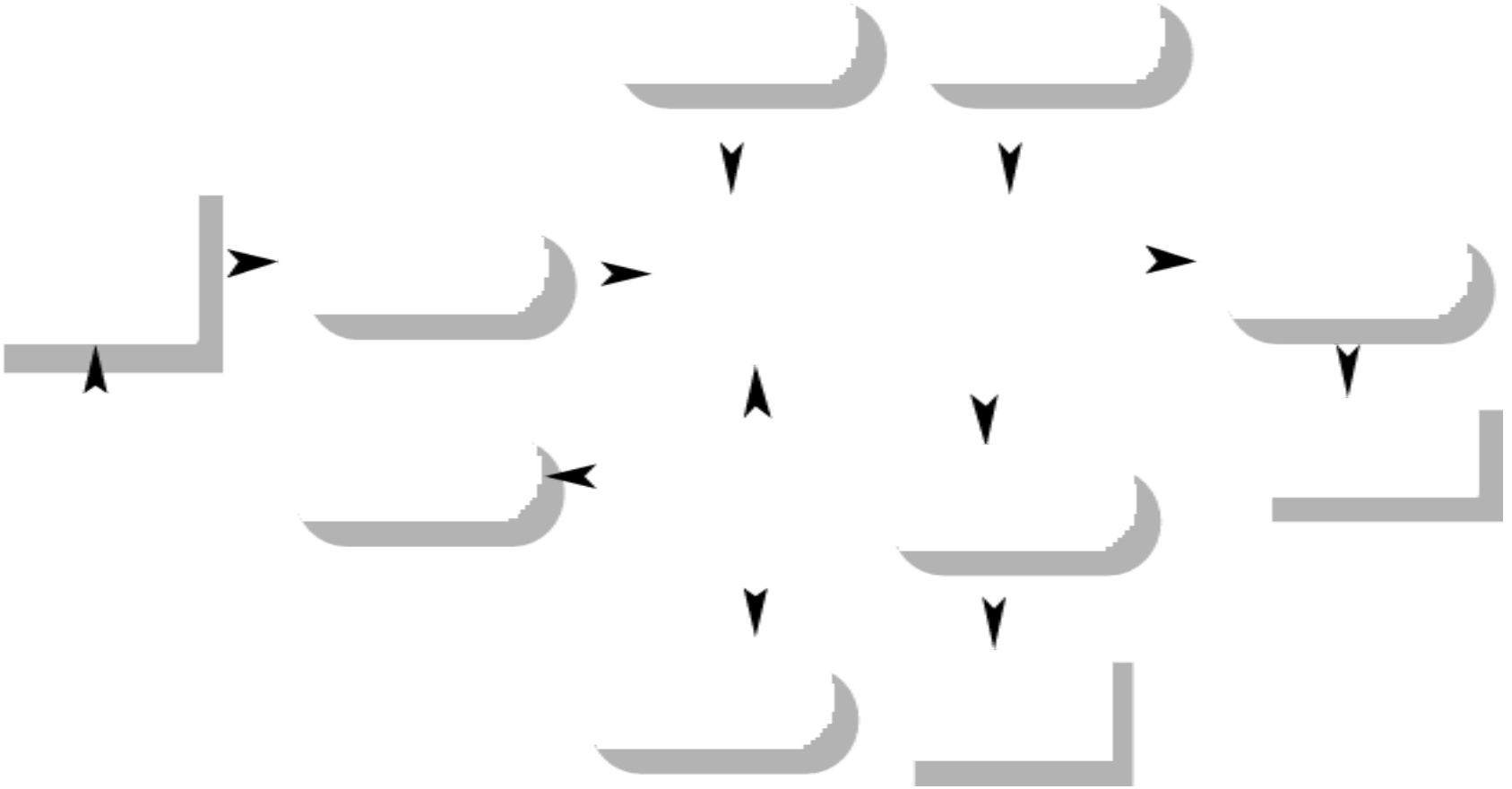
Process support

- CASE (Computer-Aided Software Engineering) tools provide automated support for software engineering processes
- The most mature CASE tools support well-understood activities such as programming, testing and project management
- Support for requirements engineering is still limited because of the informality and the variability of the process

Two types of CASE tools for RE

- Modeling and validation tools support the development of system models which can be used to specify the system and the checking of these models for completeness and consistency.
- Management tools help manage a database of requirements and support the management of changes to these requirements.

A requirements management system



Requirements management tools

- Requirements browser
- Requirements query system
- Traceability support system
- Report generator
- Requirements converter and word processor linker
- Change control system

Process improvement

- Process improvement is concerned with modifying processes in order to meet some improvement objectives
- Improvement objectives
  - Quality improvement
  - Schedule reduction
  - Resource reduction

Planning process improvement

- What are the problems with current processes?
- What are the improvement goals?
- How can process improvement be introduced to achieve these goals?
- How should process improvements be controlled and managed?

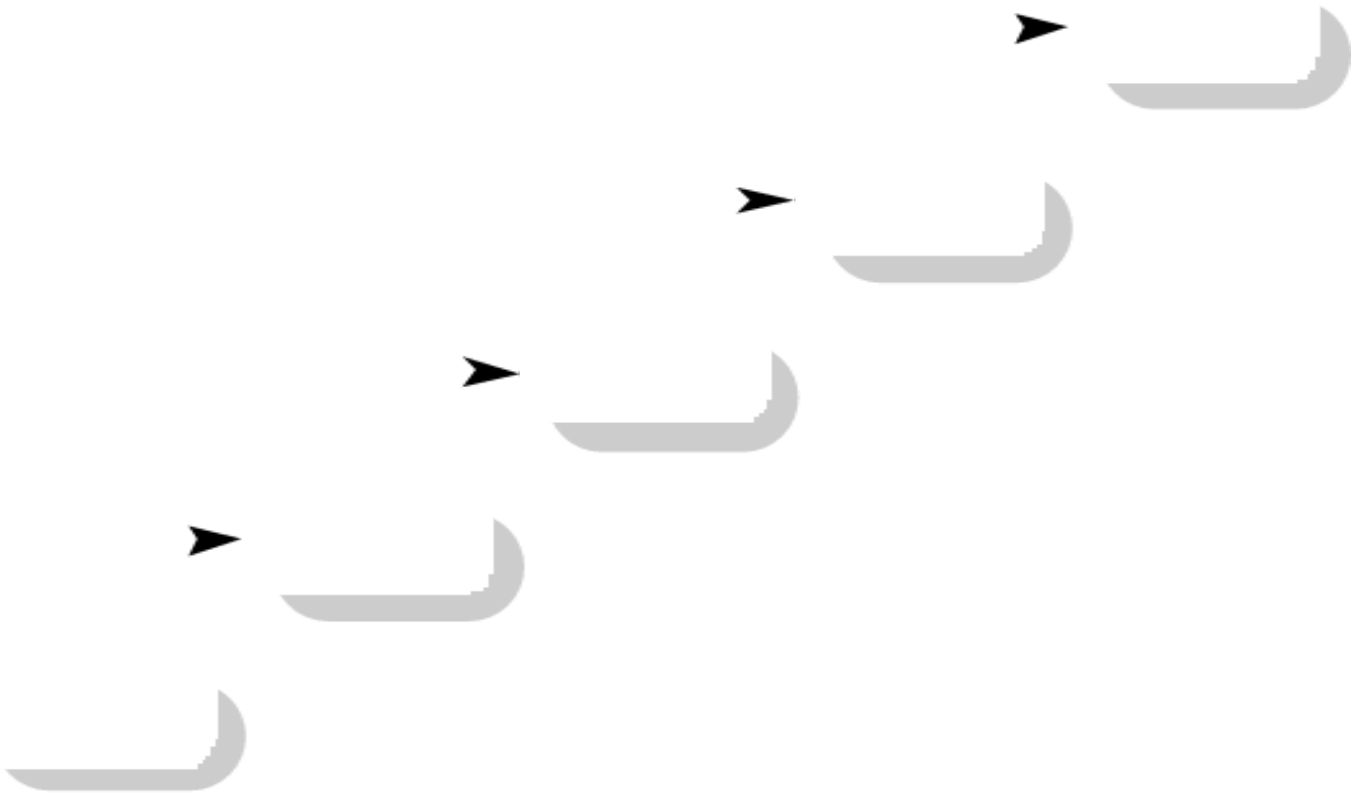
RE process problems

- Lack of stakeholder involvement
- Business needs not considered
- Lack of requirements management
- Lack of defined responsibilities
- Stakeholder communication problems
- Over-long schedules and poor quality requirements documents

Process maturity

- Process maturity can be thought of as the extent that an organization has defined its processes, actively controls these processes and provides systematic human and computer-based support for them.
- The SEI's Capability Maturity Model is a framework for assessing software process maturity in development organizations

Capability maturity model



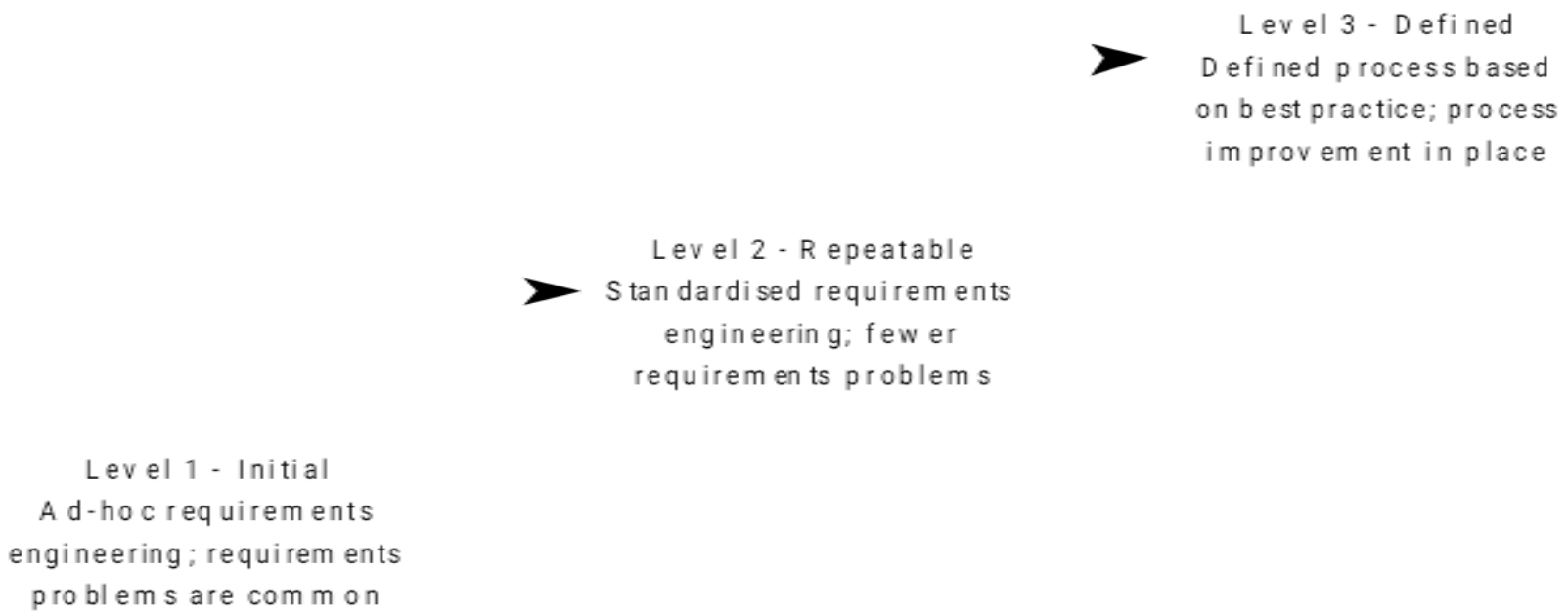
Maturity levels

- Initial level
  - Organizations have an undisciplined process and it is left to individuals how to manage the process and which development techniques to use.
- Repeatable level
  - Organizations have basic cost and schedule management procedures in place. They are likely to be able to make consistent budget and schedule predictions for projects in the same application area.
- Defined level
  - The software process for both management and engineering activities is documented, standardized and integrated into a standard software process for the organization.

Maturity levels

- Managed level
  - Detailed measurements of both process and product quality are collected and used to control the process.
- Optimizing level
  - The organization has a continuous process improvement strategy, based on objective measurements, in place.

RE process maturity model



RE process maturity levels

- Initial level
  - No defined RE process. Suffer from requirements problems such as requirements volatility, unsatisfied stakeholders and high rework costs. Dependent on individual skills and experience.
- Repeatable level
  - Defined standards for requirements documents and policies and procedures for requirements management.
- Defined level
  - Defined RE process based on good practices and techniques. Active process improvement process in place.

Good practice for RE process improvement

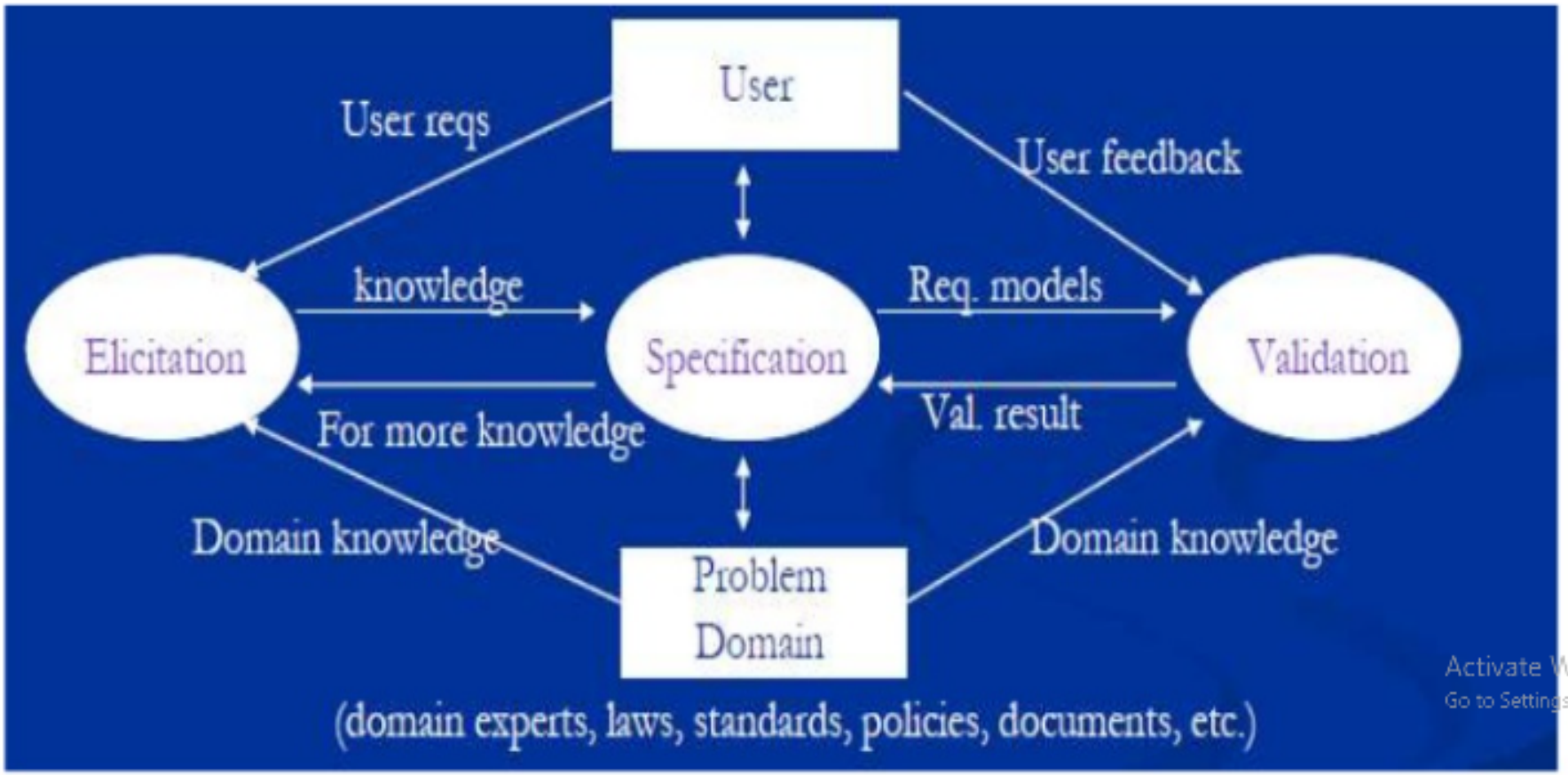
- RE processes can be improved by the systematic introduction of good requirements engineering practice
- Each improvement cycle identifies good practice guidelines and works to introduce them in an organization

Examples of good practice guidelines

- Define a standard document structure
- Uniquely identify each requirement
- Define policies for requirements management
- Use checklists for requirements analysis
- Use scenarios to elicit requirements
- Specify requirements quantitatively
- Use prototyping to animate requirements
- Reuse requirements

RE Process – A Basic Framework

- 3 fundamental activities: understand, (formally) describe, attain an agreement on, the problem



Assignment 2

- Explain why there is a great deal of variability in the requirements engineering processes used in different organizations?
- Explain why both coarse-grain and fine-grain activity models of a process should be produced in an organization.
- Explain why waterfall model of the software process is not an accurate reflection of the detailed software process in most organizations. Why is spiral model more realistic?
- Why is it important to understand the roles of people involved in requirements engineering processes?
- What factors are likely to be particularly significant when considering requirements engineering process improvement?