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Requirements Engineering & Management

Context II – Structure of the Requirements Engineering Context

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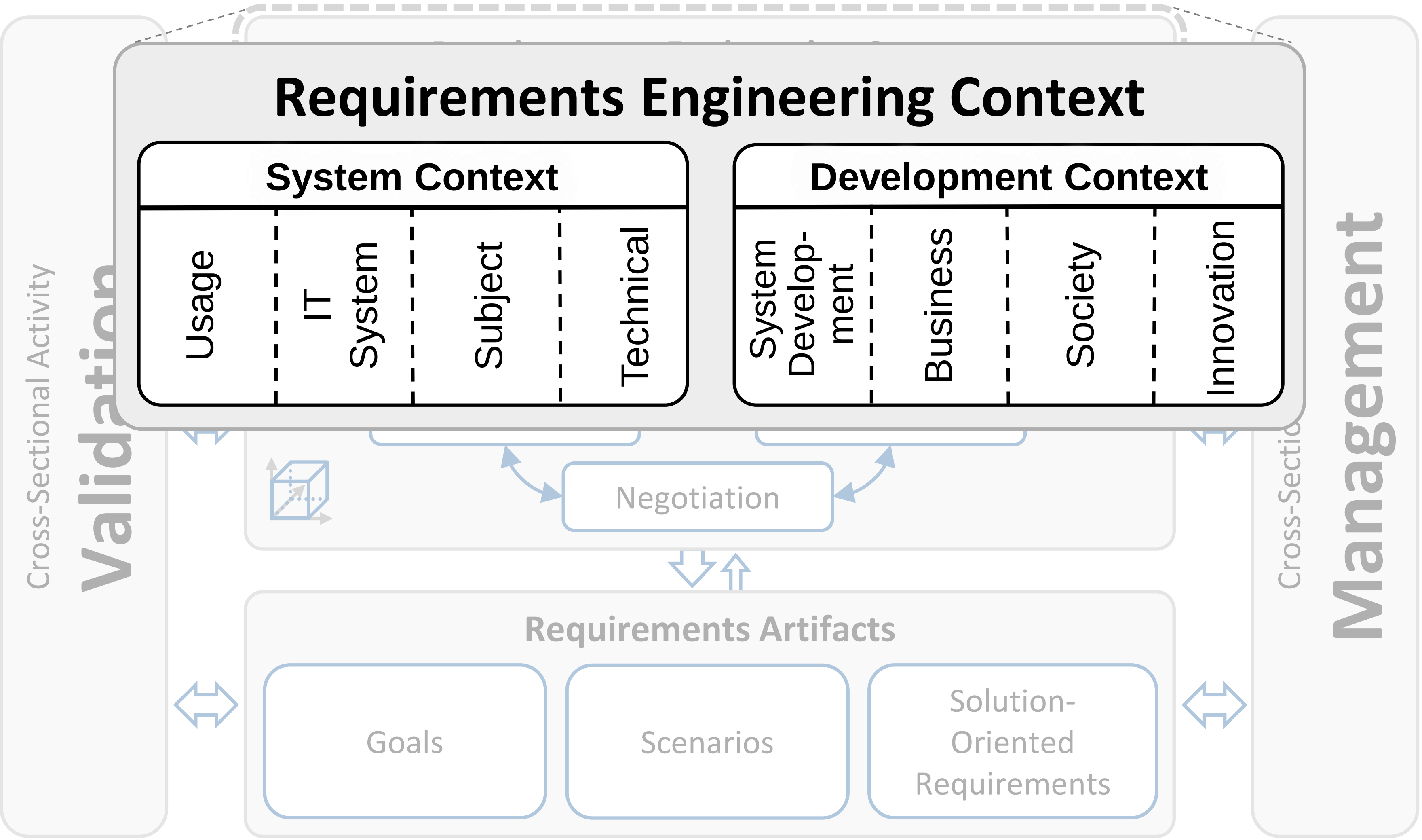
Framework for Requirements Engineering



Agenda

1. Structuring the Context using Perspectives
2. System Context Perspectives
3. Development Context Perspectives

1. Structuring the Context using Perspectives

Motivation for a Structuring the Context

- The context is **complex** and needs to be considered **in all requirements engineering activities**.
  - **Various context objects** and **context information** to be considered
- **Identifying** potentially relevant objects and information is an essential, yet **challenging task**!
  - → Risk that important aspects remain **disregarded**!

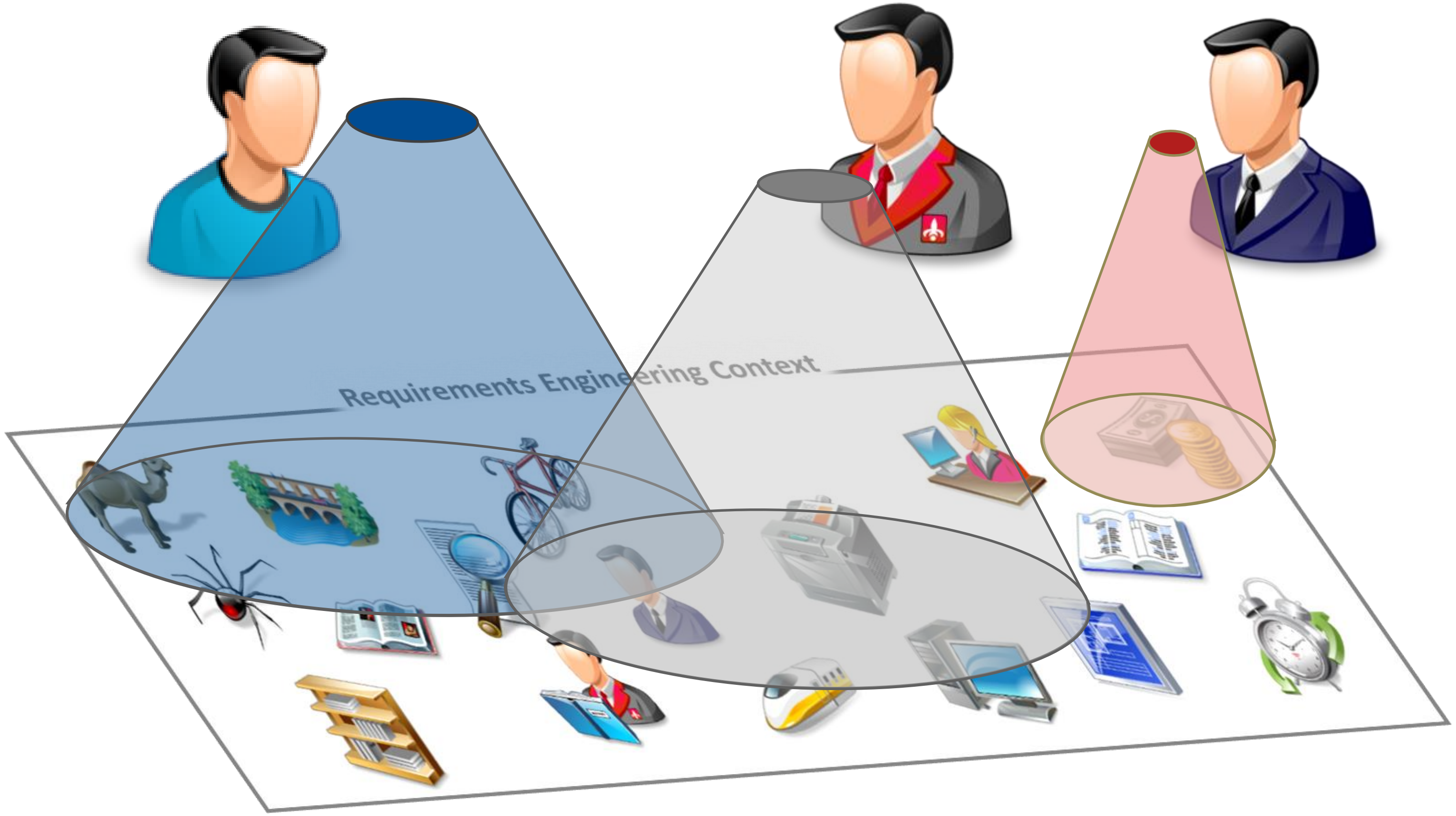
Two Parts of the Requirements Engineering Context

D The **system context** is the part of the requirements engineering context in which the **system to be developed will be operating/embedded**. It is further structured into the usage, IT system, subject, and technical facet.

D The **development context** is the part of the requirements engineering context, **in which the system is developed**. It is further structured into the system development, business, society, and RE-specific facet.

Context Perspectives (1)

- Each part of the context is **further structured** by means of **perspectives**.



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Context Perspectives (2)

- **Approach**:
  - Understanding a **complex matter** and **reducing its complexity** by considering it from **different perspectives**
- **Advantages**:
  - Dedicated perspectives **support abstraction**
  - **Focus** is guided on **aspects relevant from a specific perspective** (similar to advantages of taking multiple perspectives into account to validate requirements specifications, see L-19 Validation)
  - Each perspective **spotlights specific context objects** and **context information** relevant for conducting the requirements engineering activities while **abstracting from other aspects**

Checklist for Each Context Perspective

- **Checklists** in general:
  - Document **experience** gathered from previous projects
  - Are built on **best practices** and expertise
  - Guide the **focus on relevant aspects**
  - …
- **Checklists** for **context consideration**:
  - Support the **identification** of (potentially) relevant **context objects**
  - Point at certain kinds of **context information**, which might be **necessary to consider**
  - Support the **elicitation of requirements** based on context information

Checklists are used to **explain the focus of each perspective** in the following sections

2. System Context Perspectives

System Context Perspectives

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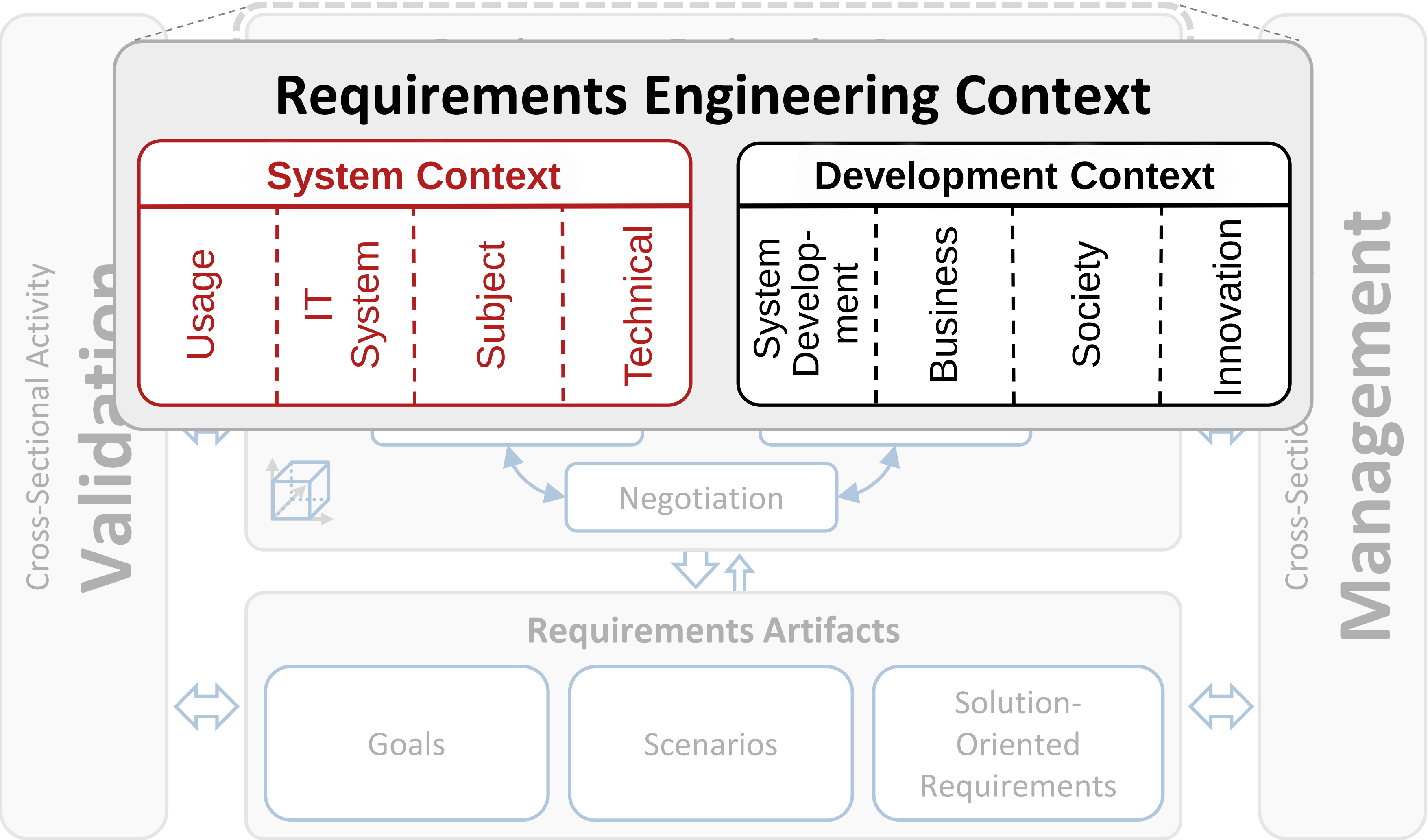

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Generic Principles of any Software-System (1)

Software-intensive systems

- **represent information** about subjects in the (current or future) real world,
- **process this information** and provide some functionality
- **provide an output** to users in the context

Generic Principles of any Software-System (2)

Example: Car Rental Information System

- Supports its **users** (e.g., **customers, clerks**) in making an **online car reservation**, renting a car, or controlling the maintenance of cars, …
- **Stores** and **processes** relevant **information about cars** in the company's portfolio, customers, repair shops, …
- Provides **information about cars** available for rent to customers and clerks

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Subjects

IT Infrastructure

System Usage

Subject Perspective

Focus: Context objects and properties **about which information is stored and processed** by the software-intensive system

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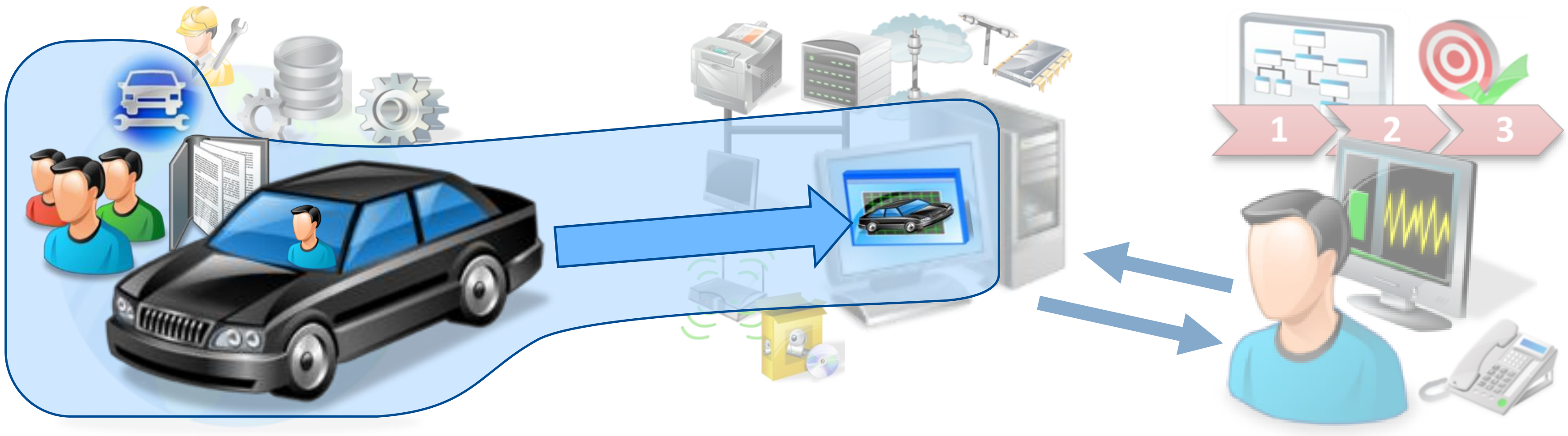

Subject perspective IT System perspective Usage perspective

Subject Perspective: Checklist

- **Information Stored/Processed:**
  - Accessibility
  - Domain experts
  - Pre/post-Processing
  - Technical restrictions
  - …
- **Quality of Information:**
  - Accuracy
  - Timeliness
  - Trustworthiness
  - Validity
  - …

- **Information Providers:**
  - Experts
  - Sensors
  - Users
  - Other software systems
  - Trustworthiness
  - …

IT System Perspective

Focus: Hardware and software systems connected to the system under consideration

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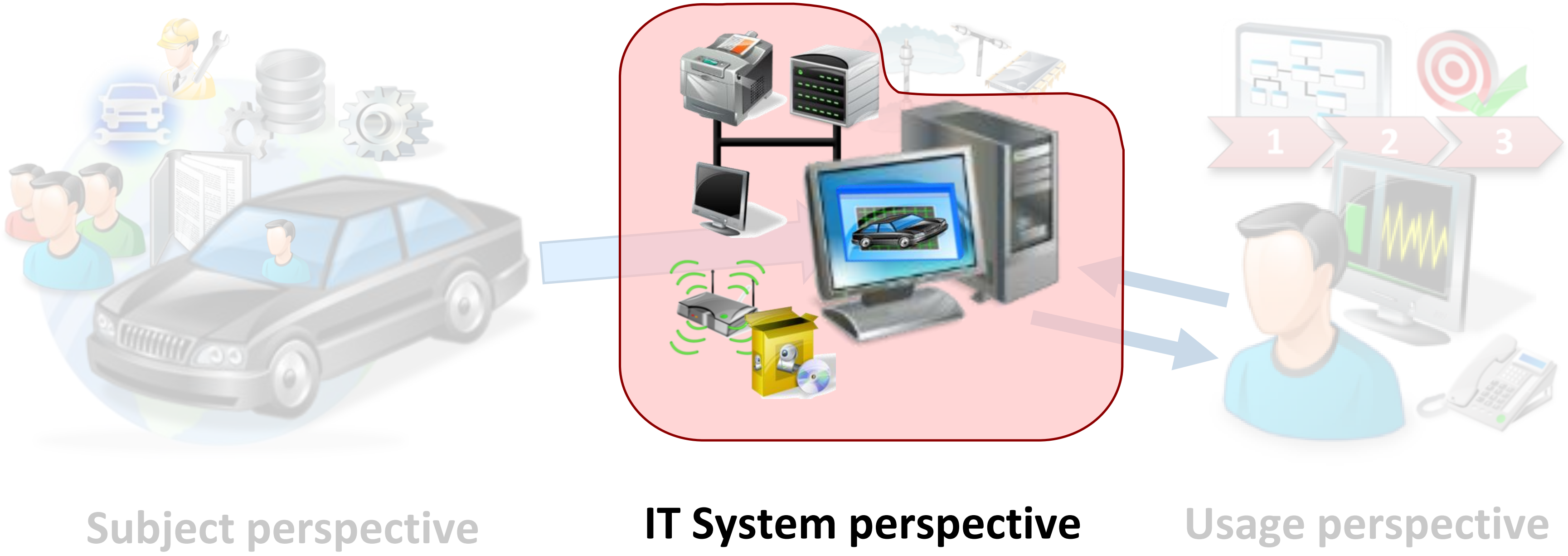

IT System Perspective: Checklist

- **Hardware Resources:**
  - Computing/communication infrastructure
  - Energy consumption
  - Peripheral devices
  - Virtualization technology
  - …
- **Software Services/Systems:**
  - Data storage
  - PaaS, SaaS, …
  - APIs
  - Service Level Agreements (SLAs)
  - …
- **Service Providers:**
  - Legal restrictions
  - Licensing models
  - …
- **Operation and Maintenance:**
  - Deployment
  - Failure/recovery procedures
  - ….
- **IT Strategy, Regulations, Standards:**
  - Data protection, processing, storage
  - Frameworks/Technologies
  - …

Usage Perspective

Focus: **People** or other **technical systems**, which **achieve a goal** or fulfil some **task** by **interacting with the system** and **using** its provided **functionality**

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Subject perspective

IT System perspective

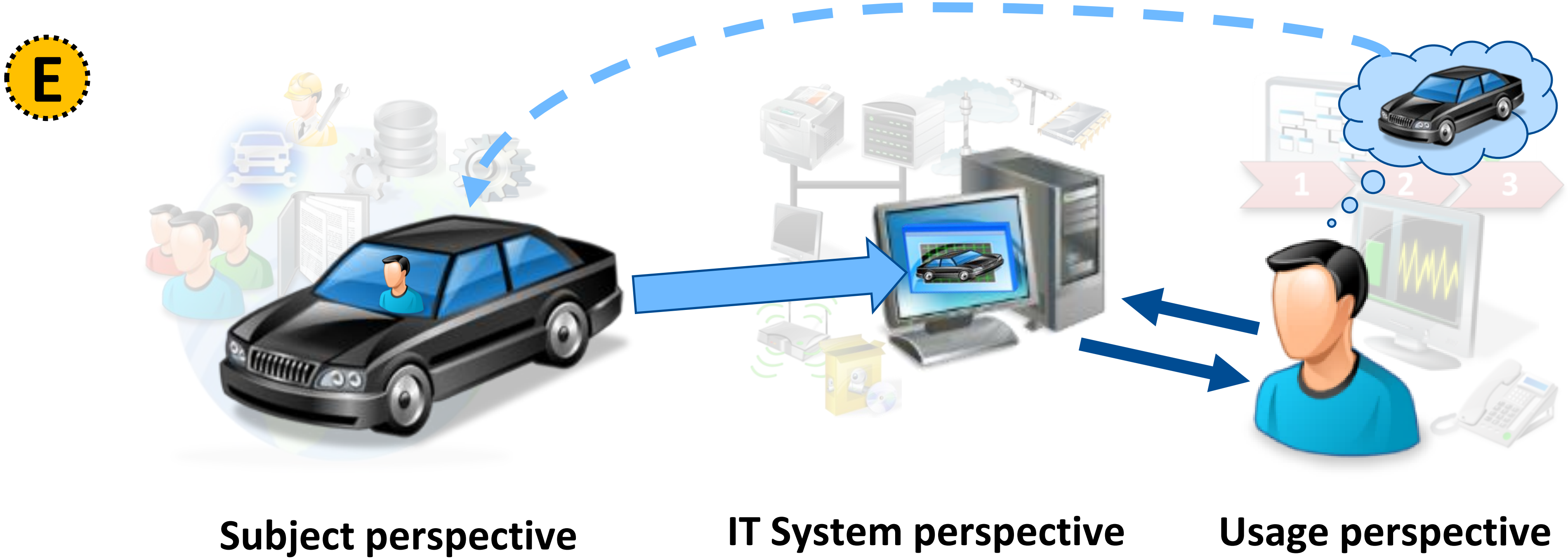
Usage perspective

Usage Perspective: Checklist

- **People:**
  - Access rights
  - Benefits of usage
  - Experiences and skills
  - Usage regulations
  - User roles
  - …
- **Systems:**
  - Availability
  - Benefits of usage
  - Interfaces
  - …
- **Usage patterns:**
  - Goals of usage
  - Interaction sequences
  - User habits
  - …
- **Information required/produced:**
  - Pre-processing (aggregation, …)
  - …
- **Additional context objects:**
  - HCI experts
  - Geographical/spatial distrubution
  - …

Relationships between Usage, IT System and Subject Perspectives (1)

- Only if the user is able to **correctly map** the **information represented in and provided by the system** to the **real-world object** that is actually captured by the system the **system achieves its purpose**!



Relationships between Usage, IT System and Subject Perspectives (2)

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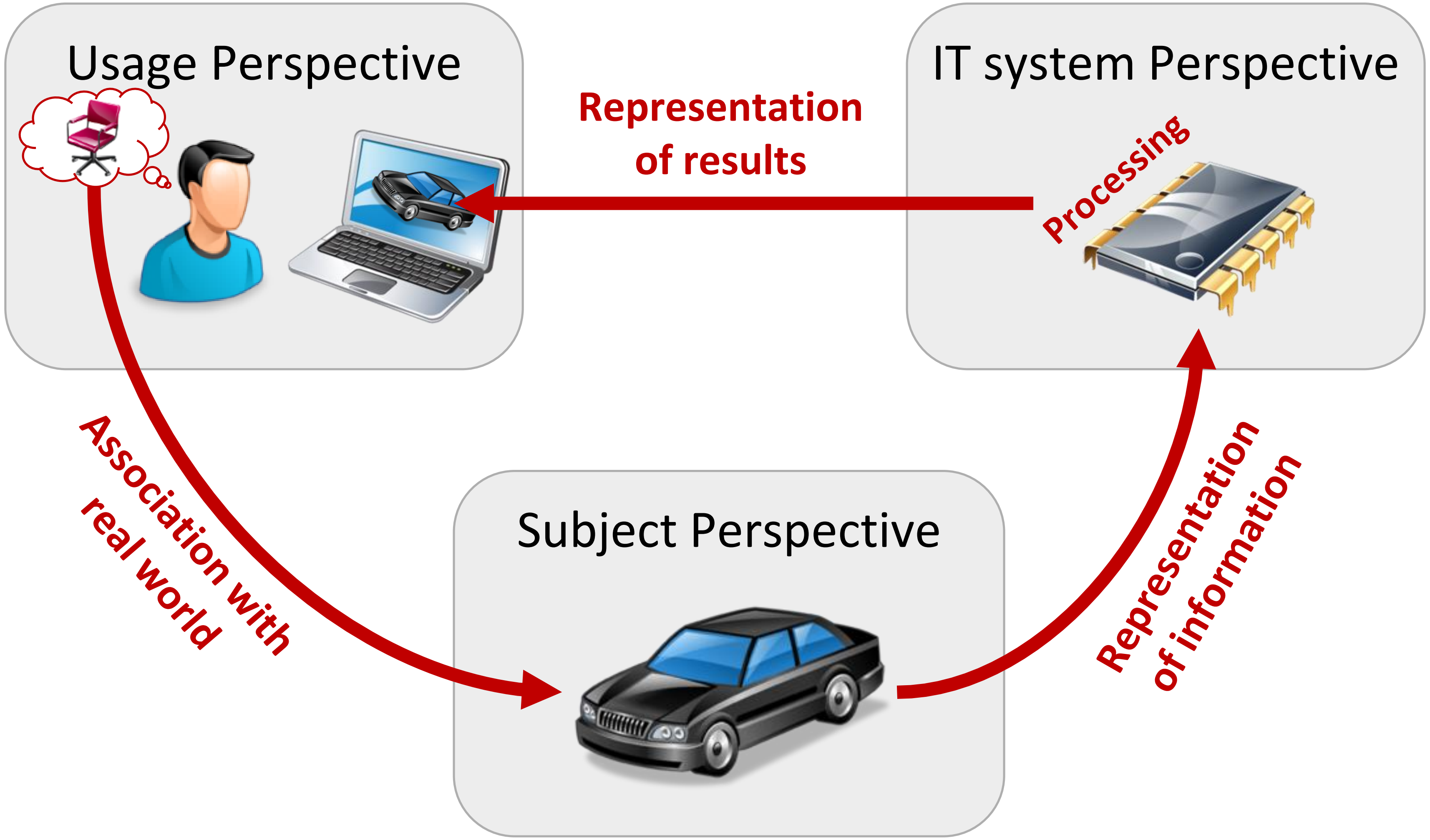
Usage Perspective
IT system Perspective
Subject Perspective
Representation of results
Processing
Association with real world
Representation of information

Technical Perspective

Usage, IT System and Subject Perspective are **not sufficient** for considering the context of **modern systems** (e.g., adaptive, cyber-physical systems etc.)!

→ Need for an **additional, "technical" perspective**!

Focus: **Non-IT systems** in the system context and characteristics of the **physical surroundings**

- In addition to the IT infrastructure, **other non-IT systems** in the system context need to be taken into account, e.g.:
  - mechanical systems/devices (e.g., valves)
  - biological systems (e.g., a lake or river)
- Characteristics of the **physical surroundings of a system** (e.g., geometrical dimensions, spatial aspects, weather conditions, physical laws ...)

Technical Perspective: Checklist

- **Physical laws:**
  - Gravity
  - Force
  - Radiation
  - Elecctricity
  - …
- **Mechanical/physical devices:**
  - Valves
  - Electricity infrastructure
  - Material characteristics
  - Buildings
  - …
- **Spatial/Geometrical aspects:**
  - Dimensions (height, length, width)
  - Volume
  - Density
  - ...
- **Biological/natural systems:**
  - Weather (temperature, etc.)
  - Atmospheric conditions
  - Material deterioration caused by natural influences
  - Organic components (including parts of the human body)
  - …

2. Development Context Perspectives

System Context Perspectives

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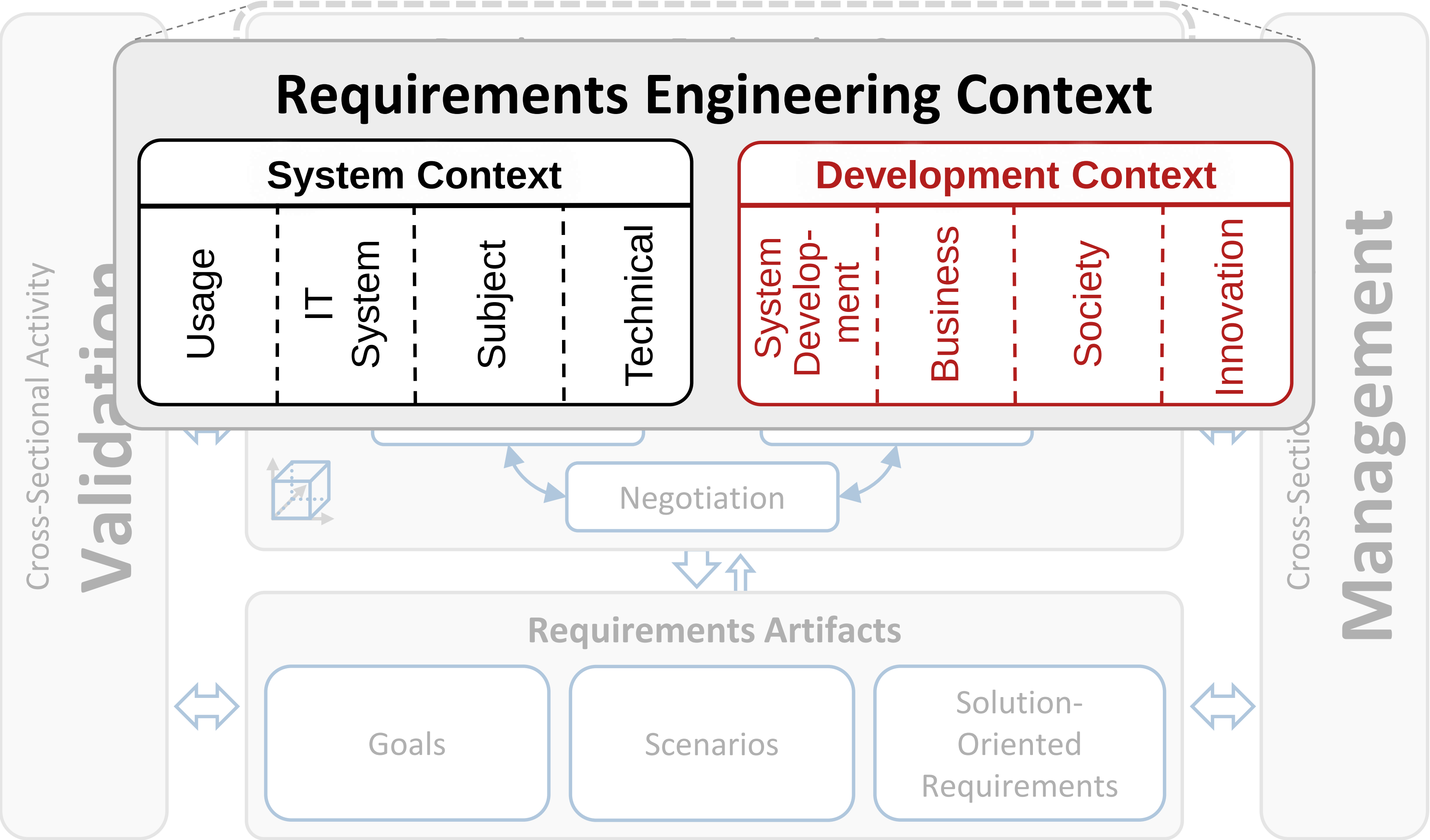

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System Context AND Development Context

- Merely **considering the system context** during requirements engineering **is not sufficient**!
- Anticipating the **operation of the system** and its embedding into the system context is **only one aspect** of the context.
- A software-intensive system also constitutes a **product of a development process**.

→ Context information pertaining to the **development of the system** also need to be considered!

System Development Perspective

Focus: Context objects and context information impacting the **actual engineering activities** to realize the system

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***System development setting 1*:**

Budget: **120.000$**

Max. development time: **2 months**

Development method: **Scrum (agile method)**

***System development setting 2*:**

Budget: **1.000.000$**

Max. development time: **7 months**

Development method: **V-model (traditional method)**

Quality assurance: According to **ISO-9000**

System Development Perspective: Checklist

- **Development process/strategy:**
  - Approach (waterfall, agile, …)
  - System updates/reuse
  - In-house/outsourcing
  - …
- **Tools/Technologies:**
  - Frameworks
  - Development platforms
  - …
- **Organisation-specific Regulations:**
  - Make or buy decisions
  - …
- **Resources:**
  - Budget
  - Personnel
  - ...
- **Artefacts:**
  - Formal proofs/ simulation
  - Traceability
  - ...
- **Contracts:**
  - Service and training providers
  - Service level support
  - ...

Business Perspective

Focus: **Business** in which the system is **used** and **developed**

- Including **organisations**, **business processes, financial aspects** etc.
- Context objects and information going **beyond** the characterization of **immediate system usage**

Examples of considered context objects and information:

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- Contracts with a car repair shop
- Embedding of the car rental company into the broader organisational context of an airport

Business Perspective: Checklist

- **Organisational/Business Processes:**
  - Marketing
  - Product management
  - Change potential
  - Workflows
  - …
- **Strategies:**
  - Business
  - Customer Relations
  - …
- **Finance:**
  - Licensing/Pricing
  - …
- **Regulations/Contracts:**
  - Labour unions
  - Market regulations
  - Supplier contracts
  - …
- **Enterprises:**
  - Competitors
  - Contractors
  - Customers
  - Suppliers
  - …

Society Perspective

Focus: Impacts the system and its development have on society, and impacts of society on the development project

- System and development impact on society: Including ecological and economical impacts
- Societal (e.g., cultural, ethical, …) impacts on system development

Examples of considered context objects and information:

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- Productivity gains might imply job losses
- Pricing affects citizens’ tendency to rent a car instead of using public transport

Society Perspective: Checklist

- **Culture:**
  - Beliefs, norms, principles
  - Education
  - Languages
  - Traditions
  - …
- **Ethics/Human values:**
  - Creativity
  - Equality/non-discrimination
  - Fairness
  - Integrity
  - …
- **Social impact:**
  - Health
  - Jobs
  - Non-governmetal organisations
  - Wealth
  - …
- **Ecology/Environment:**
  - Ecological impact / foot print
  - Energy/resource consumption
  - Sustainability
  - Pollution
  - …

Innovation Perspective

Focus: Innovations enabled by the system and potentially useful for developing the system

- Generation of innovative ideas and inspiration from the context (e.g., additional experts)
- Looking beyond the other perspectives in a creative and far-sighted manner

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Examples of considered context objects and information :

- System analogy: Boat renting systems, Taxi dispatching services
- Experts for (future) governmental programmes supporting e-mobility

Innovation Perspective: Checklist

- **Competitor/Legacy/Related systems:**
  - Customer relations
  - Functionality and quality
  - Unique selling points
  - Market share and market strategies
  - …
- **Innovative technologies:**
  - Current/future trends
  - Human-Computer Interaction
  - Development frameworks
  - Artificial intelligence
  - …
- **Creativity Factors:**
  - Creativity techniques
  - Psychological studies
  - Equipment for workshops etc.
  - ...
- **Forums/Documents:**
  - Open source development platforms
  - User forums
  - ...
- **People/Experts:**
  - Technology experts
  - Psychologists
  - ...

Summary

- The requirements engineering context is structured into the system context and the development context.
- Each part are further structured by means of perspectives, i.e., dedicated viewpoints that support the identification of potentially relevant context objects and context information.
- The system context is the part of the requirements engineering context in which the system to be developed will be operating/embedded. It is structured into four perspectives:
  - Subject perspective
  - Usage perspective
  - IT system perspective
  - Technical perspective
- The development context is the part of the requirements engineering context, in which the system is developed. It is structured into four perspectives:
  - System development perspective
  - Business perspective
  - Society perspective
  - Innovation perspective

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Legend

D Definition

E Example

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