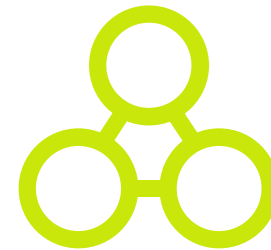


Agent-oriented Constructivist Knowledge Management



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Outline

- ▶ Introduction:
 - ▶ Constructivist Knowledge Management
- ▶ Ongoing Projects
- ▶ ARKnowD: KM Systems Development Methodology
 - ▶ Combining Tropos + AORML
- ▶ Methodology to Model Organizational Goals and Processes
 - ▶ Combining Tropos + ARIS
- ▶ Conclusions



Knowledge Management

KM can be defined as a systematic process for acquiring, organizing and communicating knowledge to all members of an organization, enabling them to be more effective and productive in their work.

Conveying to people the **right piece of information**
at the **right place**, in the **right time**.

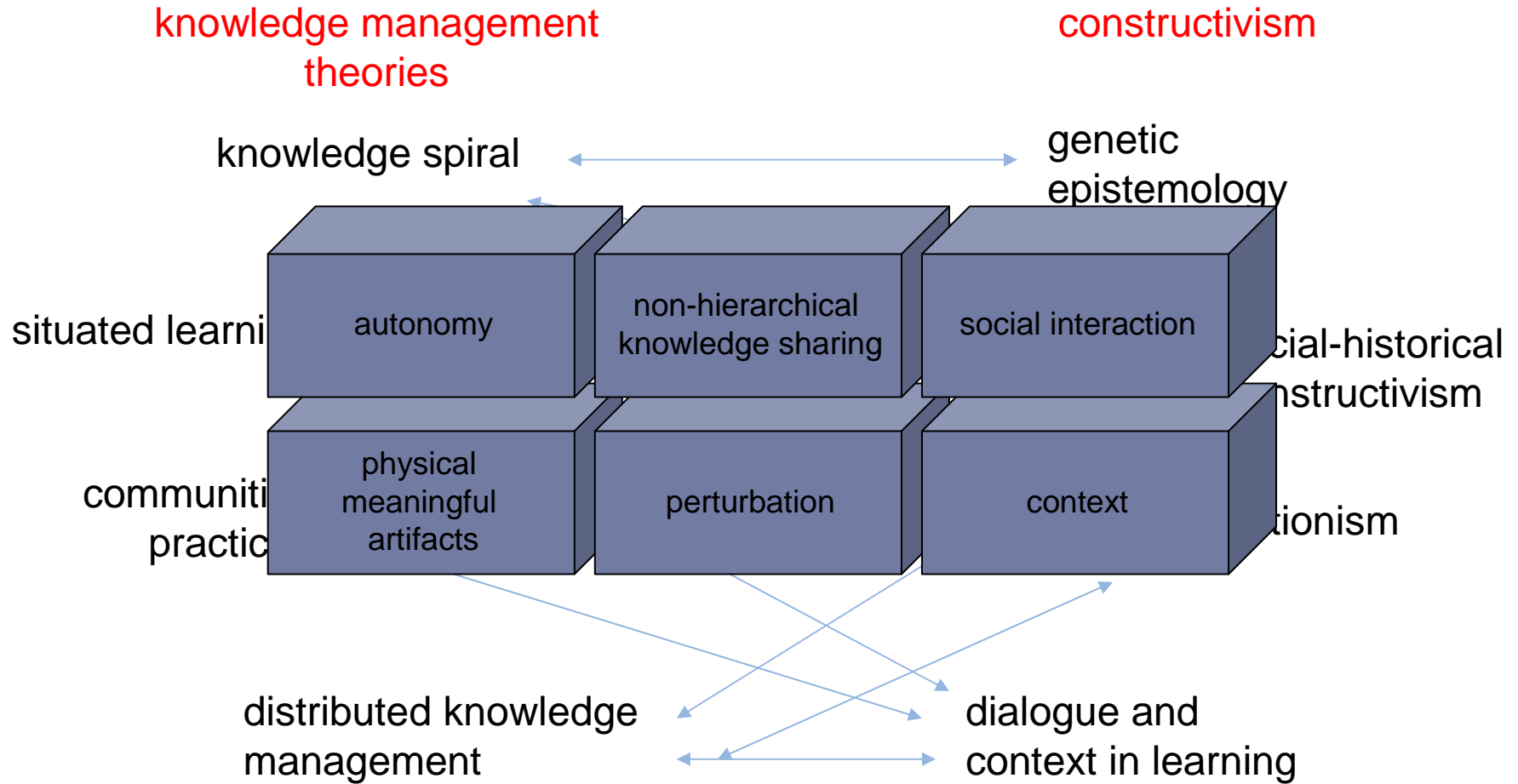


Knowledge Management Pitfalls

- ▶ “There is no time for filling in the system with new knowledge.” *Detachment from daily working practices*
- ▶ “Oh, it’s too much effort to fill in the system, and then I can never find something useful in it when I need it.” *Effort vs. Knowledge availability*
- ▶ “What if someone does something wrong with the knowledge I give away?” *Lack of trust*
- ▶ “Why should I share my knowledge if knowledge is power?” *Lack of motivation*

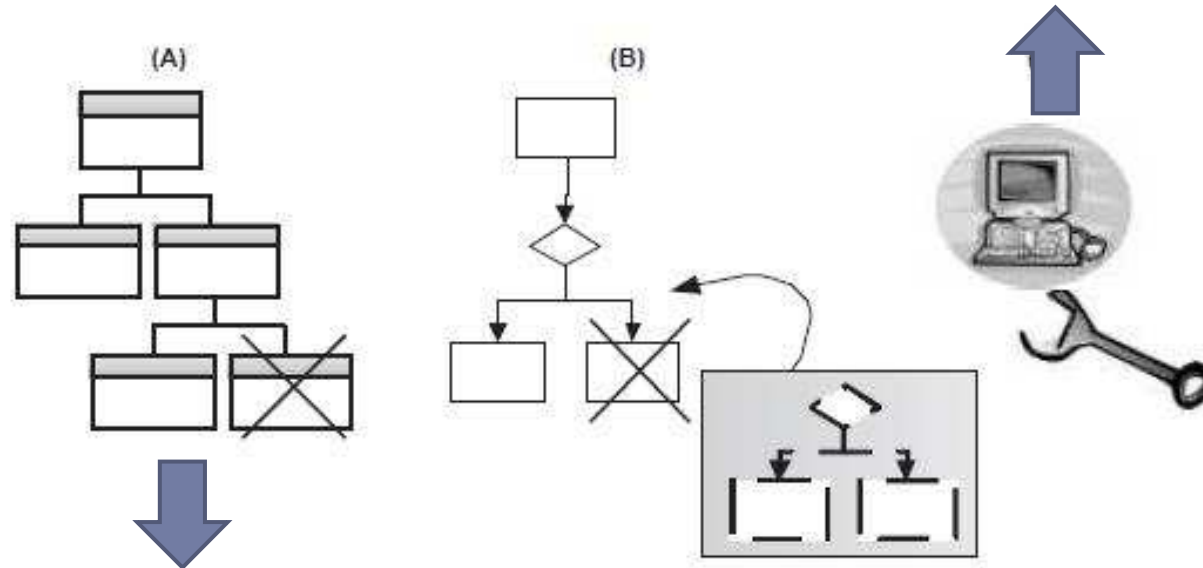


Theoretical Framework



Knowledge Management Support

Three possible types of support: **Automated or Non-automated tools**



Organization Reengineering

Business Process Modeling



Developing a Methodology to Support KM

- ▶ **Requirement 1:** Developing a good understanding of the organizational setting before jumping into the solution space.
- ▶ **Requirement 2:** Designing the solution (i.e. information system, process) with an enough amount of detail to enable coding



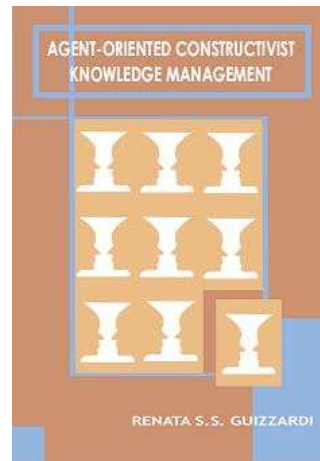
Developing Effective KM Solutions



Ongoing Research and Applied Projects

Ongoing Projects (1 / 3) – KM Methodology

- ▶ To enable the development of KM Systems: i*/Tropos+AORML (PhD thesis result)



- ▶ To enable the development of KM Goals and Processes: i*/Tropos+ARIS (HUCAM University Hospital project)



Ongoing Projects (2/3): KM Enabling System

- ▶ KARE: Knowledgeable Agent for Recommendations (PhD thesis result)
- ▶ Web-based system to support collaboration and knowledge exchange, enabling social network-based projects (Habitat Living Lab)



<http://www.ufes.br/habitat>



Ongoing Projects (3/3): Organizational Model to Enable Semantic Interoperability

- ▶ ANTT (National Agency for Terrestrial Transportation) **MGIC Project**



- ▶ Ontology
- ▶ KM artifacts + competences





ARKnowD: Methodology to
Develop KM Systems

ARKnowD: Agent-oriented Recipe for KM Systems Development

- ▶ Emphasis on initial steps: organizational analysis.
- ▶ Agents as metaphors
 - ▶ Cognitive and social characteristics.
- ▶ Combining Existing work
 - ▶ **Tropos** for *Analysis* & **AORML** for *Design*
- ▶ MDA-inspired Transformation from Tropos to AORML
- ▶ Ontology for the Agent domain
 - ▶ Clarifying definition of applied concepts.
 - ▶ Assisting the transformation from Tropos to AORML.
 - ▶ Evaluating and adjusting ARKnowD's notation.

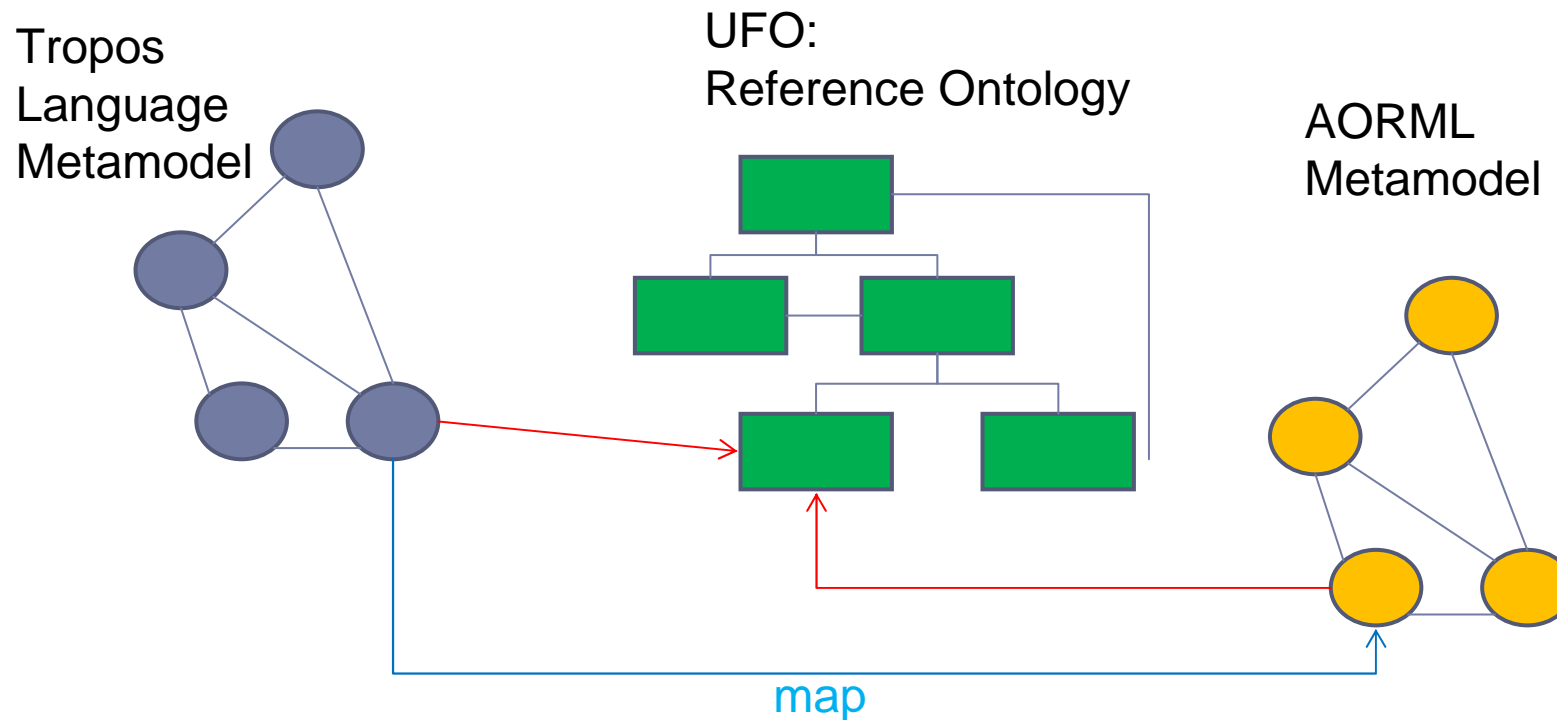


Organizational Analysis - Diagnostic

- ▶ how much **autonomy** is given to each organizational member to share knowledge;
- ▶ if the creation and sharing of knowledge happens in a bureaucratic way or if it is rather **non-hierarchical** and natural;
- ▶ how well organizational processes favor **social interaction**, an essential ingredient for the disambiguation of tacit knowledge, and thus for the generation of innovation;
- ▶ what kind of **meaningful artifacts** are exchanged among organizational members, carrying knowledge throughout the organization
- ▶ how **constructive perturbations** are generated and coped with, triggering the dynamics that motivate employees to constantly self-improve;
- ▶ what kind of **contexts** emerge or are actively planned by the organization for knowledge creation, integration and sharing. In this way, carrying knowledge throughout the organization



Foundational Ontology applied to map two modeling languages



Map the concept C1 of Tropos language into the concept C2 of AORML in a way that C1 and C2 reference the same concept in the reference ontology.

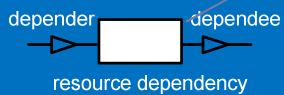
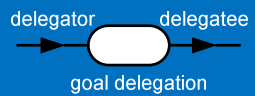
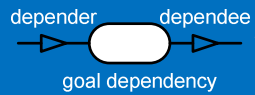


ARKnowD

Tropos

AORML

Early Requirements



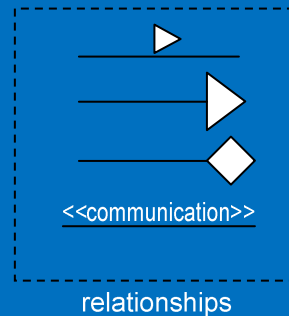
Late Requirements



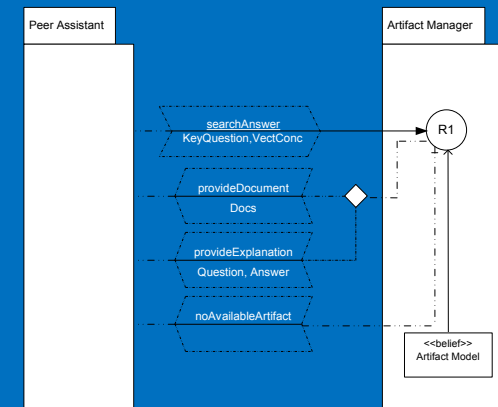
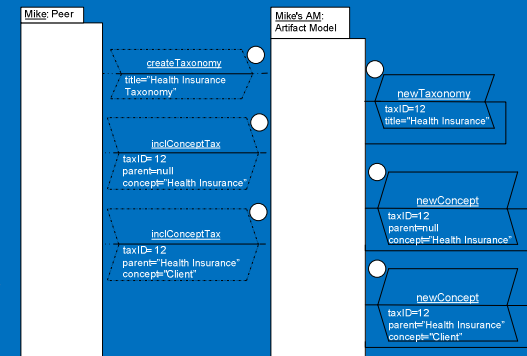
Architectural Design



Transformation



Detailed Design



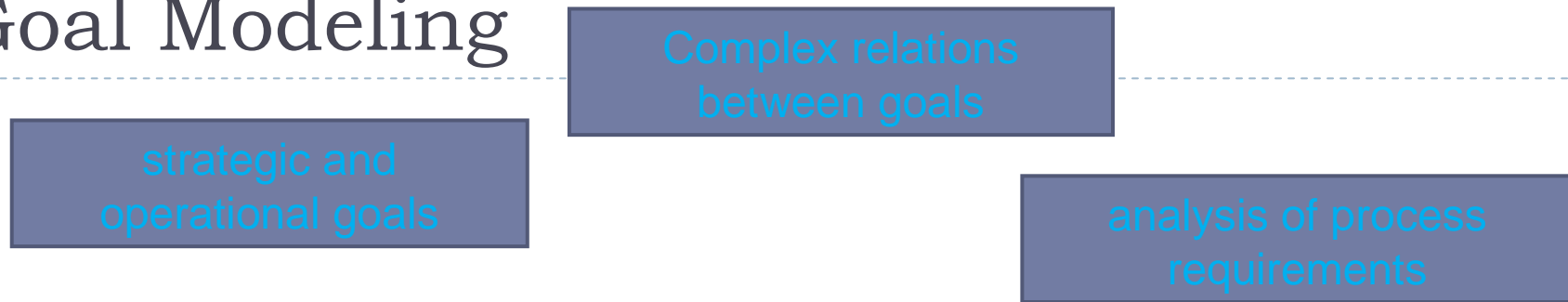
Methodology to Model Organizational Goals and Processes

Methodology to Model Organizational Goals and Processes

- ▶ Considers two dimensions of an organization: *intentional (strategic) dimension* and *process (operational) dimension*
- ▶ Combining Existing work
 - ▶ *i*/Tropos* for Analysis & **ARIS** for BPM
- ▶ MDA-inspired transformations (explicit metamodel mapping rules)
- ▶ Ontology-based Mappings
 - ▶ Clarifying definition of applied concepts.
 - ▶ Assisting the transformation from Tropos to ARIS (thus, assisting in the link between the goal and process dimensions).
- ▶ Iterative process: goal and BPM elicitation and modeling



Goal Modeling

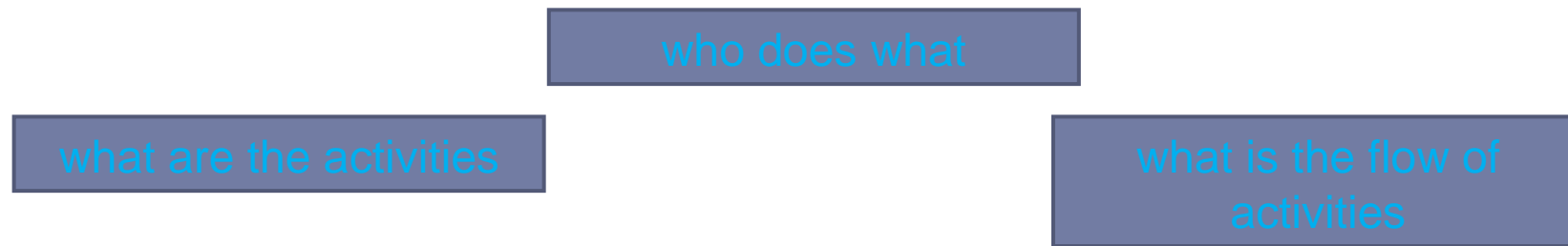


Makes **motivations (strategies)** explicit

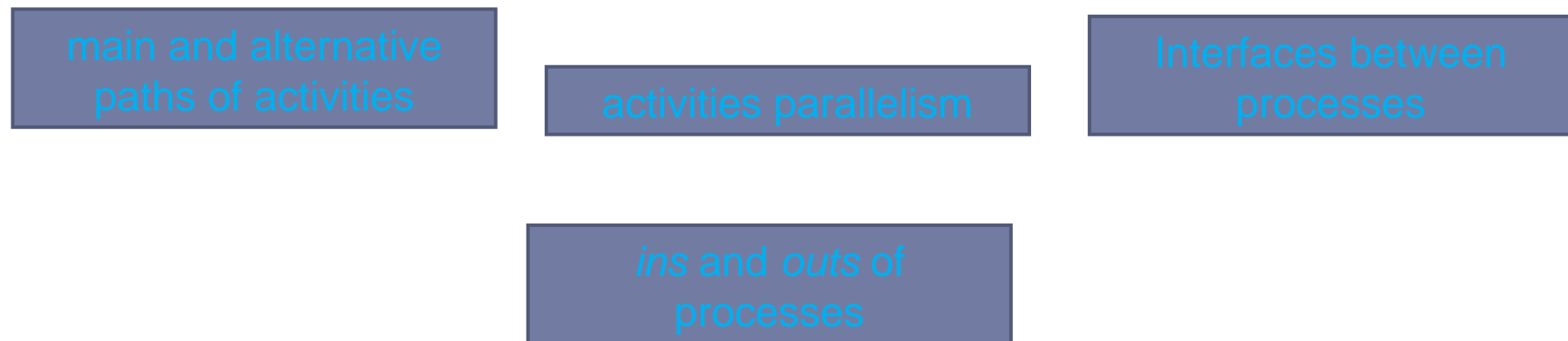
- ▶ What leads an organization to execute processes in a way it does?
- ▶ *Intentionality* behind processes



Business Process Modeling



Business Process Modeling focuses on a **detailed understanding** of the chain of activities that deliver the organization's **products and services**.



Main benefits of combining goals and BP

- ▶ Allowing **traceability** between goals and business process models
 - ▶ How goals are operationalized into BP.
 - ▶ How BP impact the achievement of goals.
- ▶ Providing Modularity both to Goal and BP models.
- ▶ Diagnosing needs for reengineering.
- ▶ Developing process-oriented information systems which are aligned with organization's goals.

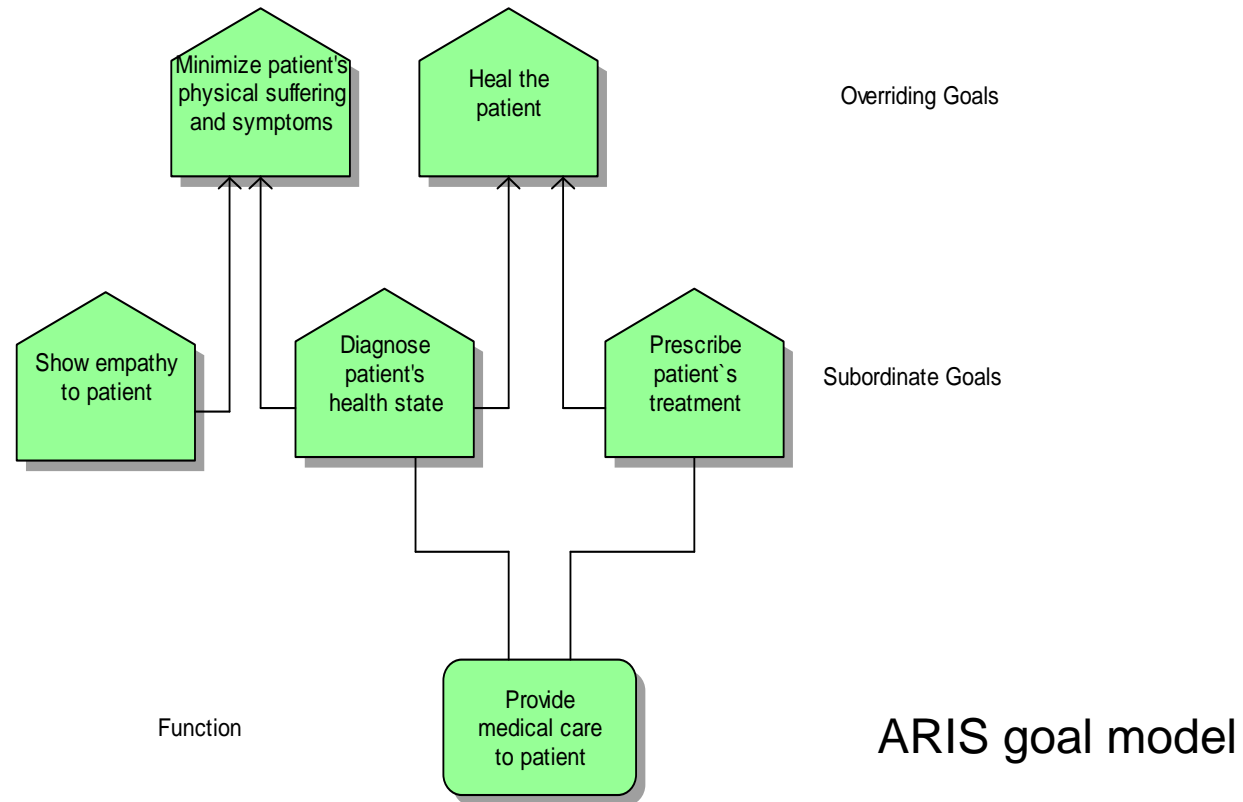


Limitations of goal models of BPM approaches

- ▶ Do not allow an in depth goal analysis
 - ▶ Unclear semantics for decomposition.
 - ▶ It does not model alternatives.
 - ▶ It does not allow one to reason about how a goal directly impacts other goals.
- ▶ Weak connection to processes
 - ▶ Relation about goals and processes is not clear.
- ▶ Lack of methodological guidance to elicit and model goals.



BPM Approaches Neglect Goals



Goal Modeling using i^* / Tropos

- ▶ Some important concepts: agent, goal, resource, plan, decomposition, means-end and contribution.
- ▶ It allows goal refinements (or decomposition), capturing strategy's complexities.
- ▶ It documents distinct alternatives and the reasons for choosing one strategic alternative instead of the other.
- ▶ Elicitation of goals: work in progress
- ▶ Integration of goals and processes: work in progress



Combining Goals and BPM

Organizational Model =

Goal modeling + Business Process Modeling



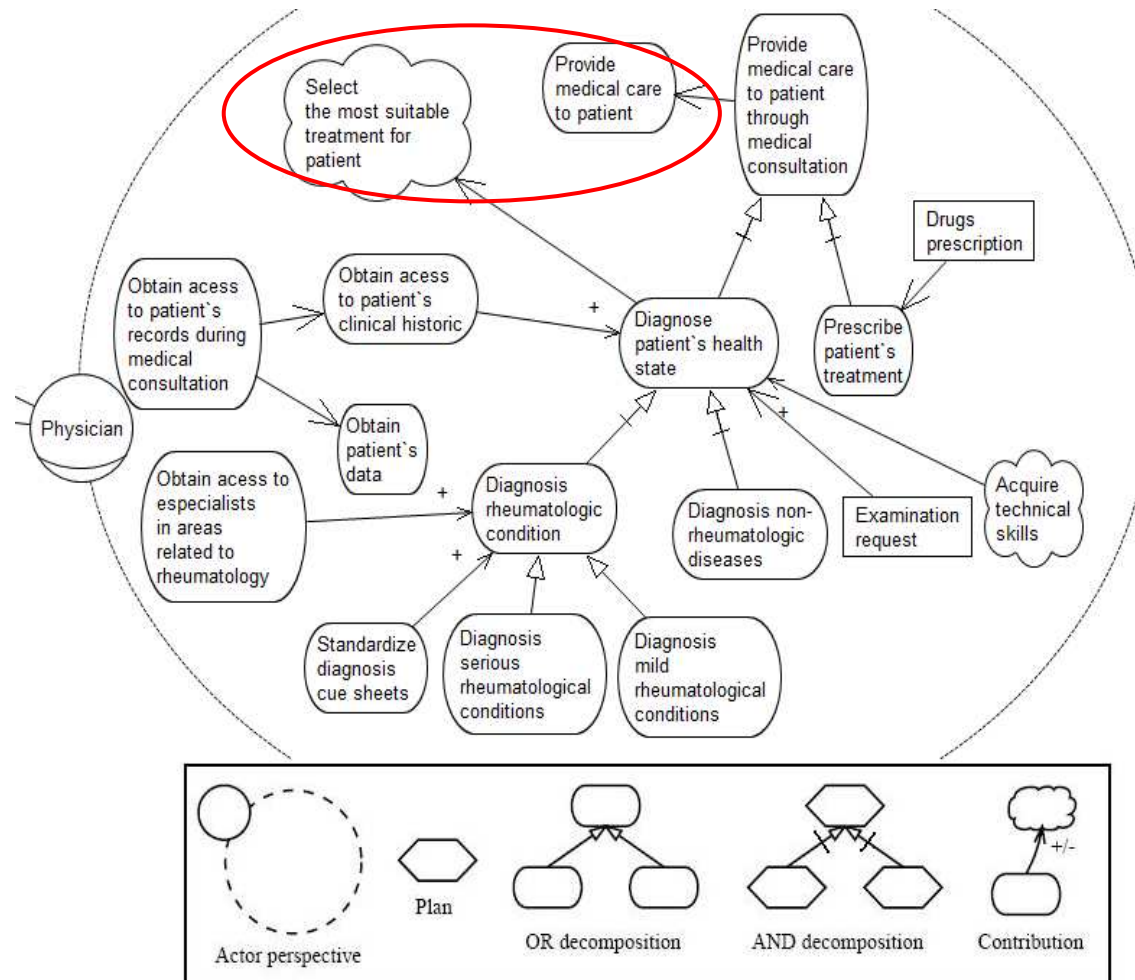
Tropos



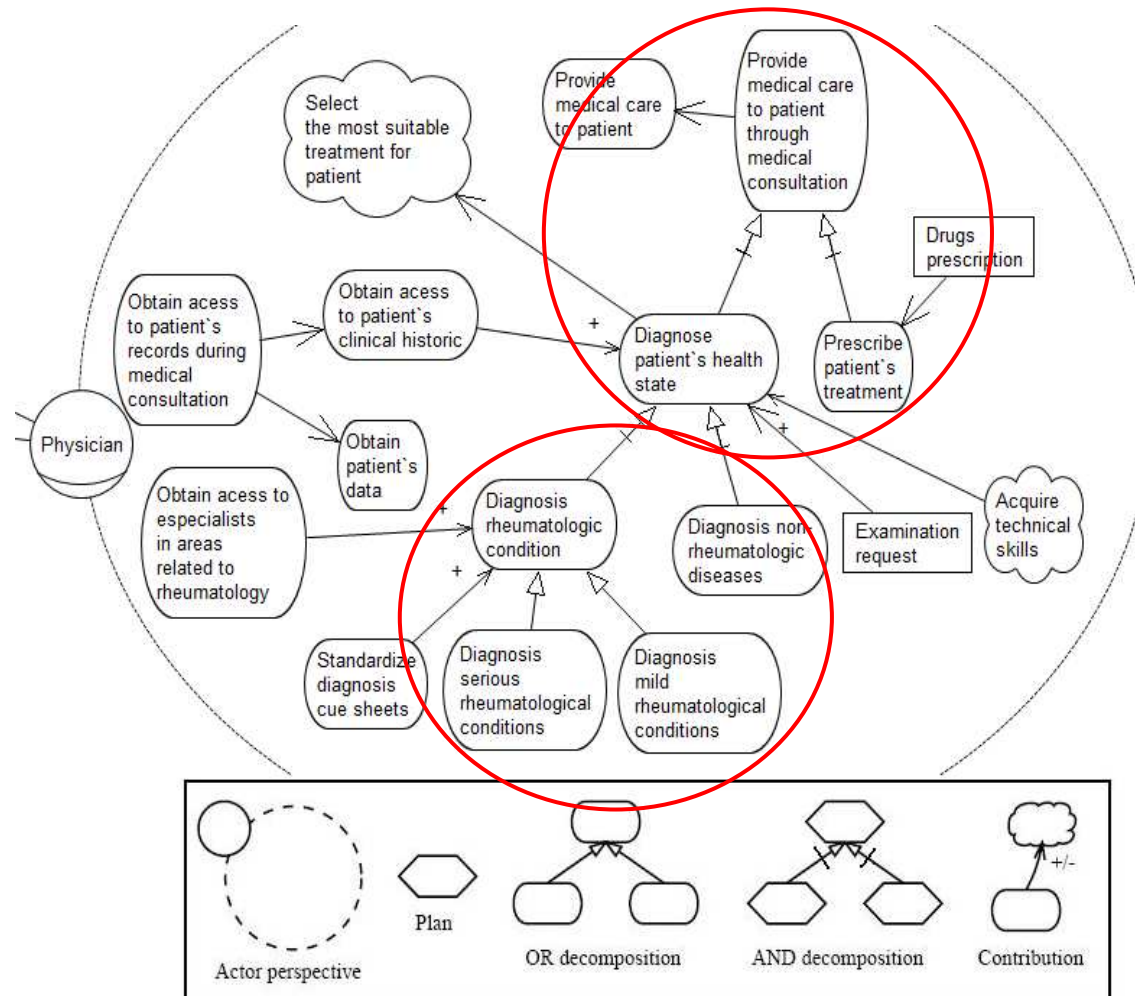
ARIS-EPC



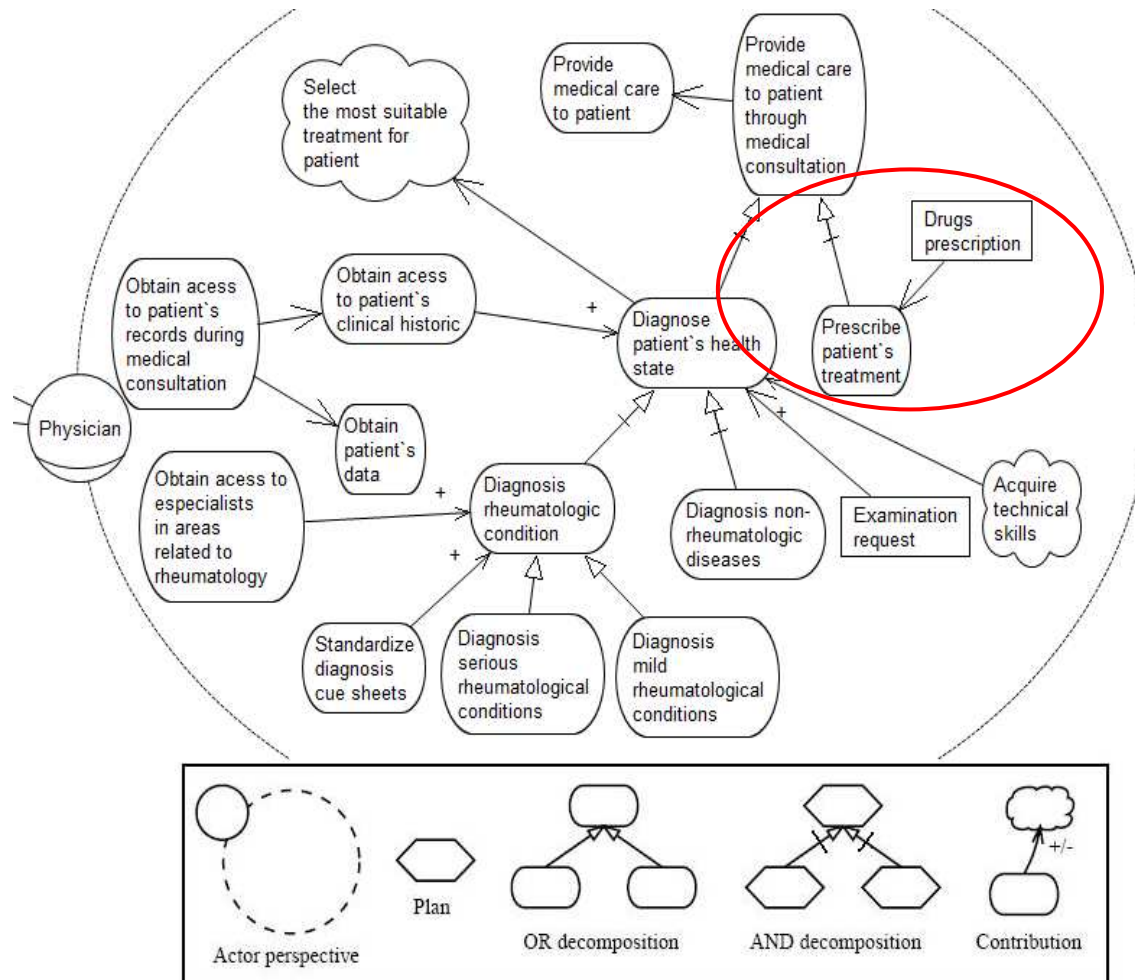
i*/Tropos - Example in the Health Care Domain



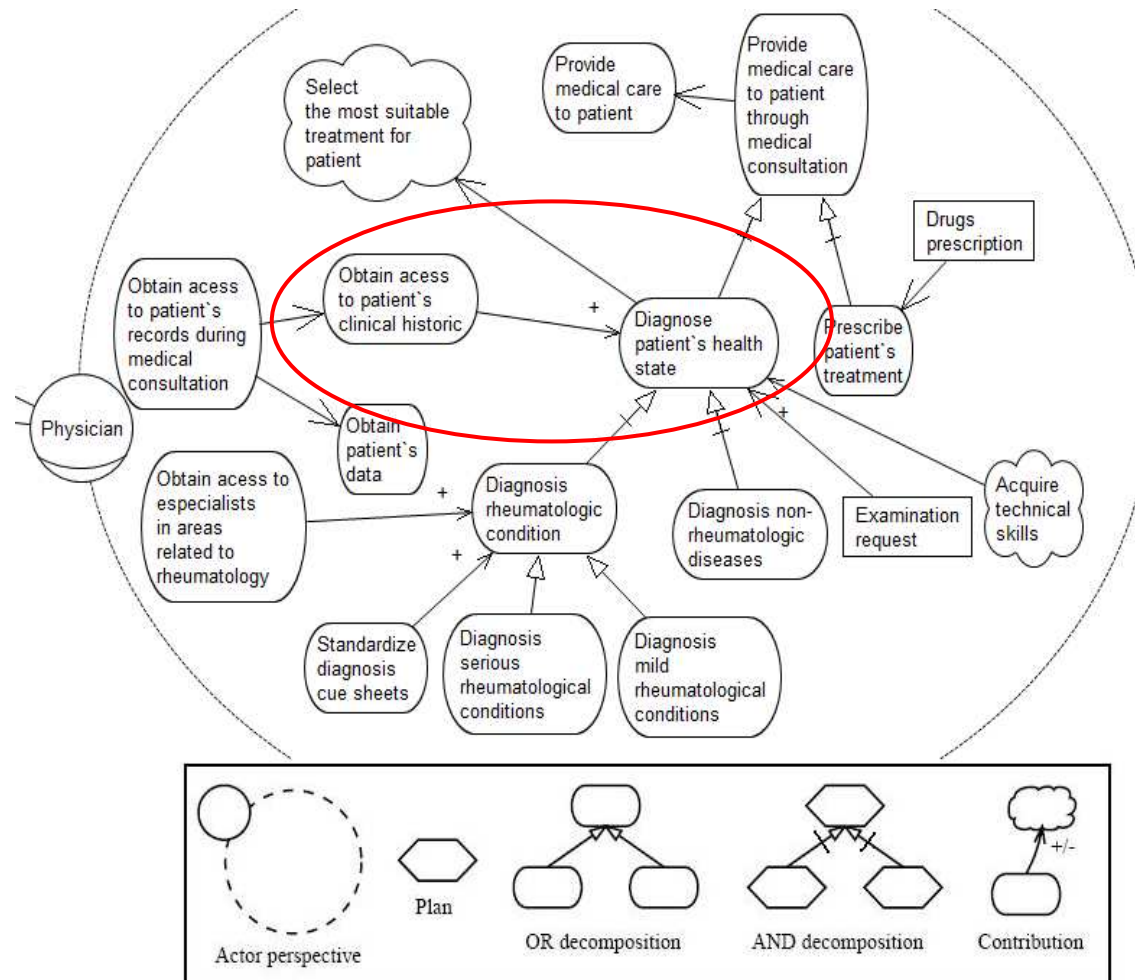
i*/Tropos - Example in the Health Care Domain



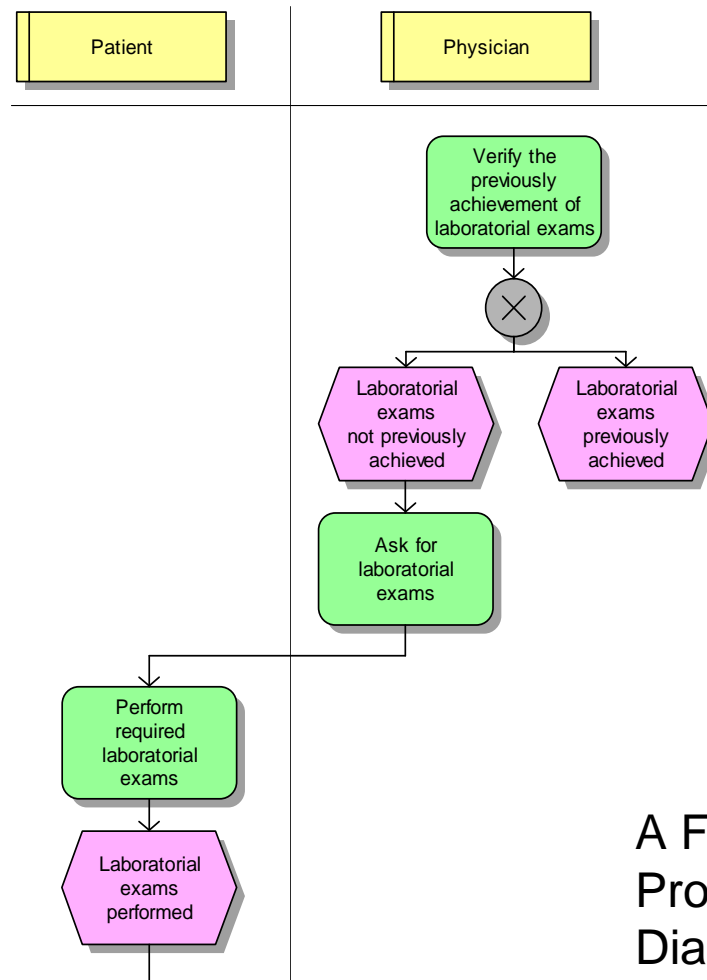
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i*/Tropos - Example in the Health Care Domain

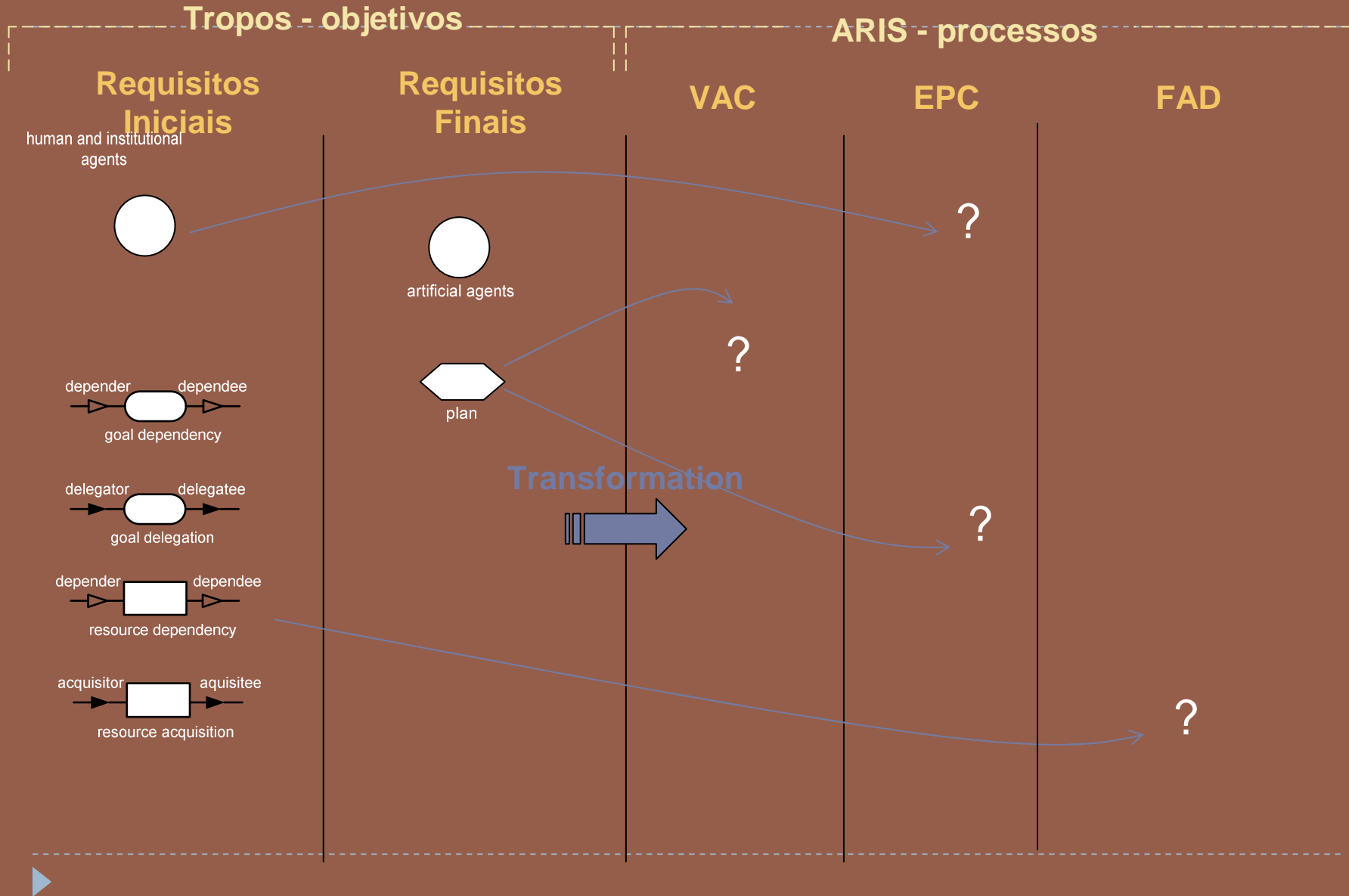


Example – BPM (ARIS-EPC)



A Fragment of a Business Process Model in ARIS: Diagnosing a Patient

Atualmente: Tropos+ARIS



Case Study

- ▶ A case study in a real organization was conducted with the purpose of supporting the investigation regarding the relations between goals and processes.
- ▶ Three phases:
 - ▶ *Elicitation phase*: goal models and BPMs were captured;
 - ▶ *Harmonization phase*: a goal taxonomy was created to help in the alignment of goals and BPs;
 - ▶ *Alignment phase*: UFO is applied to clarify the semantics of the elements of both models, enabling the alignment.



Elicitation Phase

- ▶ Preliminarily, standard methods were applied: interviews and observation of work.



process oriented goals

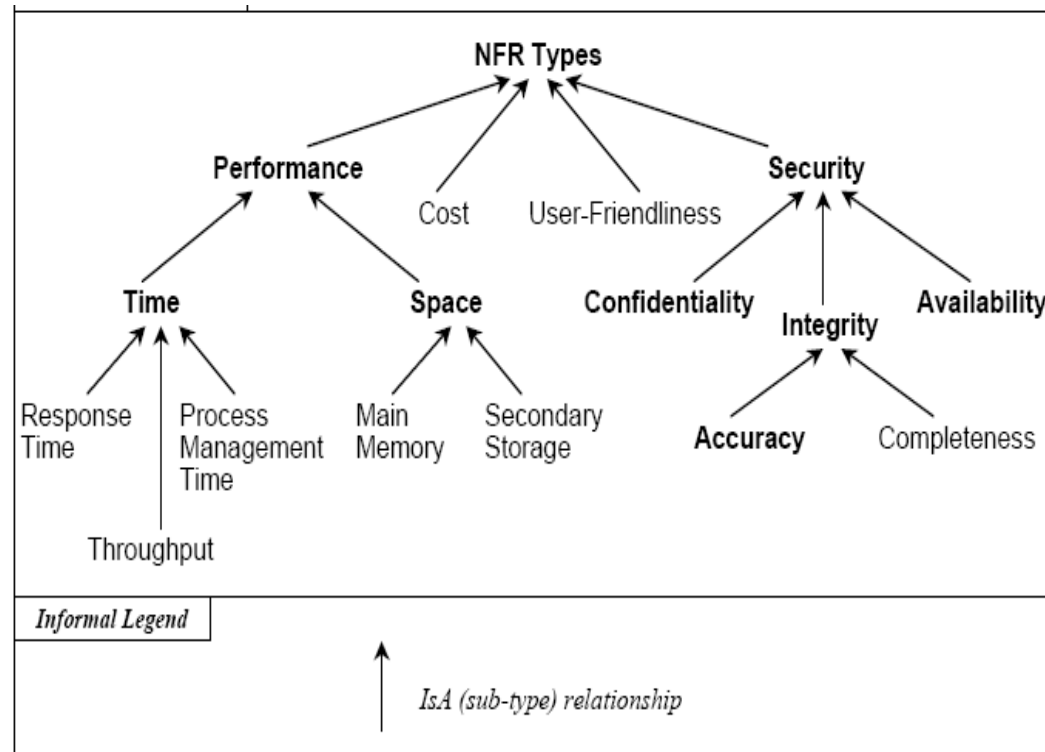
- ▶ Non Functional Requirements (NFR) Catalogues were applied, helping to elicit



allowed a more strategic point of view



NFR Catalogue (Chung et al., 2000)

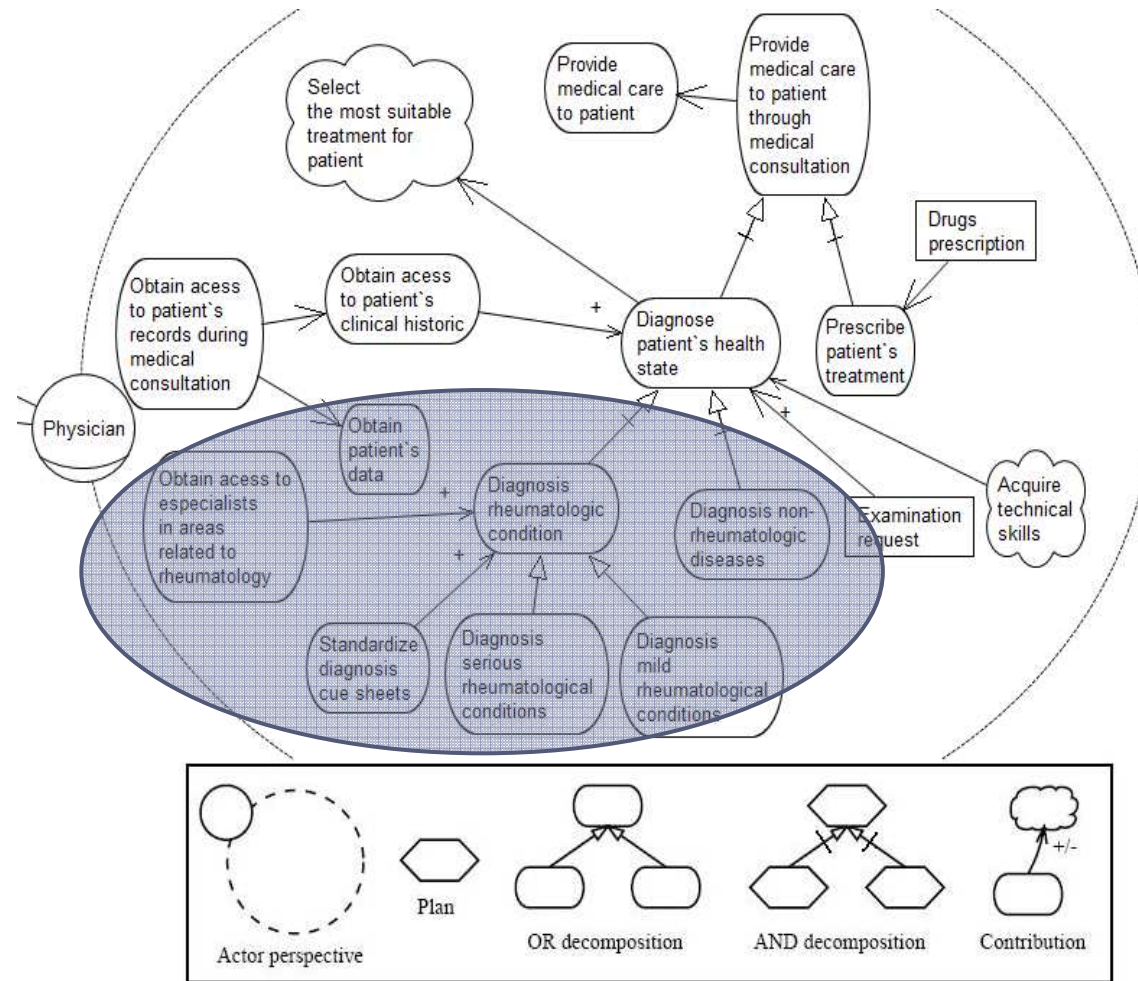


Adjusting NFRs BP Requirements

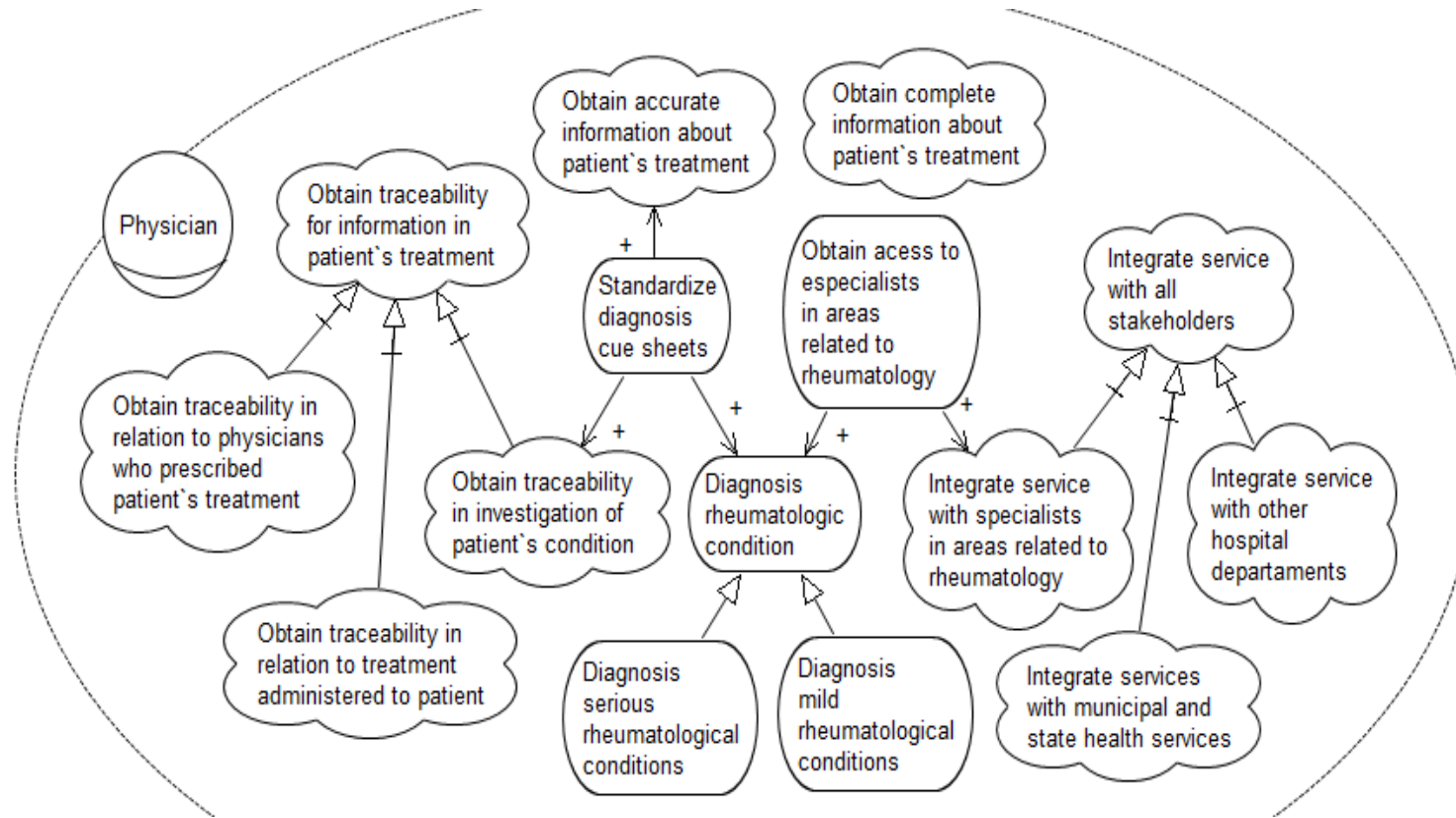
- ▶ NFRs have been originally proposed for system requirements elicitation. We should adjust them for eliciting BP requirements.
- ▶ Approach: translating NFRs to the medical goal domain, relating the existing NFR types to selecting goals in our models.
- ▶ One big distinction:
 - ▶ originally, they lead to Tropos softgoals
 - ▶ in our case, they may lead both to Tropos goals and softgoals.



A Model without NFR



A Model with Catalogue



A few examples

- ▶ **Accessibility** - Access patient's data records;
- ▶ **Confidentiality** - Maintain healthcare information private;
- ▶ **Completeness** - Obtain complete information about patient's treatment;
- ▶ **Accuracy** - Obtain accurate information about patient's treatment;
- ▶ **Traceability** - Obtain traceability for information in patient's treatment (refined into Obtain traceability in investigation of patient's condition, Obtain traceability in relation to treatment administered to patient and Obtain traceability in relation to physicians who prescribed patient's treatment);
- ▶ **Integrability** - Integrate service with other hospital departments, Integrate service with municipal and state health services and Integrate service with specialists in areas related to rheumatology;
- ▶ **Trust and confidence to the provider** (assurance) - Trust physician
- ▶ **Empathy** – provide patient with caring and personalized attention



Harmonization Phase

- ▶ Taxonomy to guide how goals connect to processes (or portions of processes)
- ▶ Total of 15 different goal types, classified according to 6 dimensions.
- ▶ Examples:
 - ▶ Dimension: Level of abstraction
 - ▶ Fundamental goal (provide medical care to patient)
 - ▶ Process goal (diagnose patient health state)
 - ▶ Activity goal (prescribe patient's treatment)
 - ▶ Dimension: Temporal Aspect
 - ▶ AS-IS (approve the treatment proposed by the resident)
 - ▶ Change goal (standardize diagnosis cue sheets)
 - ▶ TO-BE (coordinate patient care with other healthcare providers)



Ongoing Work

- ▶ Identify how the more detailed FAD model can assist in the integration of goals and processes.
 - ▶ FAD models rules, risks and and other concepts which present new challenges (in terms of ontological agreement) but also more modeling opportunities.
- ▶ Connect measurement strategies (e.g. using KPI – Knowledge Performance Indicators) to allow one to understand the impact processes have on goals.
- ▶ Tool support

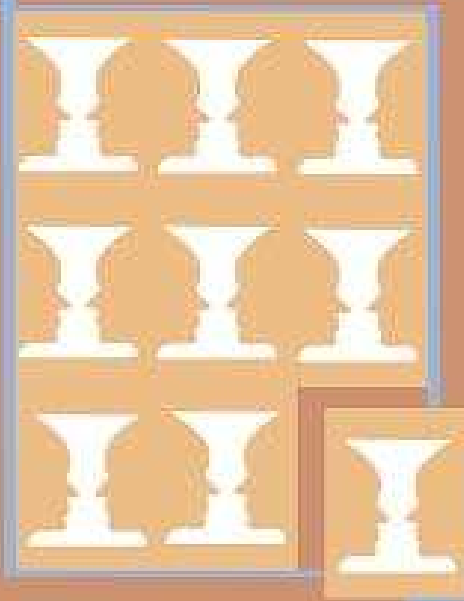


Conclusions

- ▶ Knowledge Management support should be pursued taking a top-down and bottom-up approach and negotiating the *intentions* of the **organizational top management** and the **knowledge holders**.
- ▶ Knowledge Management can be supported in different ways, especially by changing organizational **structure** and **process**, or by adding an **information system**.
- ▶ Our works investigate several issues regarding these three possibilities. This is still *ongoing work* with **many problems to solve** but we believe we are taking a **safe and adequate** direction.
- ▶ We welcome **all kinds of collaboration!** :)



AGENT-ORIENTED CONSTRUCTIVIST
KNOWLEDGE MANAGEMENT



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