



Protégé In Modeling Management Systems

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The Generic Management System Standard Phenomena

1. Generic Management System Standards provide requirements, guidance, models and conceptualization for company-wide management processes and organizational artifacts at highest level of abstraction;
2. 100.000s of organizations in all types of industries applying **GMS** Standards for diverse Management domains (E.g. ISO 9000 [Quality Management], ISO 14000 [Environmental management]), Information Security Management; **GMS** are independent from size, type and culture of organizations; Independent from industrial context;
3. More types of **GMS** standards gaining popularity: Information Security Management, Accounting, sigma project for sustainability Management etc.
4. Serve as Contractual requirements; good practice models;





3 types of Management System Standards

- ◆ Type A: management system requirements standards, both generic and sector-specific. E.g. ISO 9001, 14001, ..**defines requirements** about what to do. No requirements about how to do.
- ◆ Type B: management system guidelines standards, both generic and sector-specific. ISO 9004, 14004,...**gives advice** about how problems can be solved
- ◆ Type C: management system related standards; E.g. ISO 9000 (*concept definition, approaches or guidance on related supporting techniques*)

Refer to ISO GUIDE 72

- ◆ GMS standards **embedding knowledge** which can be applied in all organizations. They can be re-used in all types organizational modeling





Concepts used in standards are difficult to grasp – need for shared conceptualization–

- ◆ Customer; Who is it ?
- ◆ Product Design; what is it?
- ◆ Delivery; What does it mean ?
- ◆ Nonconforming product
- ◆ Contract
- ◆ Product
- ◆ Quality
- ◆ Effectiveness of processes and Systems
- ◆ In a jail; school?
- ◆ for a chemical product?
- ◆ in the service industry?
- ◆ For a software product?
- ◆ In an university?
- ◆ in the service industry?
- ◆ of a service?of an financial advice
- ◆ For an artificial conceptual system?





*Concepts used in standards are difficult to grasp
– need for shared conceptualization–*

Effective application needs

Ontological Commitment





Problems with implementing GMS Standards - an ontological solution -

Problem

1. Implemented systems reflect often organizational reality not sufficiently;
inconsistencies tamper effectiveness of system
2. Documentation systems rather than Management Practice
3. Integration of TQM and general Management tools difficult
4. Deployment of IT systems not harmonized

Solution

1. Maintaining consistency as organizational ontology
2. Semiautomatic generation of system documentation in line with Management Practice
3. Implementing Management tools by integration of tool ontology in the overall model
4. Using model as communication platform for IT projects





Need for Ontology in GMS

- ◆ Lack of shared conceptualization
 - ❖ E.g. Concept of nonconformity, Intangible products, design in service sector
 - ❖ Language barriers in translation problems (servicing, contract)
- ◆ Organizational Modeling in compliance
 - ❖ Workflow, ERP, Security Models, IT solutions





GMS requirement standards and guidance documents as Problem solving methods (PSMs)

- ◆ **GMS Standards provides not only concepts and roles in organizations; general applicable control processes to be applied in dealing with problems and also achieving goals**
- ◆ **GMS standard requirements defines management context-independent reasoning**
- ◆ **GMS specify management behavior which can be used across all industries**
- ◆ **Industrial domain-independent reasoning components**
- ◆ **Specify patterns of behavior which can be reused across different management systems**





Potential of GMS

- vision of a shared management conceptualization-

- ◆ Creating a globally shared conceptualization of organizational domains (quality, Information technology, environmental issues...) as reservoir of components for organizational modeling
- ◆ Reservoir for re-usable organizational concepts
- ◆ Using GMS as Generic upper management model for a formal conceptualization of methods and concept ontologies
- ◆ An ontology which embraces concepts from products to conceptual models like Management Systems
- ◆ Base for Generic organizational Management Modeling
- ◆ Reference model for defining constraints in IT development





Goal 1 - An Ontology Editor for the Management Domain

- ◆ Generating, maintaining, communicating, exchanging Organizational domain and Process Ontologies
- ◆ Designing Organizational Structures and Processes
- ◆ Maintaining Consistency of all organizational concepts
- ◆ Integrating Ontologies from Product/Service level up to Organizational Conceptual level
- ◆ Maintaining Compliance with diverse GMS





Goal 2 – Building a GMS ontology

- ◆ Create a generic ontology based meta-model which:
 - ❖ Support **implementation, maintenance and operation** of Management Systems based on GMS ; especially requirement standard (A-type)
 - ❖ To **integrate concepts** related to all types of organizational artifacts in one consistent model; **from product, service definition to organizational strategic concept**
 - ❖ Building a library of **Generic Management Problem Solving Methods (GM PSM)**
 - ❖ To provide a **framework for maintaining a sharable library of TQM and other organization tools** so that they can be used in a manner like PSM





Generic Management Standards as Ontologies

- ◆ Generic Management standards (GMS) can be understood as upper domain ontologies of organizational realities
- ◆ Generic Management standards defines ontologies
- ◆ Requirement standards defines generic reusable Methods





Benefits

- ◆ Support for building Virtual enterprises in compliance with management standards
- ◆ Support for business process design
- ◆ Support for defining and communicating constraints on IT solutions
- ◆ Support for necessary Management System documentation





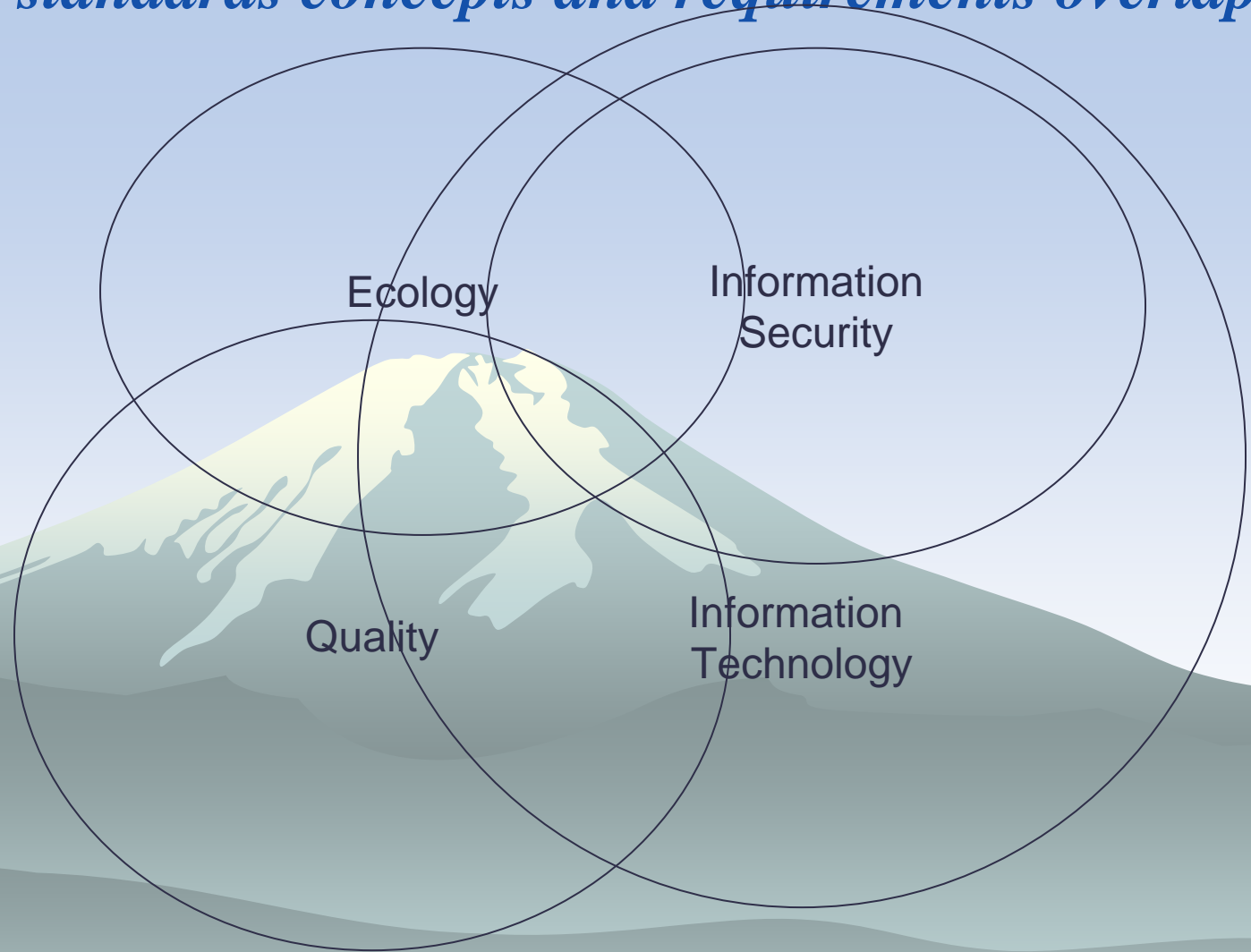
Advantages of the ontology

- ◆ Management of consistency in organizational model development
- ◆ Exchange of organizational models, visualization
 - ❖ horizontal, Vertically, domain expert - IT experts
- ◆ Machine-processable semantics of models
- ◆ Company-wide, cross-organizational process design
- ◆ Process/system auditing support
- ◆ Process Simulation
- ◆ Process Documentation
- ◆ Merging of domain ontologies
- ◆ Consistent Database design





GMS standards concepts and requirements overlap

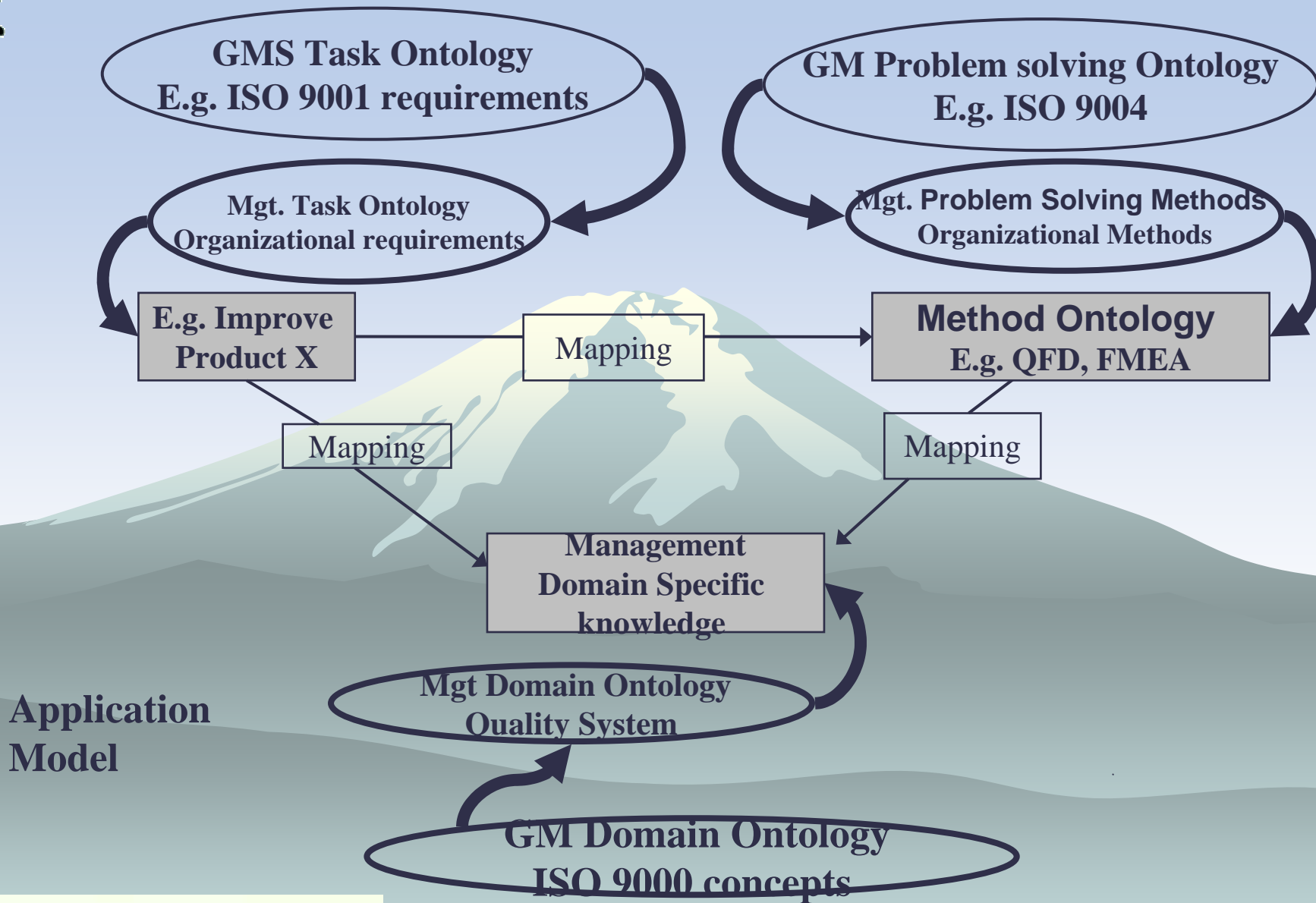


Processes and concepts of different domains can be reused





Interrelationship between Upper Generic and specific Management Ontologies





Used tools and concepts

- ◆ **GMS Standards** (Type A,B,C) as upper management domain ontology (ISO 9000, ISO 14000, BS 7799-2)
- ◆ **OPM(L)** as *ontology specification language*
 - ❖ Domain independent, used for product to conceptual systems, backward compatible to UML, fits to process approach of GMS; parts also used in Bio ontology
- ◆ **Protégé** as ontology editor
 - ❖ Visualization tools, UPML, PSM tab





Basic Generic Ontologies

- ◆ ***Generic (Quality) Management Method Ontology*** - specify the definitions of the relevant concepts and relations used for specifying the reasoning process (problem solving) to accomplish a generic management task (PDCA, Process approach). (ISO 9001:2000 requirements); For QM the domain ontology is composed of the definitions of all parts, features, relationships and concepts necessary to talk about QM
- ◆ ***Generic (Quality) Management Task Ontology*** - specifies the terminology associated with the type of task to be solved in the (Quality) domain , design, review, etc. (ISO 9000:2000 concepts)
- ◆ ***Generic (Quality) Management Domain ontology*** – generic conceptualising the particular domain, e.g. quality, contract, (ISO 9000:2000 concepts)





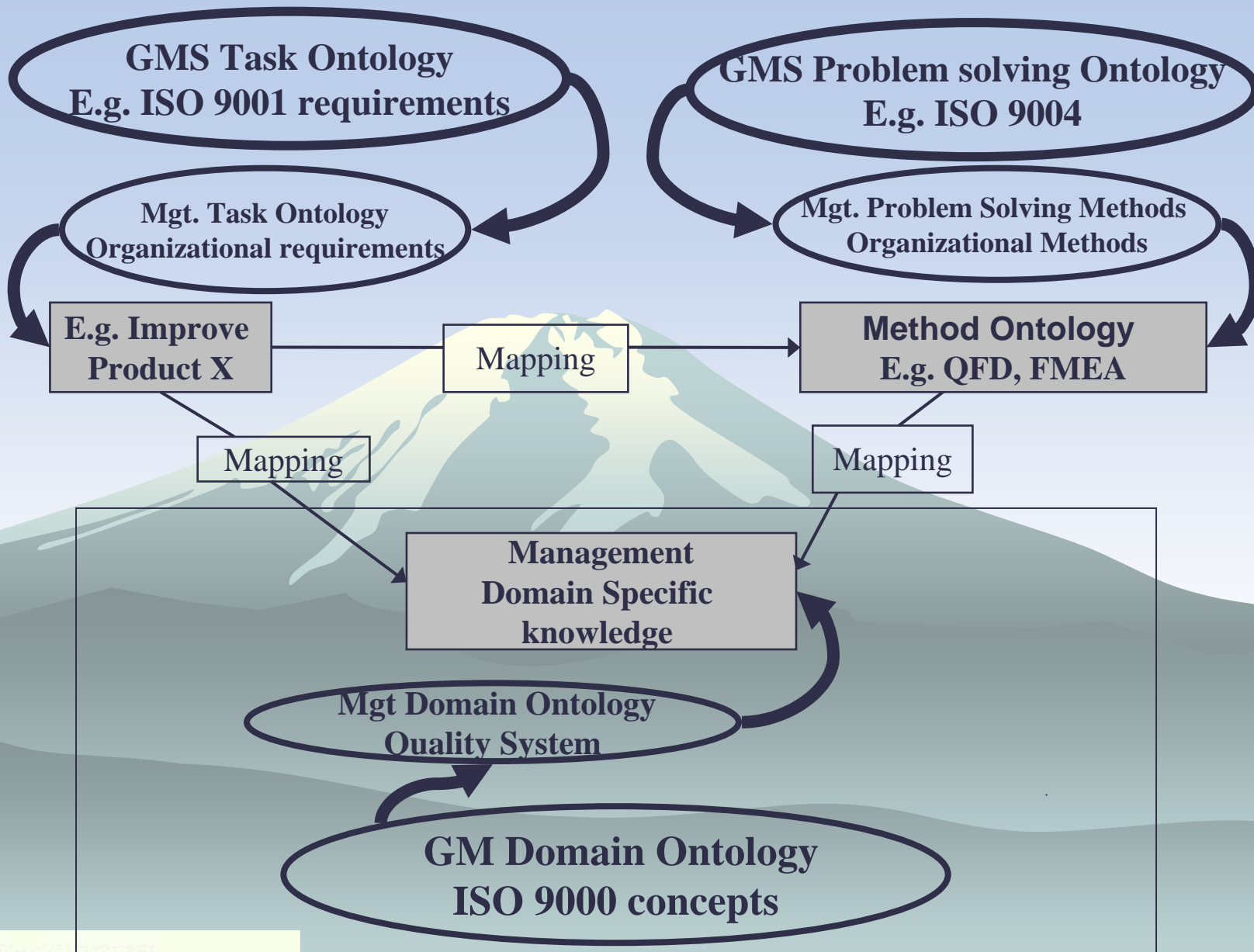
Basic Management Ontologies

- ◆ *Management Method Ontology* - specify the definitions of the relevant concepts and relations used for specifying the reasoning process (problem solving) to accomplish a management task. Inheritance from Generic Ontology
- ◆ *Management Task Ontology* - specifies the terminology associated with the type of task, e.g. scheduling, planning etc. Inheritance from Generic Ontology
- ◆ *Management Domain ontology* - conceptualising the particular domain, e.g. job-shop scheduling in quality widget etc. Inheritance from Generic Ontology
- ◆ *Management Application ontology* - contains the essential knowledge in order to model a particular application under consideration.





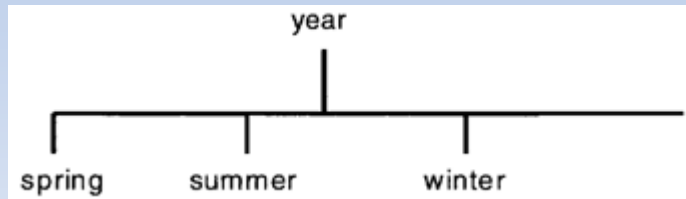
Interrelationship between Upper Generic and specific Management Ontologies



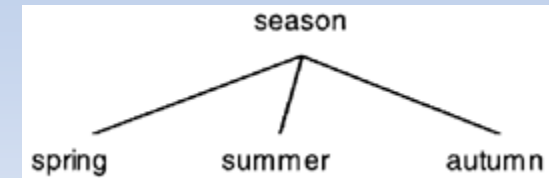


ISO 9000:2000 and Generic Domain Ontology

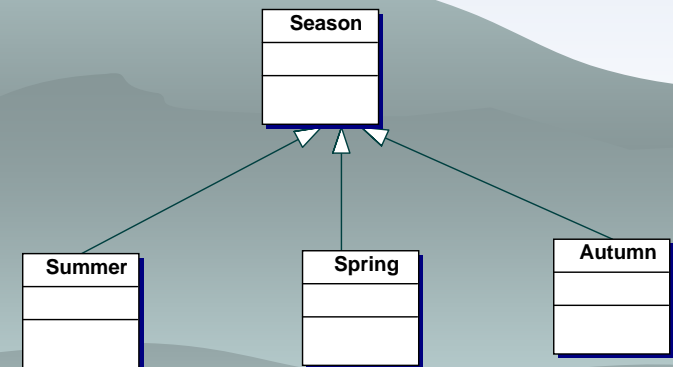
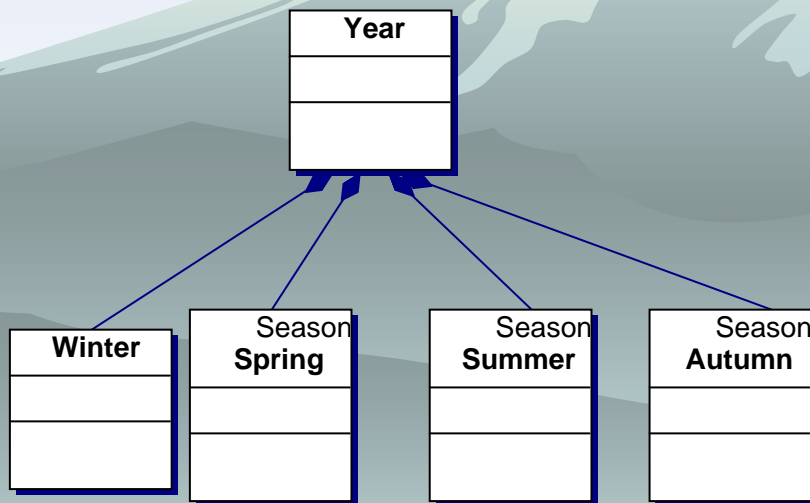
Consist-of



Is-a



ISO 9000:2000 Notation



UML Notation





ISO 9000:2000 and Ontology concepts

ISO 9000:2000 provides generic concepts and relations which can be understood in ontological terminology.

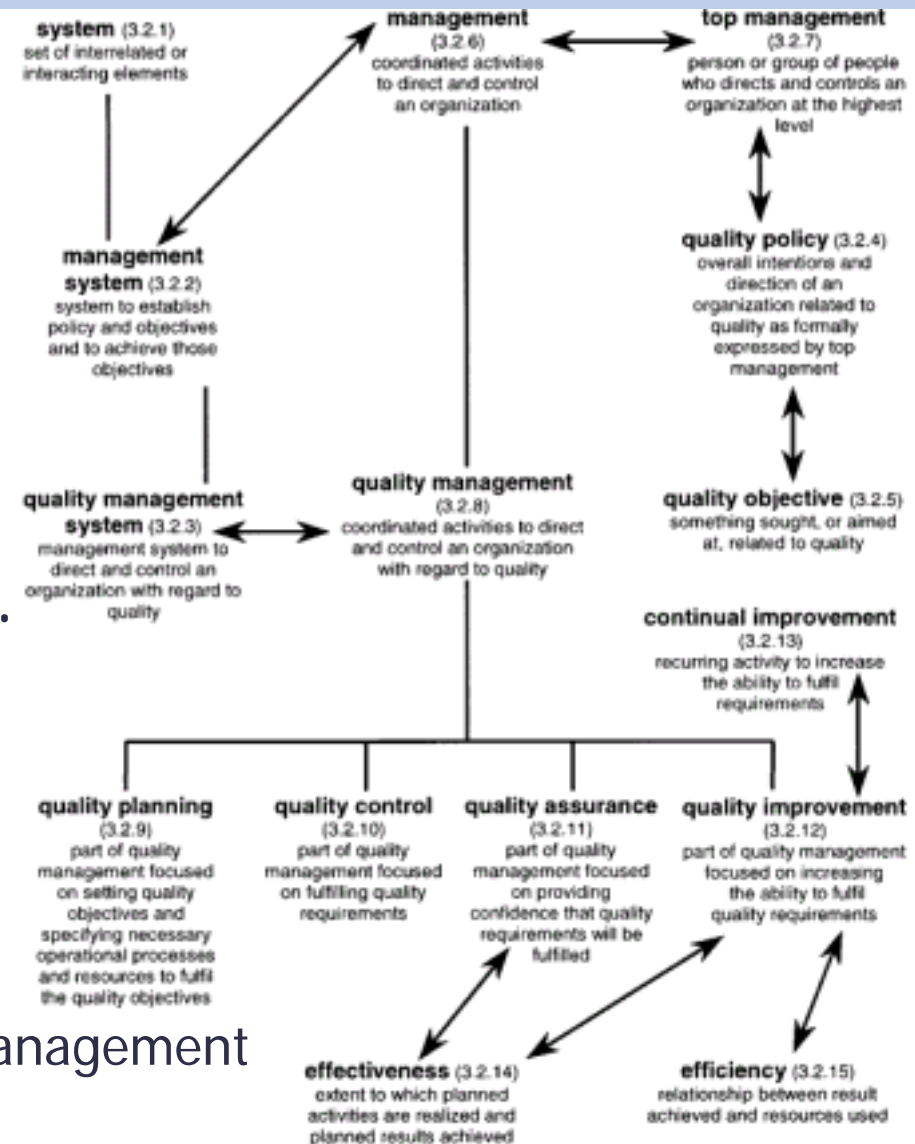
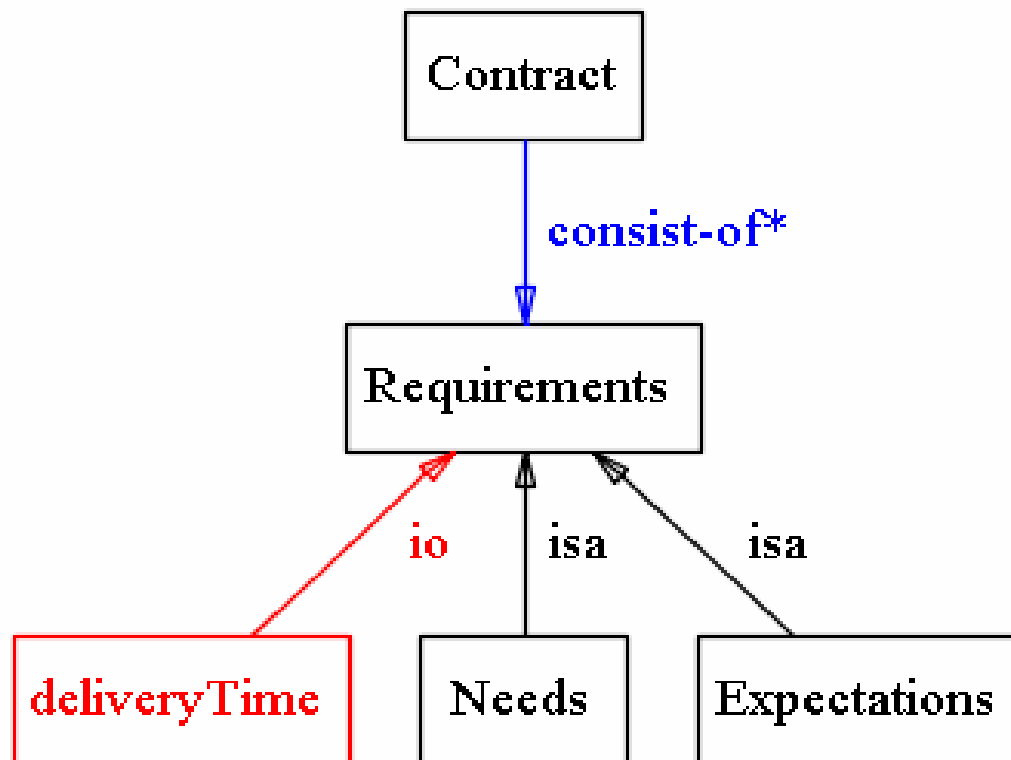


Figure A.5 :Concepts relating to management





ISO 9000 based Management Ontology





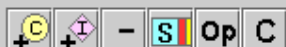
Example

◆ A WebTrading.Ltd Ontology with Protege





Config



frame	sub	sup	slx	isx	slt	sle	ins	sy
Organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Classes

- THING
- SYSTEM-CLASS
- WordNet_ROOT
- ISO9000's Concepts
 - Concepts Relating to Quality (1)
 - Concepts Relating to Management
 - Concepts Relating to Organization
 - Organization (1)
 - Organizational structure
 - Infrastructure
 - Work environment
 - Interested party
 - Supplier
 - Customer (1)
 - Concepts Relating to Process and P
 - Concepts Relating to Characteristics
 - Concepts Relating to Conformity
 - Concepts Relating to Documentation
 - Concepts Relating to Examination
 - Concepts Relating to Audit
 - Concepts Relating to Quality assurance
- Common concepts

Organization

io

WebTrading

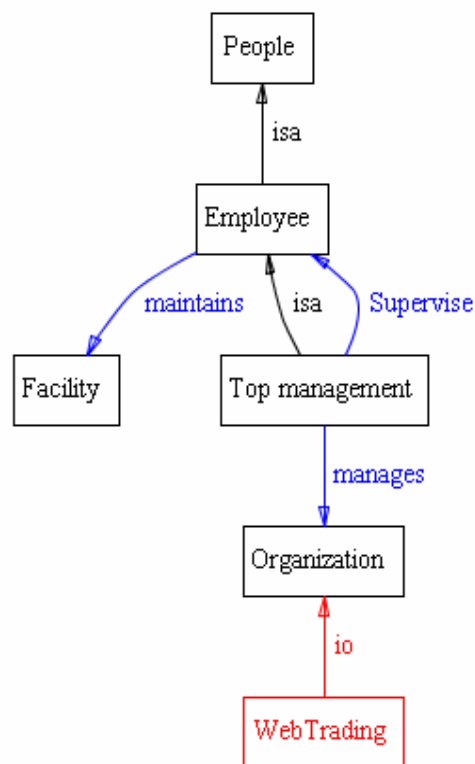


Config

frame	sub	sup	slx	isx	slt	sle	ins	sy
Organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
People	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Employee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Top manag...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Classes

- Concepts Relating to Documentation
- Concepts Relating to Examination
- Concepts Relating to Audit
- Concepts Relating to Quality assurance
- Common concepts
 - Statement
 - Obligation
 - Implication
 - Contract
- People
 - Employee (1)
 - Top management (1)
- Software
- Influence
- Feature
- Responsibility
- Authority
- Relationships
- Facility (1)
- objectives
- testgra_iso_concept027_00525
- Part



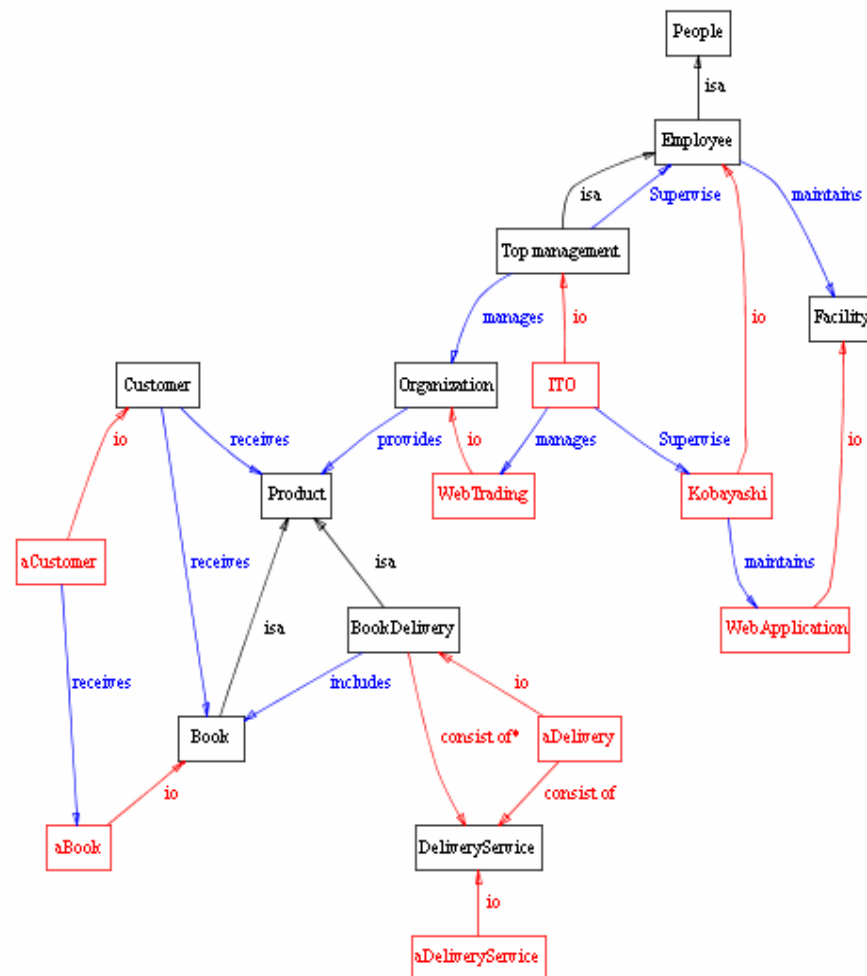


Config

frame	sub	sup	slx	isx	slt	sle	ins	sys
Employee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Top manag...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Customer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
DeliveryServ...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Book	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
BookDelivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Product	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Classes

- Concepts Relating to Quality (1)
- Concepts Relating to Management
- Concepts Relating to Organization
 - Organization (1)
 - Organizational structure
 - Infrastructure
 - Work environment
 - Interested party
 - Supplier
 - Customer (1)
- Concepts Relating to Process and Production
 - Process
 - Product
 - Book^M (1)
 - BookDelivery^M (1)
 - Procedure
- Concepts Relating to Characteristics
- Concepts Relating to Conformity
- Concepts Relating to Documentation
- Concepts Relating to Examination
- Concepts Relating to Audit
- Concepts Relating to Quality assurance f





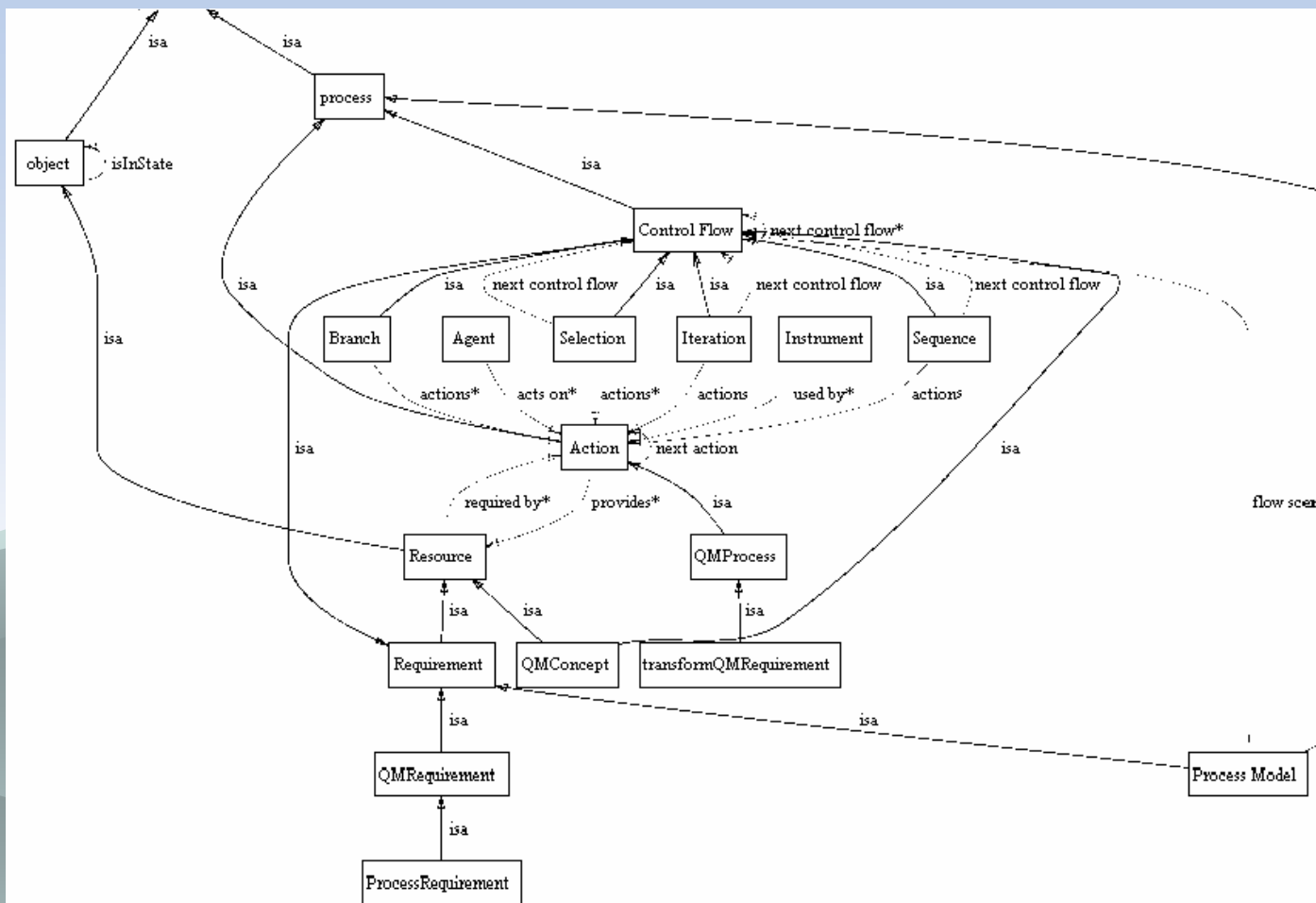
Modeling dynamic structures

- ◆ Processes needs to be modeled as Ontologies
- ◆ We use the same ontology as proposed by see John Georga
(<http://www.ics.uci.edu/~jgeorgas/ics225/procmodel.htm>)





Process requirements are modeled as dynamic structures - A process ontology



Based on (PML) :XXXXXXXXXXXXXXXXXXXX



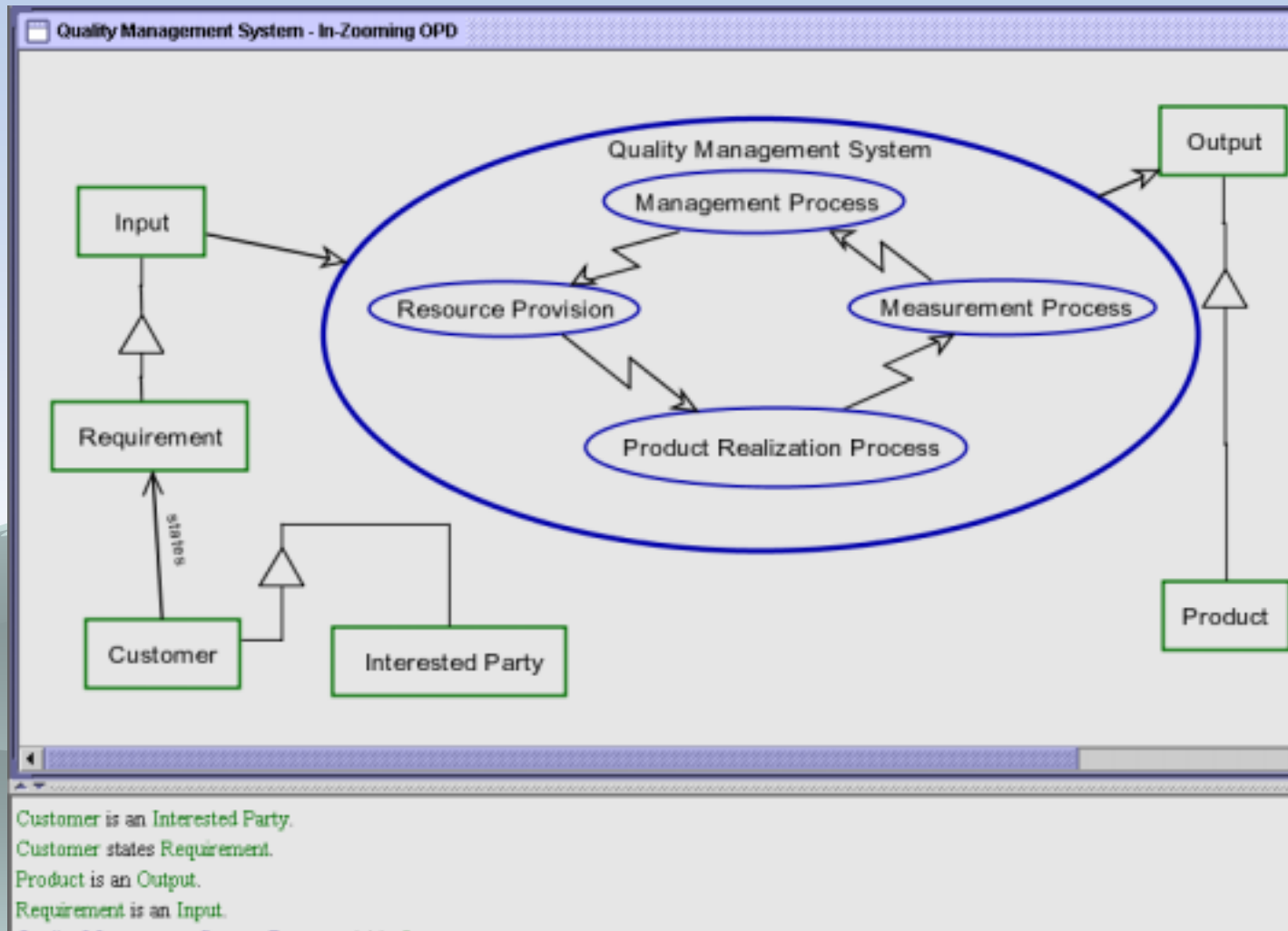
OPM as general Systems modeling language

- ◆ Need for a rich ontology specification language for GMS process modeling
- ◆ Implementation of Management Systems needs design of
 - ❖ Conceptual Systems,
 - ❖ Product design,
 - ❖ Process models
- ◆ As used in **Biological Processes Ontology**
- ◆ Details at <http://dori.technion.ac.il/opm/>



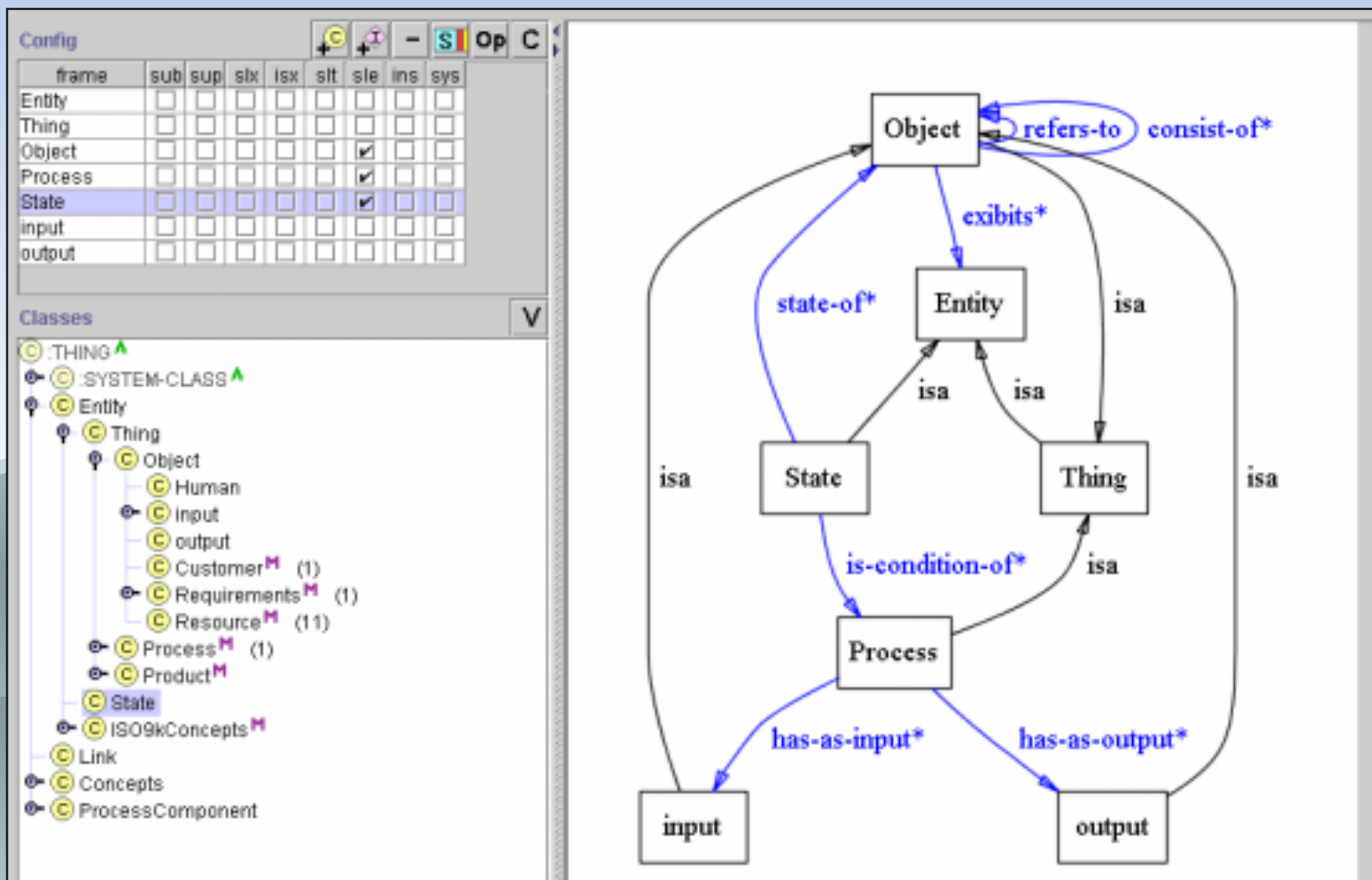


OPM fits naturally to the so called process approach in GMS standards





Object-Process Language as Ontology





Zoom-in the Product Realization Process

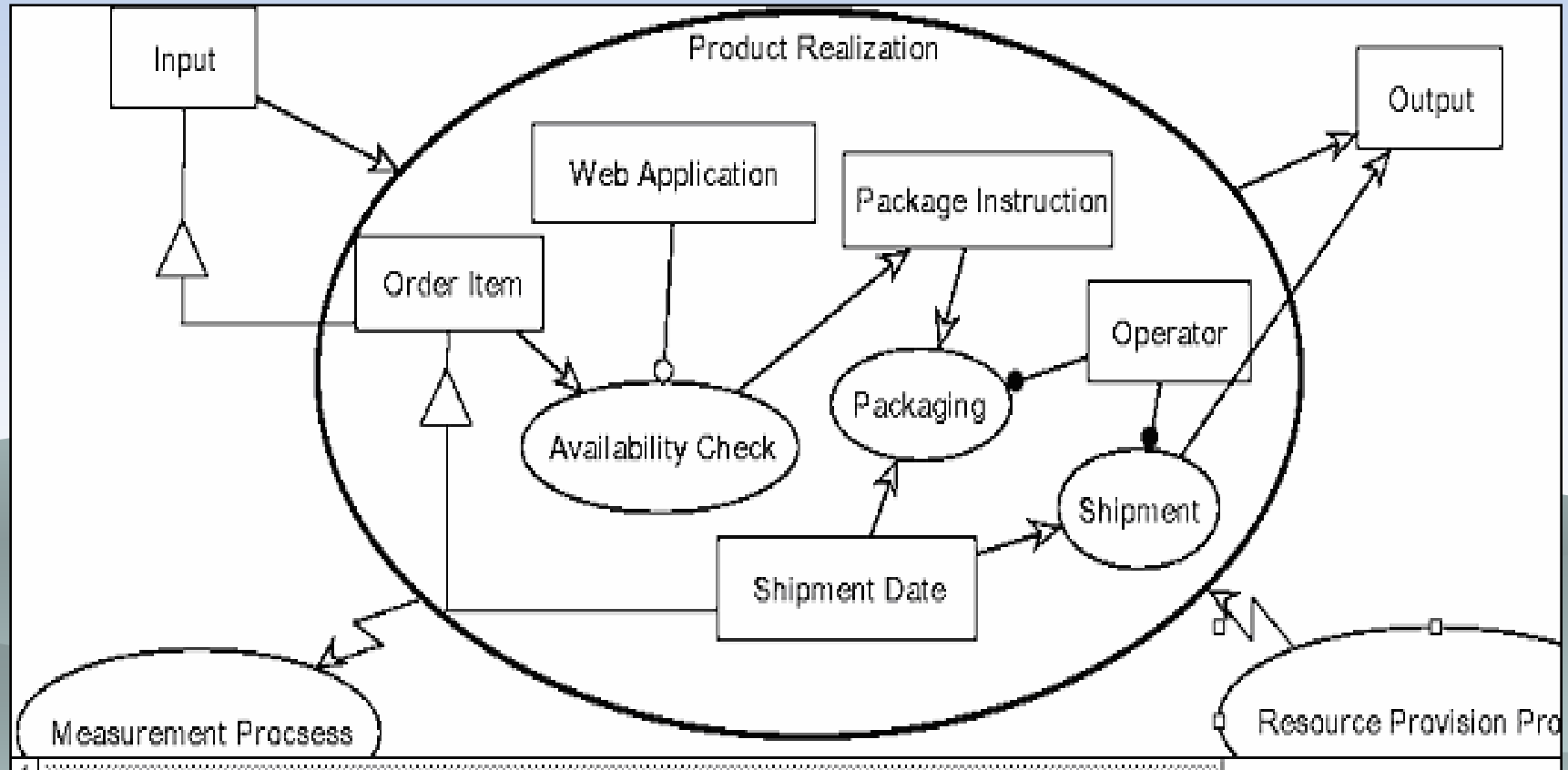


Fig. 6 Zoom -in of a product realization process



The Graph Widget visualize OPD

Classes Slots Forms Instances Queries Ontoviz

Classes

- Resource (11)
- Process (1)
- Product
- State
- ISO9kConcepts
 - Concepts_Relating_to_Quality
 - Quality (4)
 - Grade (1)
 - Customer satisfaction (3)
 - Capability
 - Requirements (1)
 - Needs
 - Expectations
 - Concepts_Relating_to_Management
 - System
 - Quality policy (1)
 - Quality objective (1)
 - Management (1)
 - Top_management (1)
 - Quality planning
 - Quality control
 - Quality assurance
 - Quality improvement
 - Continual improvement
 - Effectiveness

deliveryTime (type=Requirements)

☒ Informatical

Is-input-to

Process
Project
Design and development

ContractReview

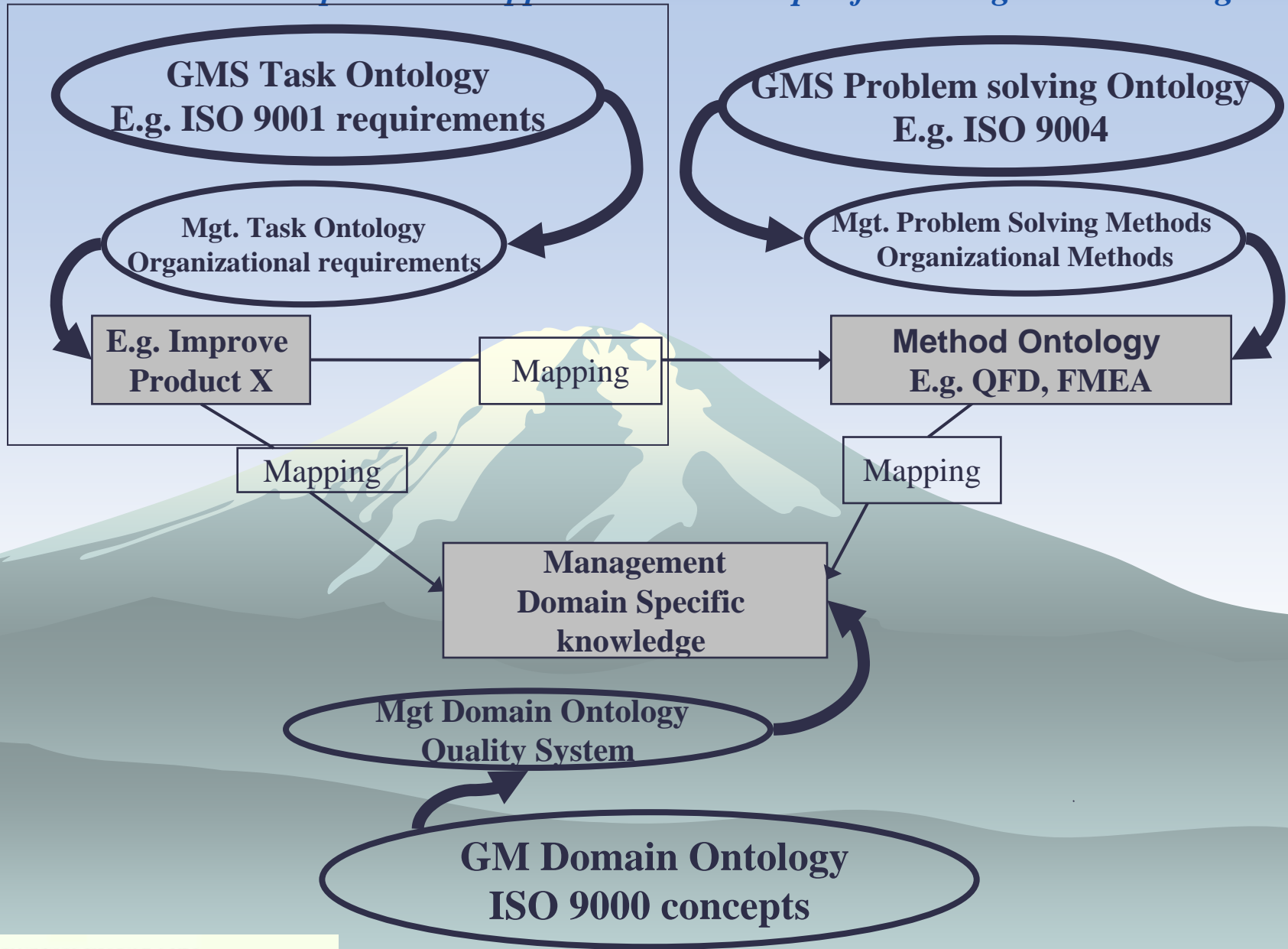
Originated-by

Kobayashi





Interrelationship between Upper Generic and specific Management Ontologies





Requirement of BS 7799:2002 part 2 are specialization of ISO 9001:2000

ISO 9001:2000 8.5.2 Corrective action: The organization shall take action to eliminate the **cause of nonconformities** in order to prevent recurrence. Corrective actions shall be appropriate to the effects of the nonconformities encountered. **A documented procedure** shall be established to **define requirements** for

- a) reviewing nonconformities (**including customer complaints**),
- b) **determining the causes of nonconformities**,
- c) **evaluating ..need for action to ensure .. nonconformities do not recur**,
- d)

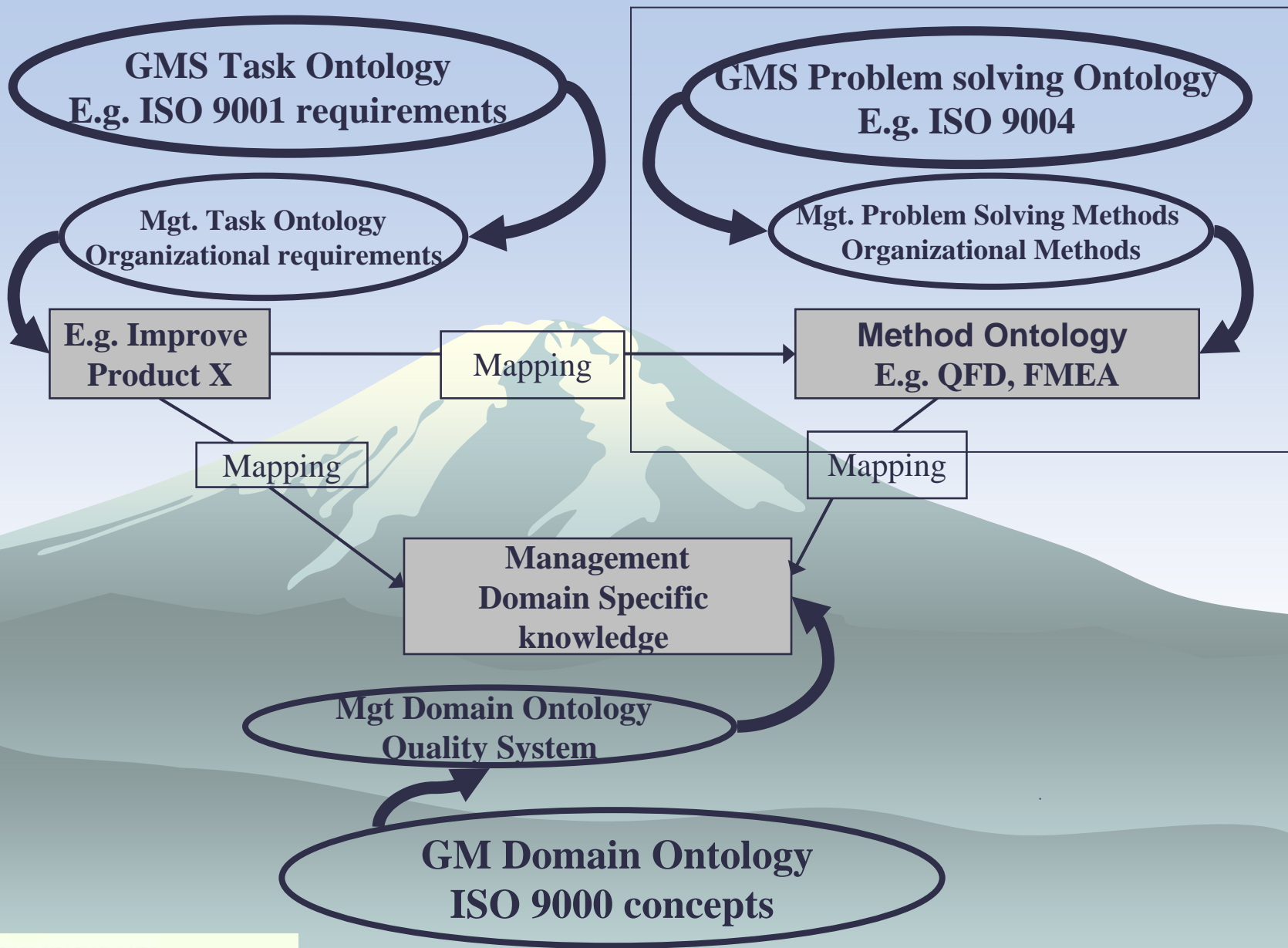
BS 7799:2002 part 2 7.2 Corrective action: The organization shall take action to eliminate the **cause of nonconformities** associated with the implementation and operation of the ISMS in order to prevent recurrence. **The documented procedures** for corrective action shall **define requirements** for:

- ◆a) **identifying nonconformities of the implementation and/or operation of the ISMS;**
- ◆b) **determining the causes of nonconformities;**
- ◆c) **evaluating .. need for actions to ensure ..nonconformities do not recur;**
- ◆d)





Interrelationship between Upper Generic and specific Management Ontologies





- ◆ A repertoire of 60 TQM tools are used in Japan which specify how to solve organizational problems
- ◆ These tools can be configured to specific domain ontologies (in UPML)
- ◆ Artifacts are mapped to or instantiated from generic concepts (Quality characteristic, preventive actions (FMEA))





Potential Application of the GMS ontology

- ◆ Management System Documentation
- ◆ Auditing of Virtual enterprises for compliance issue (no chance in physical world)
- ◆ Design, development and Maintenance of Management System
- ◆ Knowledge representation
- ◆ Database design
- ◆ Information retrieval procedure
- ◆ Software engineering of Workflows consistent with Management Systems Requirements
- ◆ Information systems in general





Summary

- ◆ ISO 9000:2000 concepts modeled as ontology
- ◆ OPM(L) as language constructs for specification of all artifacts and organizational concepts
- ◆ GMS requirement standards to be modeled as PSM library
- ◆ Advantages:
 - ❖ Using ontologies to construct models in a principled manner
 - ❖ Universal modeling approach as reference for IT
 - ❖ Support of design, implementation and maintenance of management systems
 - ❖ Integration of TQM tools





References

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- ◆ Dov Dori, Object-Process Methodology - A Holistic Systems Paradigm Springer Verlag, Berlin, Heidelberg, New York, 2002 ; <http://www.sightcode.com/>
- ◆ Software Process Modeling with Protégé
<http://www.ics.uci.edu/~jgeorgas/ics225/procmodel.htm>





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