Ontologies at Ericsson
Why and How

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Background Lars Taxén

- **M.Sc. KTH 1968**
- **Ericsson 1968 - 2003**
  - Development methods for hardware and software
  - Global information system support for coordination
- **Doctoral studies Linköping University 1998 - 2003**
  - "A Framework for the Coordination of Complex Systems' Development"
- **Now researcher and consultant**

"There is nothing so practical as a good theory." (Kurt Lewin)

Background Lars Taxén

- **M.Sc. KTH 1968**
- **Ericsson 1968 - 1990**
  - Tools, methods, processes
- **Ellemtel 1990 - 1996**
  - Development methods for hardware and software
- **Ericsson 1996 - 2002**
  - Global development of large telecom systems, information system support for coordination
- **Doctoral studies Linköping University 1998 - 2003**
  - "A Framework for the Coordination of Complex Systems' Development"
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Outline

- **Definitions of ontology**
- **Telecommunication systems**
- **"Pragmatic" ontologies at Ericsson - why and how**
- **"Formal" ontologies in the literature**
- **Comparison**
- **Discussion**
- **Conclusions**

Ontology in philosophy

"Ontology studies being or existence as well as the basic categories thereof—trying to find out what entities and what types of entities exist. Ontology has strong implications for the conceptions of reality."

Definition

"Ontologies are content theories about the sorts of objects, properties of objects, and relations between objects that are possible in a specified domain of knowledge. "

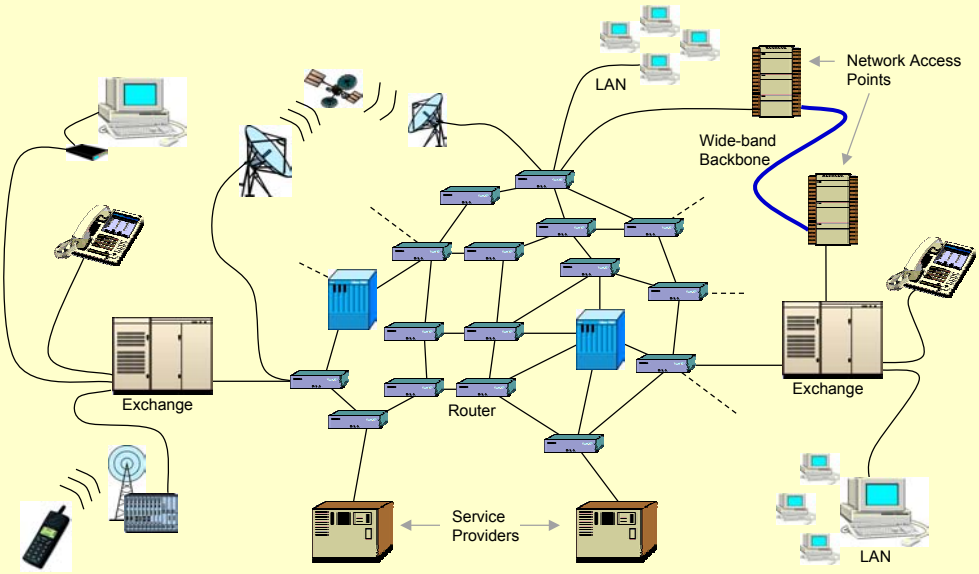
Chandrasekaran et al. (1999) "What Are Ontologies, and Why Do We Need Them?"
IEEE Intelligent Systems, Jan/Feb 1999

Two types of ontologies

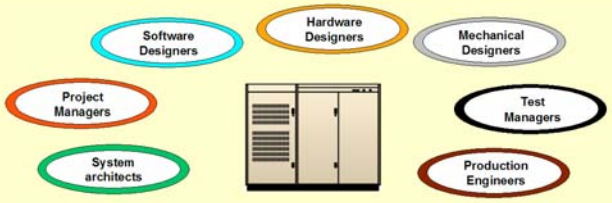
- **"Pragmatic" ontologies**
  - "Context models" at Ericsson
  - Used to coordinate complex development projects
  - Social action theories (Activity Theory, Structuration Theory, Actor Network Theory, etc.)
- **"Formal" ontologies**
  - Origin in the AI community
  - Currently "hot topic" in the Semantic Web
  - First-order logic

Telecom background

The telecom network



Developing a node



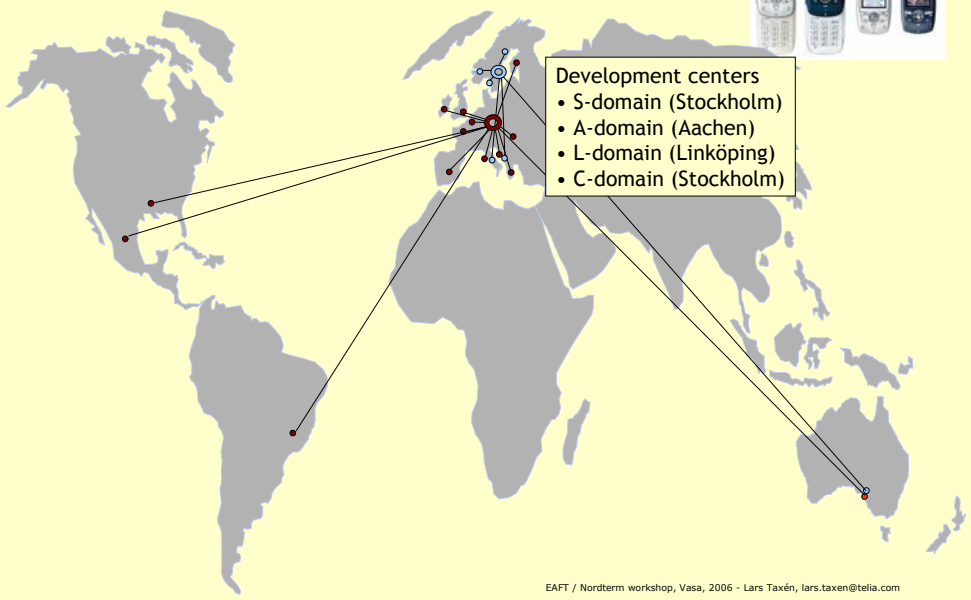
Drivers

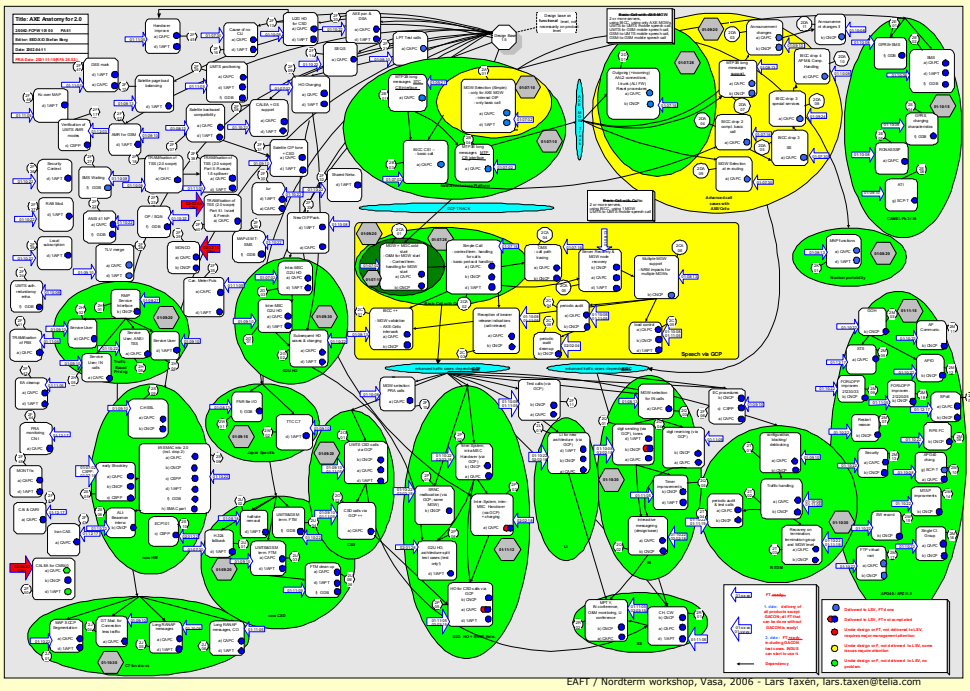
- Market push
- Shorter time to market
- More competitors
- Less margins
- Shorter product life cycles
- Technological complexity
- Standardization
- Change

Issues

- Development lead-times
- Coordination and dependencies
- Progress follow-up
- Culture - disciplines
- Geographical distribution
- Commitments and responsibilities
- Competence
- Quality

Development of 3G mobile systems





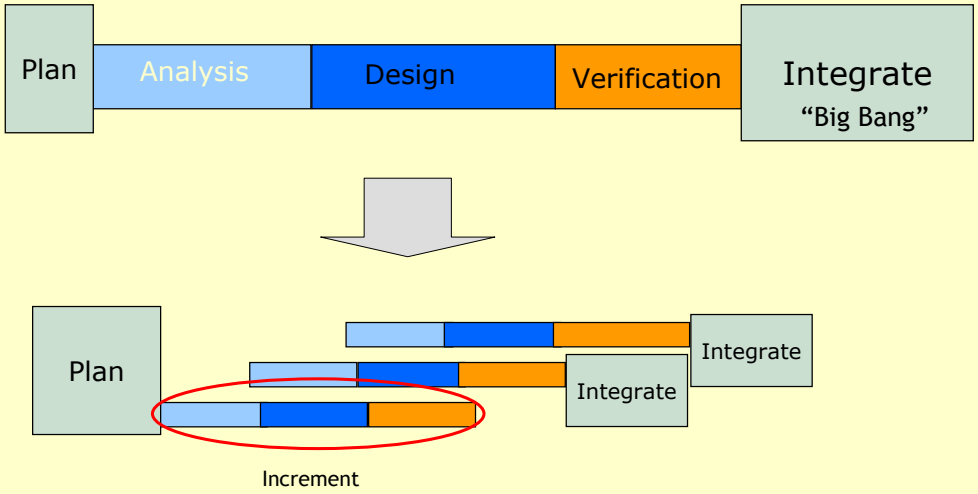
Coordination

- **"The management of dependencies btw activities"**
  - Malone & Crowston, 1994
- **Communal meaning about how to coordinate**
  - requirements
  - engineering change orders
  - products
  - documents describing products
  - test cases
  - integrations
  - baselines
  - milestones
  - deliveries
  - ...
- **Information system support**

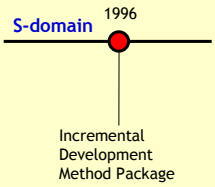
"Pragmatic" ontologies at Ericsson

- a historical Odyssey

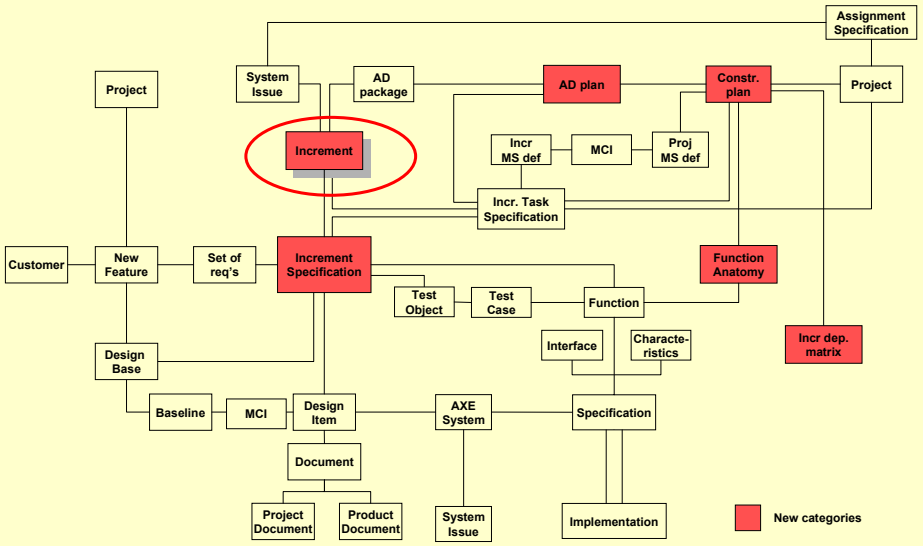
From waterfall to integration centric development



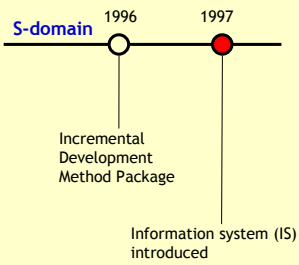
Method development



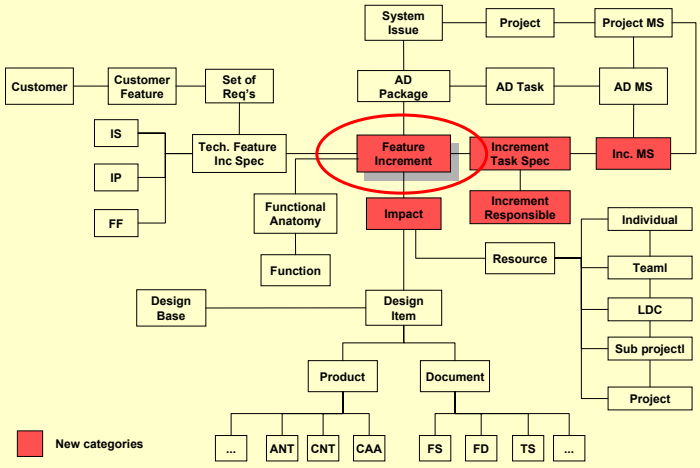
Context model S-domain 1996



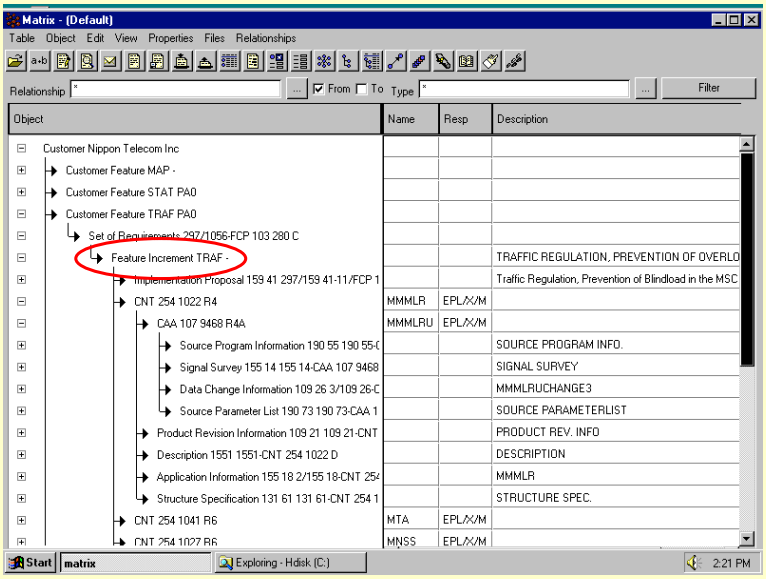
Information system support



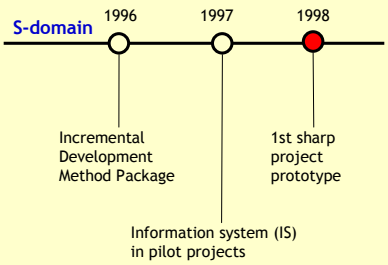
Context model S-domain 1997



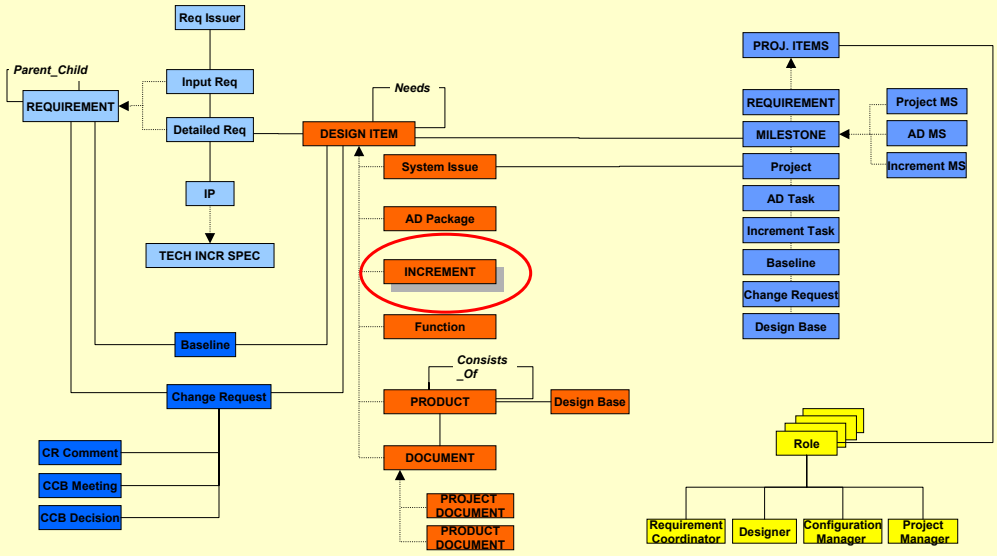
IS support for the context model S-domain 1997



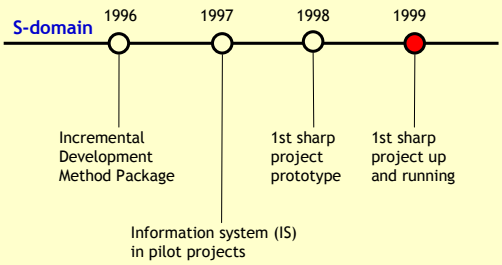
Prototyping “real” usage



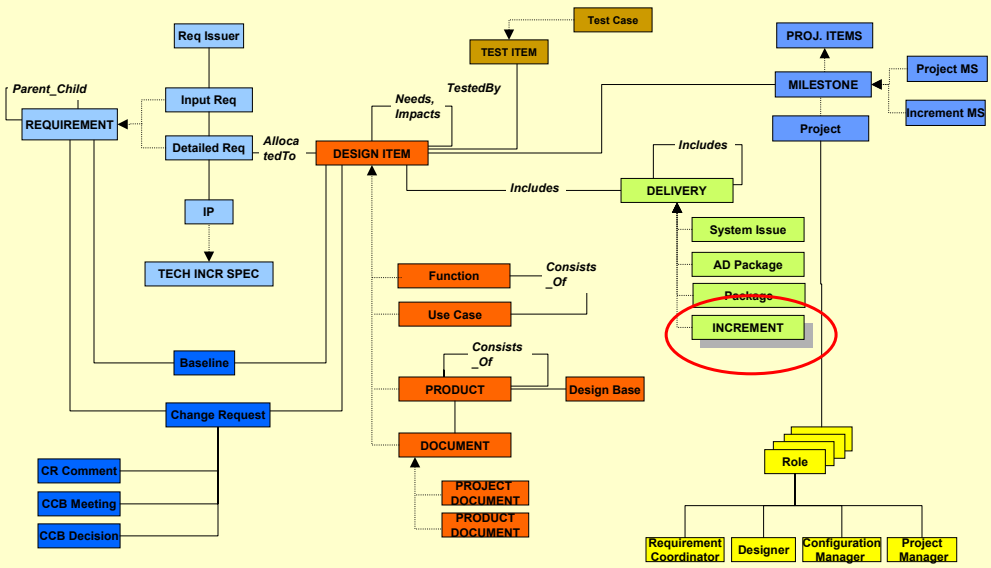
Context model S-domain 1998



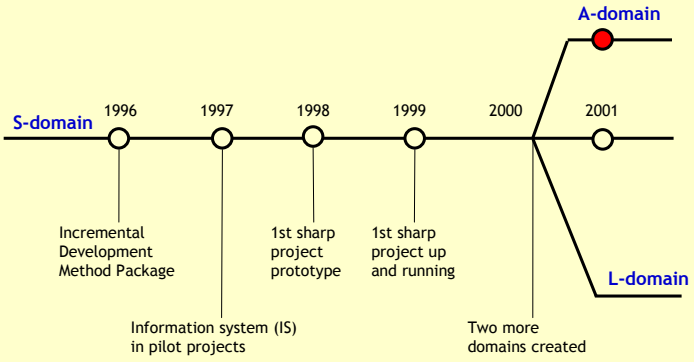
First project



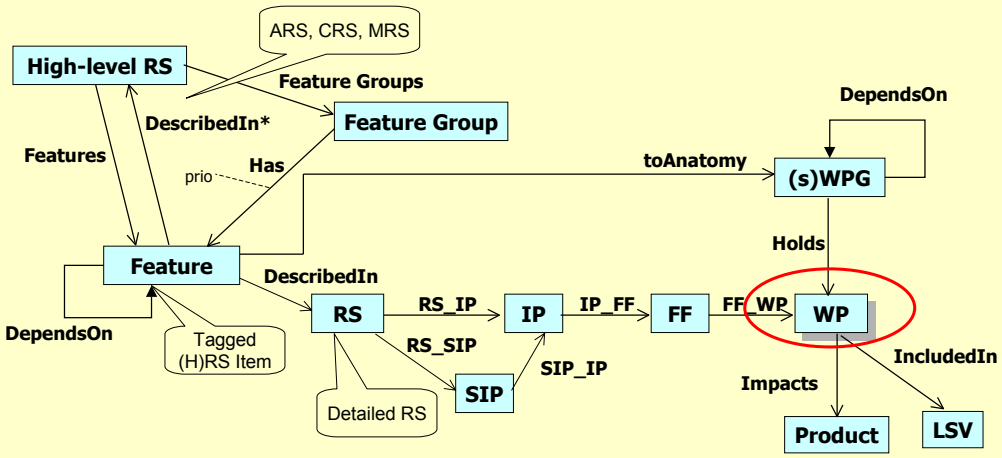
Context model S-domain 1999



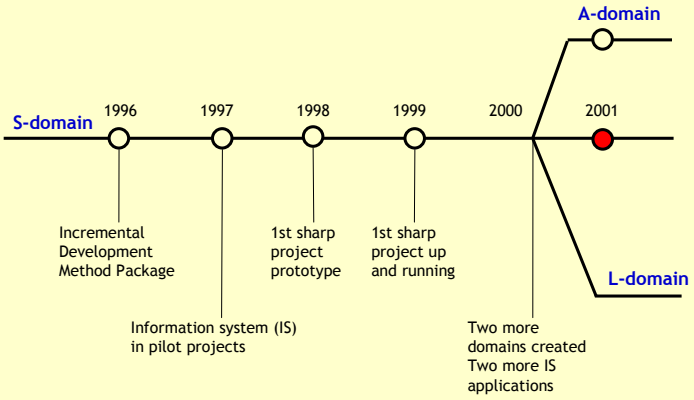
Expansion



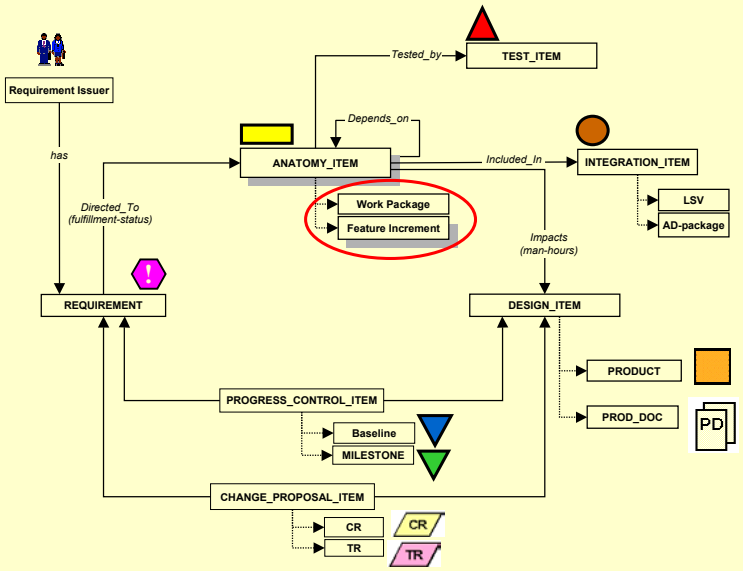
Context model A-domain 2001



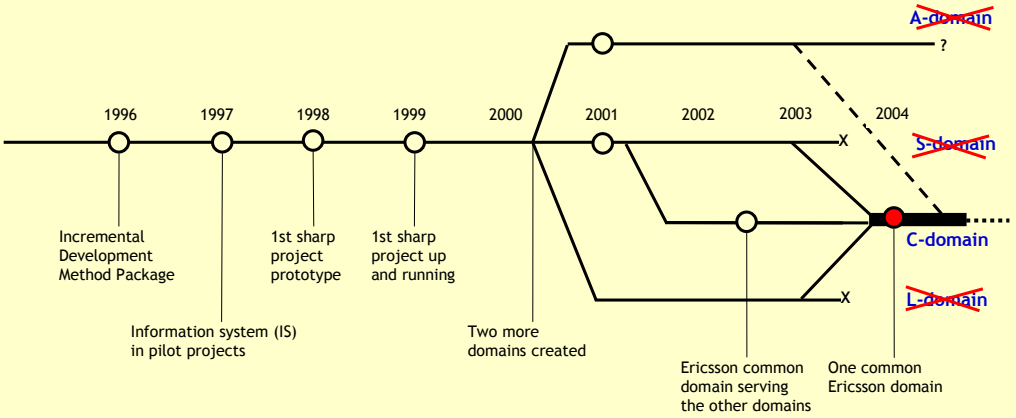
Expansion



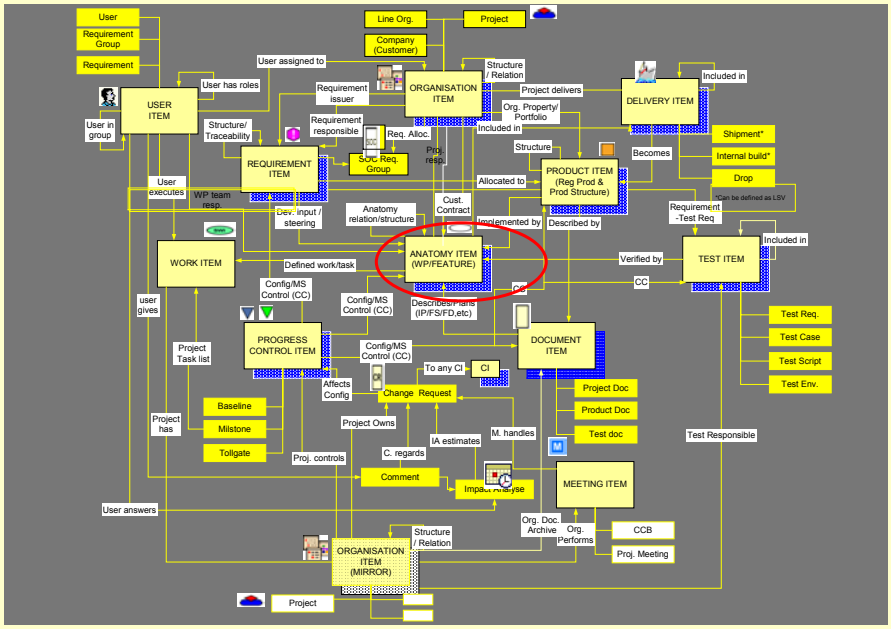
Context model S-domain 2001



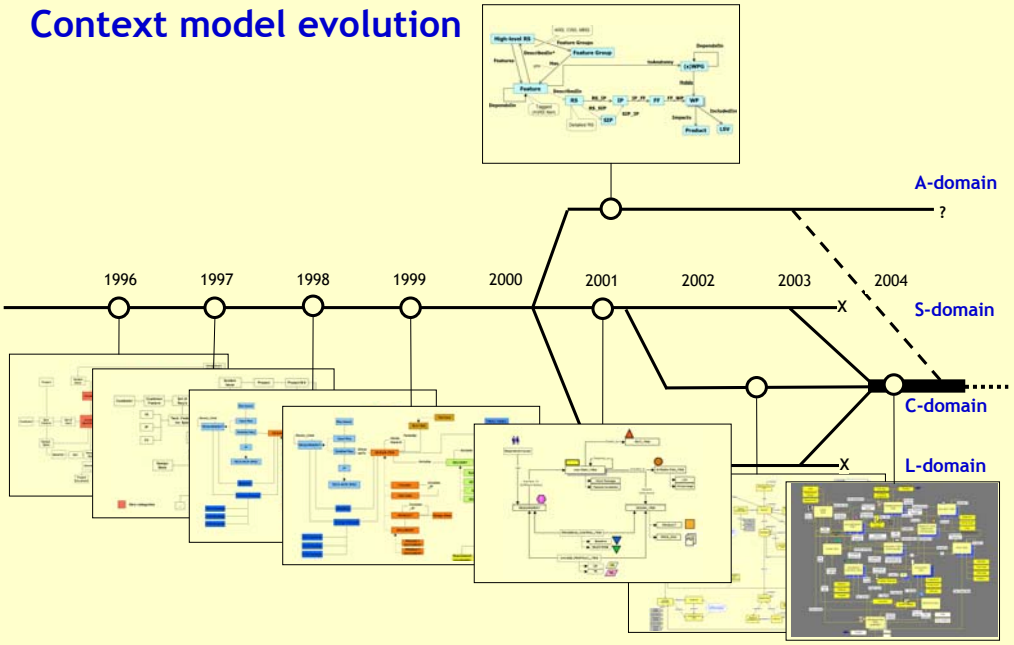
Centralization



Context model C-domain 2003

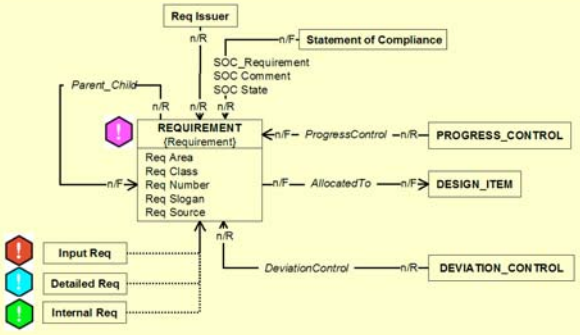


Context model evolution



Construction of context models

A detail in the context model



To be defined...

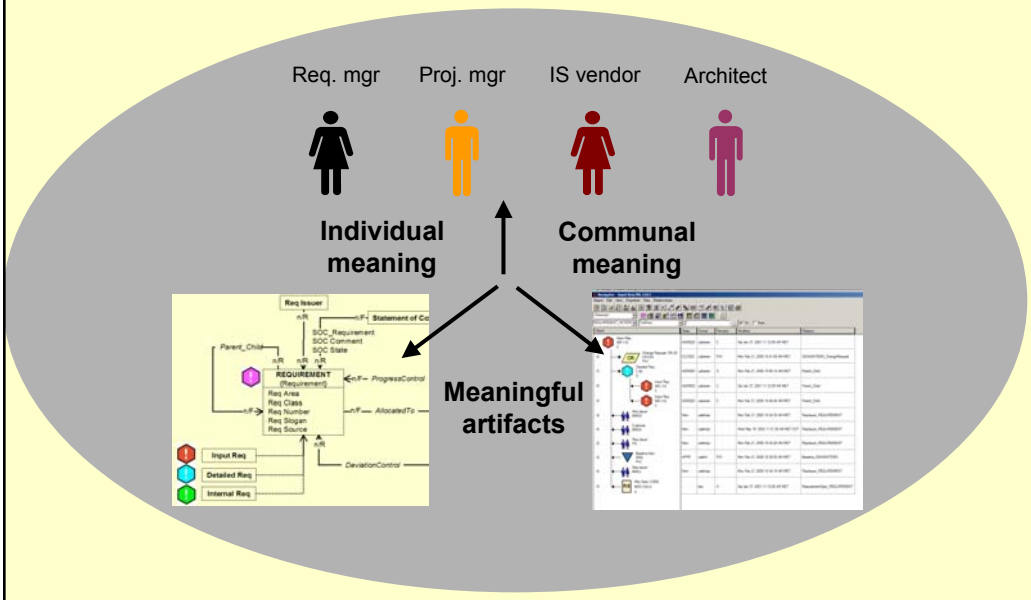
- **Entities**
- **Relations**
- **Names, icons**
- **Types of requirements**
- **Life cycle of requirements**
- **Attributes on requirements**
- **Attributes on relations**
- **Cardinalities on relations**
- **Revision stepping rules**
- **Actor roles**
- **Access rights for roles**
- **...**

Constructing communal meaning the key issue

We also had major discussion about the attributes for each and every object, what do they really mean and how are they to be used. That was also something that caused quite a lot of time.

(Project Manager 3G)

Construction process

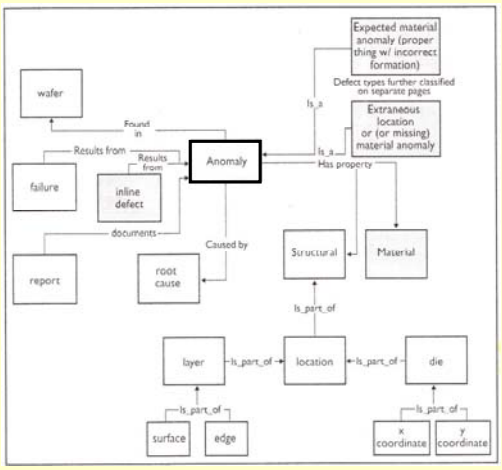


A comparison

- between context models at Ericsson and ontologies in the literature

EAFT / Nordterm workshop, Vasa, 2006 - Lars Taxén, lars.taxen@telia.com

Properties of ontologies from the literature

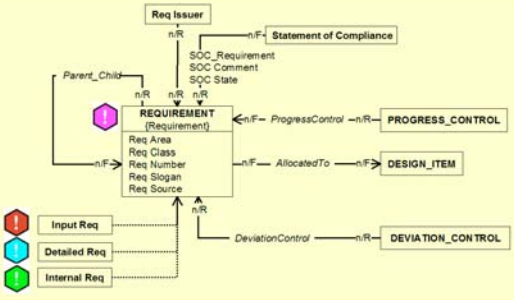


Example adapted after Edgington et al. (2004) "Adopting Ontology to Facilitate Knowledge Sharing",

- There are objects in the world
- Objects have properties or attributes that can take values
- Objects can exist in various relations with each other
- Objects can have parts
- Properties and relations can change over time
- There are events that occur at different time instants
- There are processes in which objects participate and that occur over time
- The world and its objects can be in different states
- Events can cause other events or states as effects

Chandrasekaran et al. (1999) "What Are Ontologies, and Why Do We Need Them?"

Properties of context models at Ericsson



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“Formal” Ontologies
- related to the Semantic Web

Semantic web - purpose

“The application of Semantic Web technologies to enable Semantic eBusiness provides the organizations the means to design collaborative and integrative, inter- and intra-organizational business processes and systems founded upon the seamless exchange of knowledge.”

Formally defined

"...The only languages [to describe the entities involved and the relationships between them] that are likely to fit the bill are mathematical, and the prime contenders are understandable in terms of first-order logic."

Conceptions of knowledge

"… knowledge is a collection of facts about a domain."

"…encoding knowledge in terms of the concepts and relations."

"Ontological analysis clarifies the structure of knowledge"

Meaning

"Ontologies will provide the necessary meaning to web content therefore enabling software agents to understand and retrieve information in relevant contexts."

Separation of ontology and knowledge

"An ontology provides a set of concepts and terms for describing some domain, while a knowledge base uses those terms to represent what is true about some real or hypothetical world."

Stability

"Ontology, ... is supposed to reflect ... the well established knowledge of a given area... It should be stable and throughout used.

Commonality

"Communication between distinct groups using different vocabularies creates the need to create common vocabularies, which optimally suit all involved"

Machine processing

"We have presented an automated approach to unifying heterogeneous information models based on machine-processable metadata specifications."

Discussion

Basic tenets "formal" ontologies

- **Knowledge**
  - A collection of facts that are true
  - Can be managed
  - Is discovered
  - Ontologies separate from knowledge
- **Ontologies**
  - Give meaning
  - Describe some part of the "real" world
  - External to the worlds they describe
  - Stable
  - Formally defined
  - Can be machine processed
  - Validated according to compliance with facts, truth

Basic tenets "pragmatic" ontologies

- **Knowledge**
  - Intrinsic to humans, knowledge is what a knower knows
  - Constructed in action
  - Not a commodity
  - Ontologies are inseparable from knowledge
- **Ontologies**
  - Instruments for constructing communal meaning
  - Domain specific
  - Provide a communal language in the domain
  - In constant evolution
  - Informally described - easy to interpret for humans
  - Machine processing not a prerequisite
  - Validated for usefulness in the domain

"Formal" versus "pragmatic" ontologies

"Formal"		"Pragmatic"
• Commodity	⟵ **Knowledge** ⟶	• Inherently human
• Inherent	⟵ **Meaning** ⟶	• Constructed
• Description	⟵ **Usage** ⟶	• Action
• Stable	⟵ **Change** ⟶	• Evolution
• Formal	⟵ **Model** ⟶	• Significant
• Truth	⟵ **Validation** ⟶	• Usability
• Uniform	⟵ **Commonality** ⟶	• Multitude
• External	⟵ **Existence** ⟶	• Internal

On the surface formal and pragmatic ontologies look the same

Fundamentally different conceptions of knowledge

Issues

- **Ontology for ontologies**
  - Knowledge for description or action?
  - Is knowledge equal to facts?
  - Can knowledge be managed?
  - Are ontologies external to the world it describes?
- **Meaning**
  - Do ontologies encode meaning?
- **Unification**
  - Is it possible to define "one size fits all" ontology?
- **Validation**
  - Usefulness or truth?
- **Development**
  - Stable or dynamic world?

Activity Domain Theory

- **Focus on communal meaning**
- **Activity Modalities**
  - Spatialization
  - Temporalization
  - Technologization
  - Stabilization
  - Contextualization
  - Transition
  - Pragmatic communication
- **Ontology is one modality - spatialization**
  - Other modalities need to be considered in ontology construction

Further reading

Taxén L (2003) *A Framework for the Coordination of Complex Systems' Development.* Dissertation No. 800. Linköping University, Dep. of Computer &Information Science, 2003. Retrieved from http://www.ep.liu.se/diss/science_technology/08/00/index.html (Nov 2004)

Taxén L (2004): Articulating Coordination of Human Activity - the Activity Domain Theory. In *Proceedings of the 2nd International workshop on Action in Language, Organisations and Information Systems (ALOIS-2004),* Linköping University. Retrieved from http://www.vits.org/konferenser/alois2004/proceedings.asp (Dec 2005).

Taxén L (2005) Categorizing Objective Meaning in Activity Systems, in Whymark G, Hasan H (Eds.), *Activity as the Focus of Information Systems Research*, Eveleigh, Australia: Knowledge Creation Press, pp. 169-192

Taxén L (2005) An Integrated Approach for the Coordination of Distributed Software Development Projects, *Information and Software Technology*, (in press).