TDT4252
Modelling of Information Systems
Advanced Course

Sobah Abbas Petersen
Adjunct Associate Professor
sap@idi.ntnu.no
Today’s Lecture

• Introduction to AKM
• Enterprise Knowledge Spaces
• Based on:
• Acknowledgements:
  – Frank Lillehagen, Håvard Jørgensen, John Krogstie
  – Based on lecture notes from spring 2009 (Krogstie), presentations by Frank Lillehagen and Håvard Jørgensen.
  – http://activeknowledgemodeling.com/
Challenges in industrial IT support (1)

• Aligning business, ICT and Knowledge Management (KM).
• Reducing costs for application portfolio management and integration.
• Achieving more effective solutions development, delivery, deployment and integration.
• Achieving predictability, accountability, interoperability, adaptability and trust in networked organizations.
• Achieving ease of re-engineering, reuse and management of solutions.
• Supporting concurrency, context-sensitivity, and multiple simultaneous projects and business processes.
Challenges in industrial IT support (2)

- Supporting multi-dimensional, collaborative product design and life-cycle innovation and knowledge capture.
- Providing self-organizing, self-managing and re-generating solutions.
- Semi-automating information and knowledge reuse and management.
- Supporting learning-by-doing, enabling users to acquire and activate new knowledge as work is performed.
- Achieving independence of system and IT experts.
- Designing personal workplaces and harmonizing work environments.
Hierarchy of regulation, codes and practices

Authority requirements

Design basis

Operations requirements

Drilling functional requirements

Supplementary technical specifications

Master package specifications

Frame agreement documents

NORSOK standards

How do we manage design dependencies across documents?

Which information is current?

How do we manage change?

What is relevant for me?

Duplication across documents?
Structured Product Data Management

How can this data be more easily reused in future projects?

Can the global metamodel cover all needs?

Can we simplify coding standards?

Once this is in place, will we ever be able to change?

How do we merge different system aspects?

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AKM View of EM

“Model-based approaches must enable regular industrial users to be active modellers, both when performing their work, expressing and sharing their results and values created, and when adapting and composing the services they are using to support their work.”
Limitations with current Enterprise Modelling approaches (1)

• Enterprise knowledge can only be represented in predefined, vendor proprietary or prematurely standardized modelling languages.

• The modeling approach, roles to engage, tasks to support and views to create are predetermined and cannot be adapted to the case in hand.

• Modelling is not an integral part of engineering or product development, but performed in isolation by specialists.

• The user interface is static and systems engineer oriented, and supports just one style of modeling.

• There is limited support for knowledge externalization, sharing, reuse and management.
Limitations with current Enterprise Modelling approaches (2)

• Most models are collections of static views and diagrams and give no support for adaptation and extension of meta-models.

• Models and modeling environments are detached from solution execution platforms.

• The leading concepts for modeling languages, view management and parameter definition are restricted to object-oriented thinking.
Active Knowledge Architecture (1)

- **Purpose**: to provide product designers, engineers, architects and other stakeholders a common language and workplace contents for building interoperable, collaborative and reusable services and knowledge elements.

- **Early phases of projects lack adequate support**:
  - Effective and holistic design.
  - Conceptual design of products.
  - Collaborative design.
  - Means to capture the design rationale and the knowledge of the designers and engineers.

- **Designers and engineers must feel ownership of the knowledge**.
Active Knowledge Architecture (2)

- Designers and engineers must have a workplace and the services that evolve with knowledge that is created and aggregated.
- The data and knowledge stored in and reactivated from an Active Knowledge Architecture (AKA).
- Active: implies that AKA’s contents (roles, task patterns, information structures, etc.) will automatically configure the workplaces. Work-centric data created in the workplaces are automatically folded back into the AKA.
AKA: An example

Workplaces for roles

Active Knowledge Architecture

Products

Organization Roles

Processes, Tasks

Systems, Views

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What is an Active Knowledge Model?

• To be an active model:
  - A visual model must first and foremost be available to the users of the operational information system at the time of execution.
  - The model must automatically influence the behaviour of the computerised work system support and workplace.
  - The model must be dynamically extended and adapted; users must be supported in changing the model to fit their local needs, enabling tailoring of the work environment’s behaviour.

• Active knowledge Modelling is capturing knowledge involved in building workplaces, in supporting work execution and knowledge generated by work execution.

• An active knowledge Model must support reflective views of the knowledge aspect.
Software Engineering Models

- Data/information
  - Objective
  - Rational
- Code
  - Formal
  - Static
- Rigid systems
  - Global logic
  - No change during execution
Active Knowledge Models

• From data to knowledge models
  – Pragmatic
  – Situated, contextual
  – Socially constructed and (inter)subjectively interpreted
  – Multiple views
• From code to active models
  – Adaptive systems
  – Local
  – Living, growing open system
Interactive (active) models

• Visual (graphical) models of enterprise aspects (goals, tasks, roles, organizations, persons, information, systems...)
• Available for normal users to be viewed, traversed, analyzed, simulated, executed, and adapted
• Changes to the models influence the information systems supporting (part of) the enterprise
AKM extends the role of Enterprise Modelling (1)

- Modeling specific roles, tasks, information and views to capture context, and to configure and generate role-specific workplaces.
- Modeling products, organizational resources, processes and systems to support core industrial design and engineering knowledge.
- Modeling properties and their values and value-ranges as separate structures, independent of objects.
- Managing corporate modeling elements and workplace contents in an active knowledge architecture (AKA).
- Managing contextual descriptions of work, and workplace configurations to support extensive reuse of knowledge and data.
- Enabling industrial users to build and manage their own working environments, workplaces and services.
AKM extends the role of Enterprise Modelling (2)

- Enabling life-cycle data and knowledge management, capturing and sharing experiences, unresolved issues and lessons learned.
- Expressing knowledge readily reflected as updated menus and views in model-configured workplaces.
- Building knowledge models and architectures of methodologies, information libraries and reference models, currently only available on paper.
- Building collaboration spaces and visual scenes for design, engineering, work process experimentation, validation and pro-active learning.
Model-Generated Workplaces (MGWP)

- Has been developed over a number of years, mostly related to enterprise processes on a PC/Web platform
  - EU and Norwegian Research Council financed projects
  - Startup company: AKM, recently merged with Commitment
Active Knowledge Architectures

Integrated business operations
Model-configuring workplaces and services

AKA models include business, product and workspace configuration models

Meta-models are mainly for integrating software systems and tools and their data models

ICT Infrastructure

Model builders, platform integrators and workplace engineers

Non-configurable integration, meta-data not stored in the customized AKA

EKA

Meta-model

Meta-model

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AKM Services

Core: Active Knowledge Architecture
- Principles
- Methods
- Modelling languages

Tools for modelling

Project Conception  Product Design  Processes, Management  Model-driven applications  Model-driven system development  Operational enterprise architecture

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Principles for holistic design and learning

- Data
  - interpretation
  - generates new data

- Methods
  - innovation

- Information
  - associations to other views and structures

- Experience
  - performing work in varying settings

- Skills
  - performing work

- Competence
  - associations to actions and tasks

Active Knowledge Architecture - Scenes of action
- Role structures
- interpretation
- associations to other views and structures

- Knowledge

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Multi-dimensional Knowledge

Data 1 dimension

Information 2 dimensions

Knowledge 3 dimensions

Knowledge space 4 dimensions

Interpretation

Meaning

Semantics

Action

Structure

Pragmatics

Reflection

Innovation

Collaboration

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Main Concept: AKA

- Visual modelling replaces programming.
- Learning by doing, practise and experimenting.

Right operation, by the right person, at the right time, with the right effect.

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AKA Principles for Holistic Design
Case: Model-driven applications

Create operational solutions without programming

Workplaces for roles

Utilise methods in the operational solutions

Active Knowledge Architecture

Products
Organization Roles
Processes, Tasks
Systems, Views

Project management
Systems engineering
3D Layout
Document management
Etc.

Engineering Numbering System
Project Execution Model

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Prosess Management – Work decomposition

Time
Organization
Process
Information, documents
Technology, products

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Inter-related operations

Operational task patterns constructed from all four surrounding dimensions, and bottom up by users.

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Active Knowledge-driven Services

Correct combination of services for different situations

Model-driven, not hard coded
• Composition
• Choose, search, filter
• User interface
• Events and reactions
• Rules and procedures
• Task patterns
• Collaboration

Basic ICT-services from a variety of systems

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Visual Scenes

• Visual scenes are “ensembled views to interrelated active knowledge models supporting archetypical work in an organisation.”

• Four visual scenes for future enterprising:
  - *The Innovative scene* where focus is to invent, reuse, design and learn (industrial war room concept).
  - *The Operations scene* where focus is to operate, generate, adapt, extend, manage and terminate (e.g. collaborative product development).
  - *The Governance scene* where focus is to govern, plan, decide, assign, measure and strategise.
  - *The Evolutions scene* where the focus is to analyze, configure, change, transform, align, and manifest.
Enterprise Knowledge Spaces

• Introduction to AKM
  – (Based on Lecture Slides “Active Knowledge Modelling, Introduction”, John Krogstie, Spring 2009 and a Presentation by Frank Lillehagen, Commitment AS)

• Based on:
Multi-dimensional Knowledge

Data 1 dimension

Information 2 dimensions

Knowledge 3 dimensions

Knowledge space 4 dimensions

Interpretation
Meaning
Semantics

Action
Structure
Pragmatics

Reflection
Innovation
Collaboration

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Enterprise Knowledge Spaces (1)

- A knowledge space is a four-dimensional representation, where the dimensions are mutually reflective, capable of altering each others’ meaning.
Enterprise Knowledge Spaces (2)

Community Space
- Developing legislatures, business models and common knowledge
- Common policies, rules, standards and digital infrastructures

Business Network Space
- Developing services, reference models and digital libraries
- Reuse of knowledge across roles, boundaries and borders

Innovation Space
- Developing generic and customer specific knowledge
- Improved innovation, mass-customisation and lifecycle services

Personal Space
- Developing inter-enterprise workplace views and services
- Competences and skills capture, involving all actors

Developing and improving knowledge and information systems for business and society.

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Enterprise Knowledge Spaces (2)

- **Personal Space**: reflects a user’s work and knowledge so that information systems can adapt to it, as information content, roles, tasks and views (IRTV).

- **Innovation space** reflects the products, organisations, processes and systems of an interdisciplinary collaborative team, e.g. in product design (POPS).

- **Business Network** space reflects how companies come together in value networks and supply chains, their services, networks, projects and platforms (SNPP).

- **Community space** reflects how larger industries, sectors, cultures and societies function, their values, resources, initiatives and infrastructures (VRII).
Personal Workspace (1)

- A personal workspace should contain everything that someone needs for performing their work. Personal workspace models are executed by the AKM platform.
  - Information management
    - Data and metadata
  - Role management
    - Workplaces and access control
  - Task management
    - Process enactment, task automation, rules and events
  - View management
    - Workplaces, navigation, visualisation

- Other knowledge spaces become operational through the IRTV dimensions.
Personal Workspace (IRTV)
Innovation Space (1)

- In a design project, a process is followed by an organisation using a system to develop a product.
- These dimensions are mutually dependent on each other.
- The innovation space typically contains hierarchical and aspect-oriented structures for each of the dimensions such as work-breakdown structures for processes and components hierarchies for products.
Innovation Space (POPS)
Business Space (1)

- Behind the creative work performed in innovative spaces, we find strategic management and business transactions, establishing networks of groups and companies, working together in value and supply networks, markets and consortia.
Business Space (2)

Business Space

- Service
- Project
- Networked Organization
- Platform

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Community Space (1)

- The backbone of personal knowledge spaces, innovative teams, business networks, is the society, culture and industrial setting, where the business operate.
- Although these are not under the control of the business, they influence the operation of the business.
Community Space (2)

Community Space

- Value
- Initiative
- Resource
- Infrastructure

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## Spaces in AKA

<table>
<thead>
<tr>
<th>Community and network</th>
<th>What/Why</th>
<th>Who</th>
<th>How</th>
<th>Enabler</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Resource</td>
<td>Initiative</td>
<td>Infrastructure</td>
</tr>
<tr>
<td>Business</td>
<td>Service</td>
<td>Network</td>
<td>Project</td>
<td>Platform</td>
</tr>
<tr>
<td>Project team innovation</td>
<td>Product</td>
<td>Organization</td>
<td>Process</td>
<td>System</td>
</tr>
<tr>
<td>Individual</td>
<td>Information</td>
<td>Role</td>
<td>Task</td>
<td>View</td>
</tr>
<tr>
<td>Software</td>
<td>Data</td>
<td>User</td>
<td>Code</td>
<td>Programming</td>
</tr>
</tbody>
</table>

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Reflective Views

Process

Organization

System

Product
Reflection Across Knowledge Spaces

Product

Organization

Info.

Role

View

Task

System

Process

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Mutually Reflective Views

- An object in one view may have reflections in the other dimensions
  - No layered meta-hierarchy
  - No difference between modeling and metamodeling
- Inter-view connections continually discovered, designed and created
- Types of views for each design role and discipline
- A model is a constellation of views
  - Integrating roles and disciplines
- The meaning of any element may depend upon all the other elements (holistic models)
CVW – Configurable Visual Workplaces (1)

Workplaces for roles

Active Knowledge Architecture

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Task Management

• Design work is creative
  – It does not follow a fixed process.
  – It is often based on predefined task patterns, but it will deviate by including new tasks, skip tasks, modify tasks, etc.

• Business processes that can be adapted by business users
  – Ad-hoc changes supported and managed in emergent workflows, the subject of 10 years of research by AKM.
  – Simple, straight-forward task planning, execution, coordination, monitoring and management.
  – Easily combined with routine procedures automated by customers’ process engines.

• Task-oriented, model-configured workplaces, bringing the users what they need in a context they recognize and control.
Business Process Management

Conventional BPM
- Labour/capital intensive work
- Active models
- Automatic enactment
- Repetitive processes
- Modelled by experts
- Separated definition, monitoring and enactment

AKM: Emergent Tasks
- Knowledge intensive work
- Interactive models
- Interactive activation
- Unique processes
- Modelled by participants
- Integrated process articulation and activation
- Model and structure emerges as part of the work

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Learning & Reuse

- Externalizing core design know-how
  - Automatically captured as tasks
  - Articulated into models
- Made reusable as templates
  - Repeatable task patterns and processes
  - Adapted to new rich contexts
- Joint experimentation and discussions around models
  - Fostered by view and communication facilities
AKM Technology - strengths

- Supports creative work
  - The core processes that brings competitive advantage
  - Early phases of design
- Is controlled by business and industry people, not IT specialists
  - Model-configured, customized and contextualised
- Supports knowledge sharing, communication and learning
  - Human languages, not programming languages
  - Multiple perspectives
- Visual user interaction
- Interoperable, open execution system
  - Integration through modeling, e.g. web services, databases and XML content
- A scalable way of delivering IT solutions
  - Team organization around layered service architecture
AKM: Summary

• We have looked at the following:
  – Active Knowledge Modelling and Active Knowledge Models (AKM)
  – Active Knowledge Architectures (AKA)
    • AKA’s contents (roles, task patterns, information structures, etc.) can
      automatically configure the workplaces and knowledge from the
      workplaces can be incorporated in the AKA.

• Key concepts with AKA and AKM:
  – Visual models
  – Reflective views
  – Configurable workspaces
Knowledge Spaces: Summary

• A knowledge space is a four-dimensional representation, where the dimensions are mutually reflective, capable of altering each others’ meaning.

• Four dimensions:
  – Personal Space
  – Innovation space
  – Business space
  – Community Space
Next Lecture

• Guest lecture by Harald Wesenberg, Statoil
  – Friday, 2 March 2012, 1015-1200hrs, room F4