7 Introducing Active Knowledge Modeling in Industry

The AKM approach was described briefly in Chap. 1. We will in this chapter describe the overall approach for applying the approach in an enterprise or business network setting. The business networking knowledge space is generally denoted by four dimensions; - Services, Networks, Projects and Platforms – abbreviated SNPP. When employed in a customer delivery project the four knowledge dimensions contributed by AKM will be customized through the target specific modeling activities of the solutions modeling step. The AKM models of the approach, the methodology and the platform change as customer solution models and operational solutions are scoped, used and analyzed for validity. Purpose, guidelines, principles, language and techniques for performing solutions modeling is therefore the prime purpose of this chapter

7.1 Major Industrial Computing Challenges Revisited

As described in Chap. 2, the major enterprise computing challenge is to find an approach, methods and a web-platform that consistently and persistently support innovative design approaches and methods by utilizing the knowledge of those involved. Model-configured and managed services are created and supported to dynamically develop visual design language, role-specific workplaces with powerful viewing and execution services, and more. The services are delivered as customizable product platforms or integrated operation platforms all depending on which industrial sector. This would enable industry to remove many and minimize other challenges, such as change and version management, and to find good solutions for needs not even attempted solved by traditional IT systems, such as handling information flows in supply chains and implementing visual inventory management.

The AKM approach and the CPPD methodology support collaborative Business networking (c-Business), as illustrated and explained in Fig. 7.1 in the setting of the Kongsberg Automotive seat heating case. Current in-

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formation flow is unidirectional and peer-to-peer, and knowledge and data created by partners is not shared, or developed for common values and reuse. Too much pragmatic knowledge and working methods is either encoded in software or kept hidden in the heads of experts. These are all causes for bad designs, risky faults, last minute changes, loss of expertise and experiences, and loss of market opportunities and customer satisfaction. c-Business is supported by model-designed and model-generated workplaces, configurable collaboration spaces, enterprise knowledge architectures and services, dynamic visual language composition, and powerful view handling and task execution, allowing new ways for project managers, designers, engineers and business people to interact and learn by proactive collaboration.

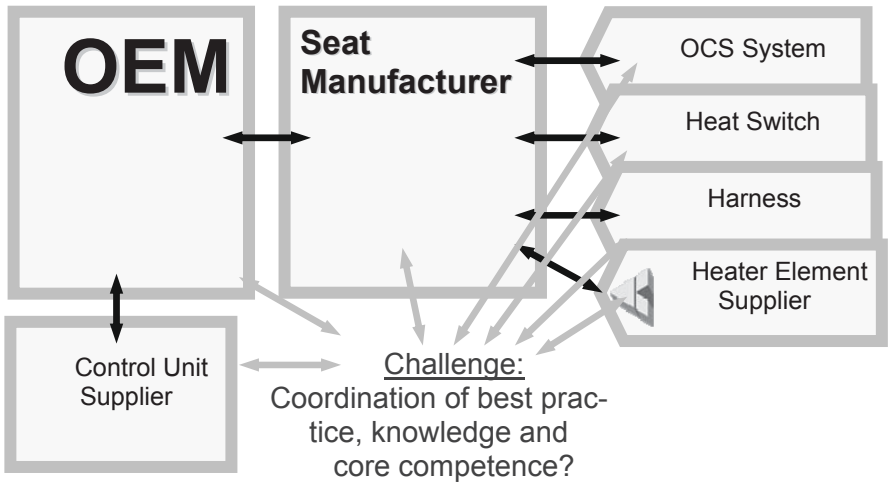

Fig. 7.1. Needs for collaborative business networking

7.2 The Customer Delivery Process

The AKM approach has at its core a customer delivery process with seven distinct steps. The first time an enterprise applies the AKM technology we recommend that these steps are closely followed in the sequence indicated. However, second and third time around work processes and tasks from the last five steps can be reiterated and executed in any order necessary to achieve the desired goals.

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Not abiding by these steps and the recommended ways of working, modeling and executing, could have highly negative fatal consequences for model, solutions and result quality. This is all about how to best capture and represent work-generative enterprise knowledge.

The AKM approach is also about mutual learning, discovering, externalizing and sharing new knowledge with partners and colleagues. Knowledge that neither you nor they knew they possessed. Tacit knowledge is most vividly externalized by letting people that contribute to the same end product actually work together, all the time exchanging, capturing and synthesizing their views, methods, properties, parameter trees and values, and validating their solutions. Common views of critical resources and performance parameters provide a sense of holism and are important instruments in achieving consensus in working towards common goals. The seven steps are defined as shown in Fig 7.2. The steps are denoted C3S3P. Concept testing, performing a proof-of-concept at the customer site, is not included in the figure. The solutions modeling stage is vital for creating holistic, multiple role-views supporting work across multi-dimensional knowledge spaces, which in turn yield high-quality solution models

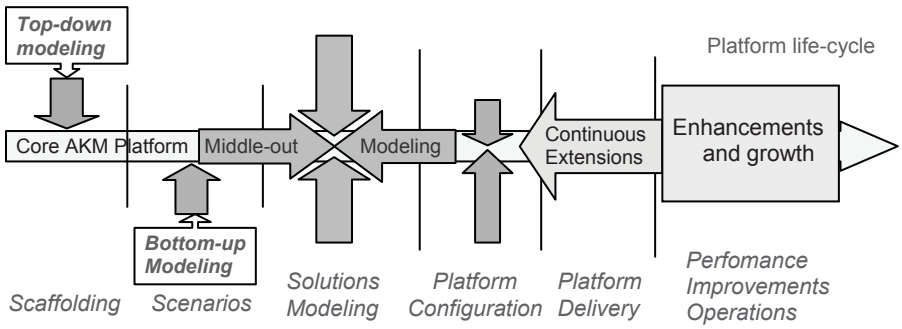

Fig. 7.2. The steps of the customer delivery process

Description of Methodology Steps

1. *Concept testing* is about creating customer interest and motivation for applying the AKM technology. This is done by running pilots and by assessing value propositions and benefits from applying the AKM approach.
2. *Scaffolding* is purely about expressing stakeholder information structures and views, and relating them to roles, activities and systems to provide a model to raise the customer's understanding for modeling

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and inspire motivation and belief in the benefits and values of the AKM approach.

3. *Scenario modeling* is about modeling"best-practice" work processes. Capturing the steps and routines that are or should be adhered to when performing the work they describe. This is the core competence of the enterprise, and capturing these work-processes is vital to perform work, support execution and perform several kinds of analyses in the Solutions Modeling step.
4. *Solutions modeling* is about cross-disciplinary and cross-functional teams working together to pro-actively learn and improve quality in most enterprise life-cycle aspects. The purpose is creating a coherent and consistent holistic model or rather structures of models and sub-models meeting a well-articulated purpose. Solutions modeling involves top-down, bottom-up, and middle-out multi-dimensional modeling for reflective behavior and execution.
5. *Platform configuration* is about integrating other systems and tools by modeling other systems data models and other aspects often found as UML models. These are created as integral sub-models of the customized AKM platform, and their functionality will complement the CPPD methodology with PLM system functions, linking the required web-services with available software components
6. *Platform delivery and practicing* adapts services to continuous growth and change by providing services to keep consistency and compliance across platforms and networks as the user community and project networking expands, involving dynamic deployment of model-designed and configured workplace solutions and services
7. *Performance improvement and operations* is continuously performing adaptations, or providing services to semi-automatically re-iterate structures and solution models, adjusting platform models and re-generating model-configured and -generated workplaces and services, and tuning solutions to produce the desired effects and results.

7.3 Each C3S3P Step

In the following each step will be described in more detail from a customer value perspective. Each step will be described by:

- Purpose: Why is this step important?
- Approach: How do we work to achieve values?
- Methodology: What CPPD language and components are used? The CPPD components will be described in detail in Chap. 9.

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- Platform services: Which services should and will be available?
- People involved: What are the customer and partner roles, and what AKM roles is necessary?
- Results: Active models driving new ways of computing and working.

The descriptions will reflect the capabilities of the current version of the CPPD methodology and of the AKM platform

7.3.1 Concept Testing

Purpose

Concept testing, performing proof-of-concept tests, is creating customer interest and motivation by assessing value propositions and benefits from applying the AKM approach.

Approach

Work processes are being developed to deliver, customize and support industrial pilots covering a rapidly growing range of application service.

Methodology

Depending on the customer purpose and scope one can select from some seven of the twelve configurable CPPD components and supporting platform services when defining customer test pilots. Also deliver services to validate the results should exist.

Platform Services

- Piloting preconfigured product platform development and customization
- Piloting preconfigured collaboration spaces and visual client-based workplaces
- Piloting configurable web workplaces and model repository structures and contents
- Piloting configurable work processes and enabling web services integration.

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People Involved

All modeling tools, languages and techniques should be performed and delivered by certified personnel. Normally a business or project manager is in charge of the test at the customer site. Piloting engineers with relevant competence and skills will also be trained to adapt and perform the test.

Results

Piloting performed as a proof-of-concept with the goal of launching a customer project to implement a platform solution.

7.3.2 Scaffolding

Scaffolding has as main purpose to acquaint industrial users with AKM technology and visual enterprise modeling, and AKM people with customer challenges, information structures and practices. In this way it has a lot of similarities to what we in Chap. 4 termed enterprise modeling for sensemaking and communication. Scaffolding can imply building models for use to widen internal understanding between departments and disciplines. Models are often laid out as a mosaic of views of existing information structures, and a description of their sources. Scaffolding models are rarely used for other purposes than agreeing on descriptions of present operations and enhancing stakeholder and employee insights. Fig 7.3 is an example on one such model, a knowledge map of which processes exist and how they are composed. Most scaffolding models do not meet the requirements nor follow the principles of solutions modeling.

Purpose

Scaffolding is about raising the customer's understanding for modeling and to achieve consensus and understanding of customer needs and preconditions. Raising the customer motivation and belief among stakeholders and helping all to select the right scope of work for the Solution Modeling step.

Approach

Select the business area of most concern and gather the most competent people holding key roles in the disciplines involved. The work is performed by conducting workshops to perform information collection, modeling and deliberation.

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The scope of modeling is the entire enterprise, but the modeling should stop at a comfortable level of generalization as no execution is intended. Only the most obvious and important relationships will normally be modeled, so model coherence is low. Professional model builders handle the modeling tools, but customer engineers may be trained for participation in the solution modeling step.

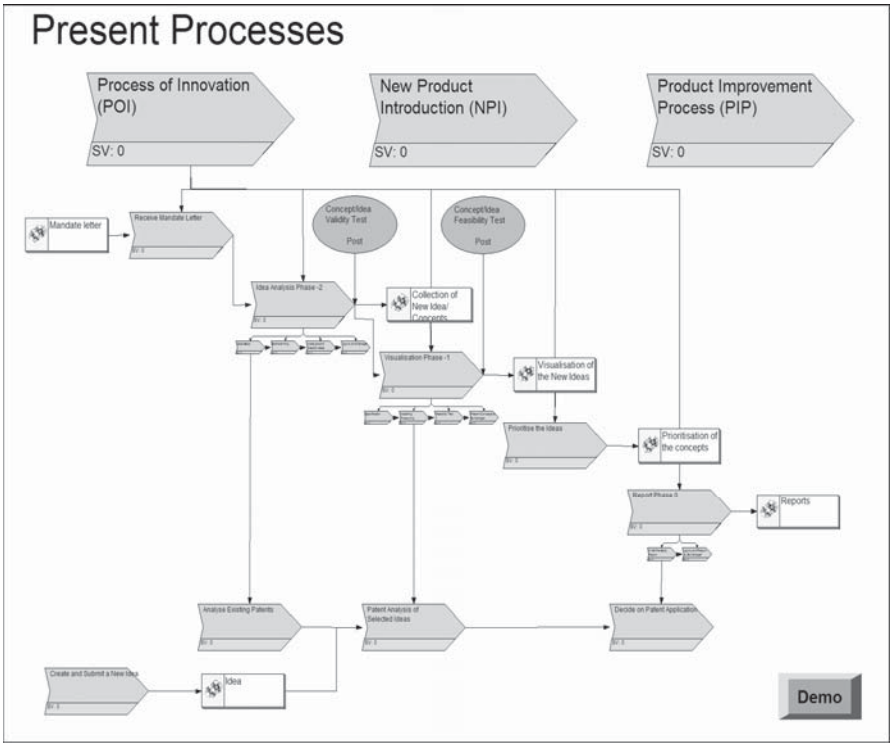

Fig.7.3. Example on scaffolding model

Methodology

The CPPD methodology components and supporting templates need not be used, but they would provide a good basis for modeling and training, so we recommend using them if they are available.

Otherwise select any modeling language capable of expressing enterprise information, as views and information structures, relating them to roles, products, information carriers, processes and tasks, and systems that can be integrated to support this step. Meta-models need not be modified

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to reflect precise types. Any part of the model can be transferred to other meta-models in a later step if appropriate.

Platform Services

The mandatory services are those for performing modeling of the selected customer business area and scope in terms of information structures and contents. Here are the most used modeling services:

- Modeling objectives and goals and the views defined in Fig. 7.4,
- Modeling product structures, organizational structures, process flows and system landscapes,
- Modeling roles, people, competences and skills and responsibilities,
- Services for supporting and performing relevant types of analysis

People Involved

All modeling tools, languages and techniques are delivered by certified personnel, but customers should use this step to involve their leading users and give them basic training in modeling and model-designed techniques.

Results

The resulting model and any sub-models created is a potential source of reference for solutions modeling. This is particularly true for the system landscape of the customer and their formal organization. Some of the aspects may be done to a level of quality that it may be reused in a solutions model.

7.3.3 Scenarios Modeling

Scenarios modeling is targeted on modeling work processes as repeatable task-patterns (Fig. 7.5). They represent enterprise core competence and "best-practice". A task -pattern may be used in several processes. This is typical of task-patterns defining core data and knowledge management services.

Purpose

Scenario modeling is about modeling the core competence of the enterprise, integrating methods on product and system structures, and capturing the core competence and skills as work-processes for execution as task-patterns.

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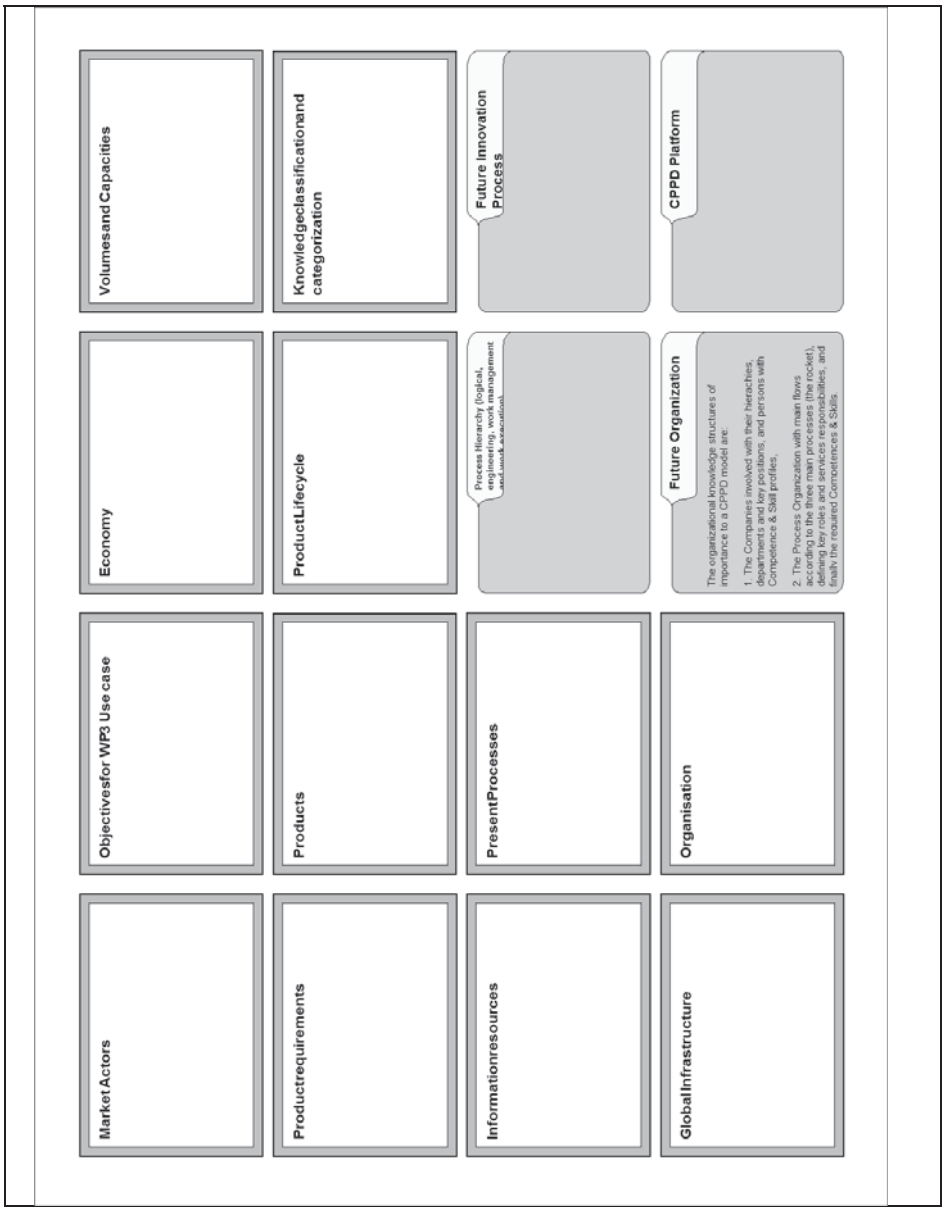

Fig. 7.4. Model views often used in scaffolding

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Approach

From the scaffolding step the modeling team may have identified the core competence and skills of the enterprise, so the major task is modeling the work processes as task-patterns, and then executing them to validate the models before they are saved for reuse.

Methodology

The work process modeling language is different from the business process hierarchy modeling language and the cross-enterprise business process modeling for execution language. These languages capture different aspects of process knowledge as explained in solutions modeling. The leaf-node processes of the business hierarchy are candidate work processes to be modeled as "best-practice" task-patterns.

Platform Services

The vital platform services required have to support these capabilities:

- Work process task-pattern modeling and execution
- Input and output data management and repository operation
- Generating visual workplaces on the web and invoking task execution

People Involved

Work process modeling is fairly straight forward, and provides a good opportunity for customer engineers to get training and gain experiences in work process modeling and executing task-patterns.

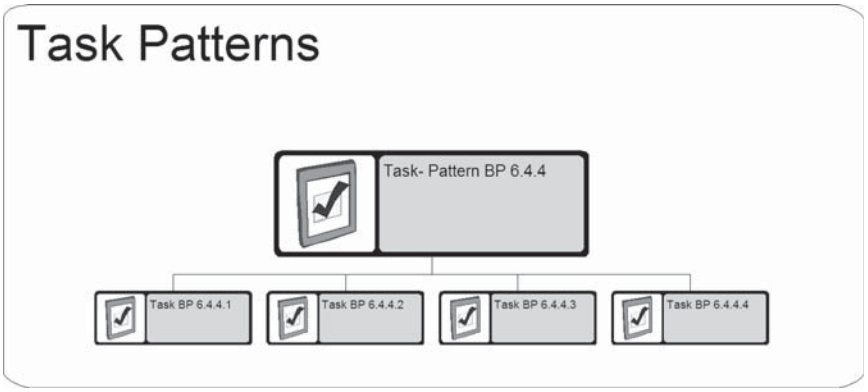

Fig. 7.5. Task patterns as reusable process fragments used in several processes

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Results

A selection of work processes representing enterprise core competence and skills are modeled and represented as validated sustainable task-patterns for reuse and repeated execution.

7.3.4 Solutions Modeling

Purpose

The main purpose of solutions modeling is to externalize holistic and pragmatic enterprise knowledge, and to represent it in an enterprise knowledge architecture that can support work process and method engineering and execution. This is the first step towards delivering model-designed computing solutions to users of enterprise knowledge and data.

Creating holistic knowledge models implies capturing knowledge across many multi-dimensional knowledge spaces and representing multiple roles, their reflective views and recursive task-patterns, striving for coherency and consistency. The objectives, goals and scope of solutions may shift and relate to new products, new or improved processes, better teamworking, competence and skills management, more effective innovation, or better control with business margins. Also the ambitions of customers may vary. Some may want to go for new advanced computing solutions, while others are content with integrating the legacy as web services. To decide on the goals and levels of ambition will always require that some kinds of analyses involving customer management are performed on the models. Project purpose, goals and scope may therefore shift as model building and analyses progresses.

Approach

Solutions modeling is performed in all industrial innovation and application projects where the ambition is to model for method and process execution. Solutions modeling requires dedicated teams of people with competences ranging from leadership in AKM, customer business management and organizational development to product design. Teams must be able to work intimately close together and be willing to try new approaches and techniques to perform and manage work. Which aspects of enterprise

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knowledge to model would depend on the objectives, goals and the scope of the customer project, and not least on the ambitions of management.

Typical of solutions modeling are these characteristic concepts, work processes and capabilities:

- The knowledge dimensions of the innovation space with product, organization, process and system aspects (POPS), with their many relationships through shared and tied parameter-sets will always be the core knowledge to model, improve and innovate,
- Many modeling languages may be involved, depending on scope and ambition, some of them will be designed and created just for the given project. An example is developing a language for creating new artifacts representing new product concepts or new design principles. Such specific languages might be developed as an adaptation of existing languages, or as totally new languages all together.
- Innovation and improvements of business processes will, with increasing globalization and customization of products involve multi-dimensional holistic modeling for innovative design of product, organization, processor system structures and services,
- Services for system integration modeling will be central, as project platforms will need to dynamically and readily integrate functionality from the existing customer network PLM systems,
- To create quality, performance, predictability and values in solutions customers would expect to find a rich set of services for different analysis and services testing. Among them: root cause and cause effect, affinity, gap, impact, network, overlap, cluster, integrity, validity, comparative, risk, association, and services to perform simulation or test runs,

Modeling for Solutions Modeling will involve modeling these aspects:

- The business process hierarchy is modeled top-down, starting with the business process, and then modeling the required sub-processes all the way down to leaf-nodes corresponding to work processes actually found in real practice. The process hierarchy gives rise to unique identities of data, identification schemes and logistics, as well as being the core for achieving holistic coherence and consistency,
- The work-processes are modeled, what we term bottom-up modeling, and already modeled task-patterns are adapted. The task-patterns are related to process-hierarchy leaf-nodes and to competence and skill profiles of roles and people involved, as illustrated in Fig. 7.6. This is the fundamental, if competence and skill management are among the services desired,

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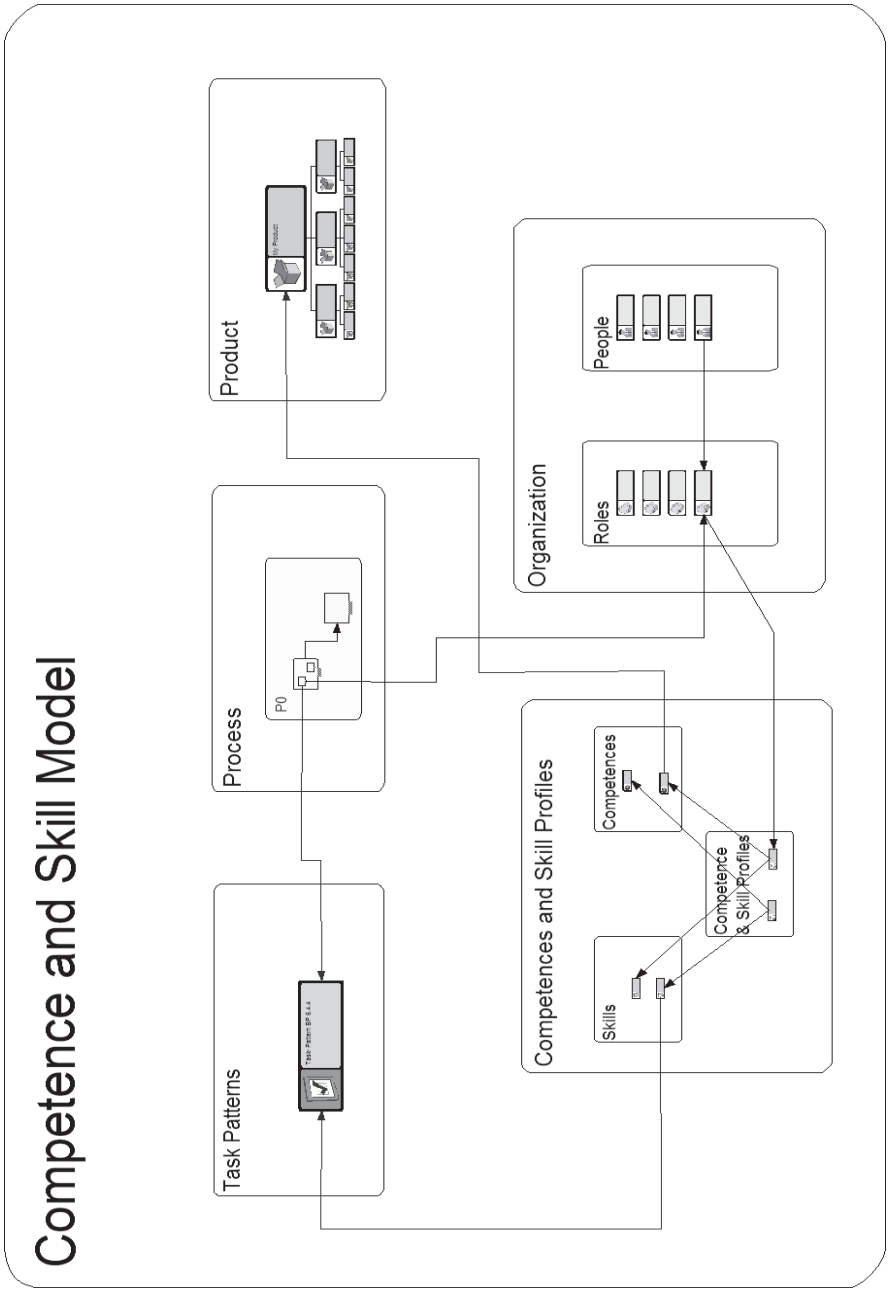

Fig. 7.6. The fundament for semi-automating competence and skill management

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- Process modeling finally also has to be performed as what is termed middle-out modeling, that is developing common views among all stakeholders to govern business performance and support visual work management as task assignment
- Similarly product modeling also need to cover many aspects, starting with a life-cycle oriented logistics structure that identifies the sub-systems of the product and the components that supports its implementation, and the services for life-cycle support,
- Other product structures that may be central to the scope of the solutions are; a dynamic conceptual design language capable of expressing new design ideas, concepts and principles, and function-means tree modeling to support initial requirements registration and categorization,
- Organizational modeling may have to cover the classical hierarchy used to identify positions, labor costs, competence areas and responsibilities, and to communicate educational needs, then networks to support collaboration, communication and messaging, and finally we will need to model collaborative service teams,

Which dimension to model first and what aspects to include are decided by purpose, scope, core knowledge availability and priorities. Solutions modeling is as complex as the most complex knowledge dimension product design, it is therefore important to involve experienced people and to select a sound methodology.

Methodology

The demand for a series of new and complementary methodologies, supporting and using powerful configurable components of active knowledge, has given birth to the Collaborative Product and Process Design (CPPD) methodology, which should be adapted and used for solutions modeling.

At least these different modeling languages will have to be involved:

- Process language for top-down modeling of the business process hierarchy
- Work process language for bottom-up modeling of task-patterns for execution
- Business process language for middle-out modeling of common process and parameter views
- Conceptual product structure for early conceptual product artifact layout and description,

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- Product structure modeling for topological definition and geometry and tolerance calculations,
- Technical product modeling languages, defining a multitude for variant structures for calculating many different properties, for defining parameter-trees, and for handling multiple parameter-sets,
- Modeling for production and assembly and for life-cycle services development and provision,

Depending on purpose and scope most of the aspects identified in Fig 7.7 will have to be modeled, and most of the CPPD methodology components may be involved. The core of a solutions model will always be the POPS dimensions of the innovation space, driven by the knowledge dimensions of the customer business network.

Platform Services

- Developing configurable product platforms with services to handle customization and multi-brand design and manufacturing,
- Adapting preconfigured collaboration spaces and visual client-based workplaces
- Adapting configurable web workplaces and model repository structures and contents
- Adapting configurable work processes and web services integration
- Adapting modeling languages

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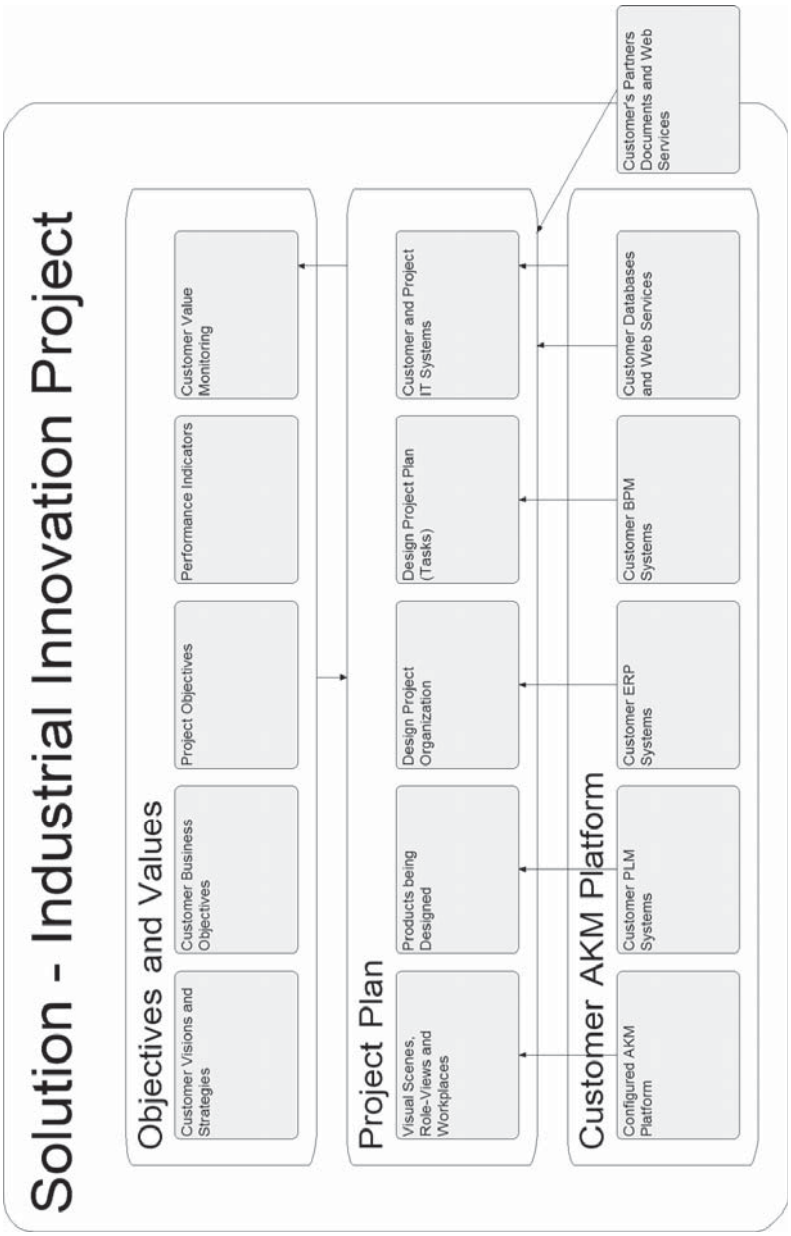

Fig. 7.7. Example of concepts in a holistic solutions model

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People Involved

All modeling tools, languages and techniques are performed and delivered by certified modeling personnel. These people will be modeling advisers and facilitators in project service teams, see description of service teams below. To overcome trust and confidence barriers stakeholders must be willing to share knowledge and IPR. This is not a problem if the users see clear benefits and values to be shared.

Results

The solution model or models and sub-models will eventually require a well-structured enterprise knowledge repository for sustainable use and management. The solutions modeling will produce the models required for whatever goals and ambitions are decided by the customer business network, and store the models and workplaces in platform repositories.

7.3.5 Platform Configuration

Purpose

Platform configuration is about integrating other systems and tools by modeling other systems data-models and other aspects, often expressed as UML models, using the CPPD CWI methodology (see Chap. 9 for more details).

Approach

Work processes are being developed to deliver, customize and support industrial pilots covering a rapidly growing range of application services.

Methodology

Integration models are created as sub-models of the customized solution models, and their functionality will be available to complement the CPPD methodology with PLM system components, linking the required web-services with available software components.

Platform Services

- Integrating configurable work processes and legacy systems as web services

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- Integrating preconfigured solutions and systems, involving development and customization
- Integrating any preconfigured collaboration spaces and visual client-based workplaces
- Integrating configurable web workplaces and model repository structures and contents

People Involved

Services and system integration is performed by a separate system integration team of experts from modeling environments and system vendors.

Results

The resulting models are referred to as integration models, they are typically sub-models of the solutions model.

7.3.6 Platform Delivery and Practicing

Purpose

Platform delivery and practicing adapts services to continuous growth and change by providing services to perform extensions and still keep consistency and compliance across platforms and networks. As the user community and project networking expands the knowledge models must be sustainable, so services for semi-automatic maintenance and validation are important.

Approach

Work processes will be developed to deliver, customize and support industrial pilots and solutions with sustaining services, covering a rapidly growing range of monitoring and management services.

Methodology

Depending on the customer purpose and scope AKM will develop and deliver sound methods for performance testing, adaptation, and eventually also deliver services for upgrading and replicating platforms and their workspaces.

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Platform Services

As user communities grow and change the platforms must expand and adapt, so these services are needed:

- Extending active models with new aspects to incorporate extensions,
- Adapting model-designed and generated visual modeling workplaces with new modeling and execution services
- Adapting model-designed and generated web workplaces with new services

As we gain delivery experiences needs for new life-cycle services, not yet known, will emerge.

People Involved

These services, languages and techniques will be developed and delivered by certified personnel. Delivery will to a large extent be performed automatically over the web.

Results

Model-designed and -configured solutions open up the possibility to automatically adapt operational solutions to customer needs and the working environments involved. This will be balanced with services to monitor and govern these changes, creating a self-adapting project platform and workplaces.

7.3.7 Performance Improvement and Operations

Purpose

Performance improvement and operations is continuously performing improvements and adaptations, and providing services to semi-automatically adjust models and re-generating model-configured and -generated workplaces and services, tuning solutions to produce the desired effects and results.

Approach

Customer network stakeholders and actors will need to know if they are working at required levels of performance and quality, controlling mar-

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gins, so services to perform and share results of performance monitoring and bench marking should be made available.

Methodology

Again we will start work to develop or find and integrate a solid methodology for configurable project platform monitoring and benchmarking.

Platform Services

Services to improve work performance and monitor operations involve:

- Measuring comparing and reporting workplace performance deviations,
- Performing service and test pilot bench marks,
- Preparing performance reports

People Involved

All services and techniques will be performed and delivered by certified personnel.

Results

Performance measurements and reports will be saved for history records, benchmarking and comparisons.

7.4 Service Teams

The customer delivery process may also be seen as seven major teams, developing and providing mutually complimentary services. Each team provides and has life-cycle responsibilities for maintaining a well-defined set of services to each of the other teams. Each team also has a set of roles with clear responsibilities and competence and skill profiles. The profiles of roles are then matched with the profiles of available staff to find who best fits each individual roles as well as team roles. The services communicating data, static information carriers, knowledge views and workplace designs with work-generative services and data.

The scope of the Solutions Model, solutions to be executed, decides the amount of work at each stage and the number of cycles and iterations between stages that must be performed.

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