Integrating Industrial Services into Manufacturing Supply Chains

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Manage growing interdependency between the Manufacturing Supply Chain and Service Providers by developing standardized reference architecture for industrial service providers

Industrial Challenge

An international consortium of industry leaders, SMEs, and universities, supported by the European Commission, has taken the challenge to enhance European leadership by developing a new standard business reference architecture and corresponding models with a key focus on operation and integration of business related services (BRS) in manufacturing supply chains. The consortium called InCoCo-S[1] (for Innovation, Coordination and Collaboration between disparate players of supply and demand networks) jointly initiated the process of developing a Service Reference Model (IRM) as well as a collaboration layer for seamlessly integrating with other standard models like SCOR from the Supply Chain Council www.supply-chain.org or VRM (formerly VCOR) from the Value Chain Group www.value-chain.org by first specifying a skeletal framework.

Using an iterative approach, the IRM has, in a first phase, been defined for 5 different service clusters, namely logistics, maintenance, retrofitting, packaging, and quality control services, all of which are closely related to supply chain partner requirements.

This article outlines the basic framework that has been developed so far, and also dwells on the business processes, as conceptualized for each cluster. The cluster processes have been defined, together with the active participation of the industrial partners, with company-specific business cases and a strong involvement of SMEs.

Growing Importance and Requirements of Industrial Services

According to a recent analysis by the European Commission, about 70% of the overall GDP is generated by the service industries in total. Over 54% of the overall GDP is generated by Business Related Services, and 30% of all Business Related Services are consumed by the production sector (EC 2003). To be able to better measure, analyze, control, and finally automate the increasing collaboration requirements of supply chain players and their service providers in business processes and underlying ICT infrastructures, a new reference framework for services is needed. To validate the industry need, an extensive survey was carried out by the InCoCo-S consortium to define the industry requirements for developing such a reference model.

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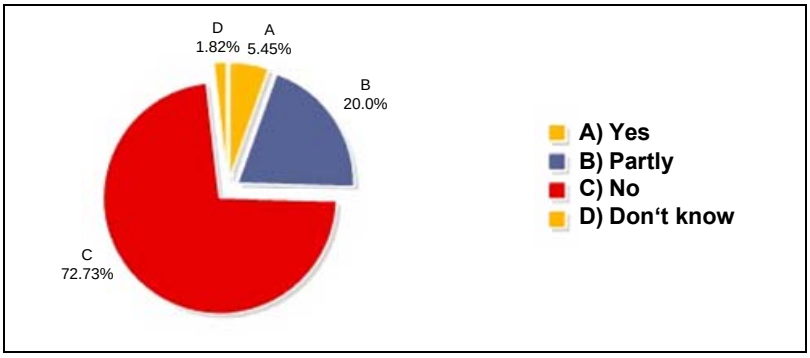

Figure 1. Service Providers using a Reference Model / Framework

The service providers reinstated the lack of reference frameworks for service domains by giving a clear and very strong statement on the use of reference frameworks. 73% of the service providers testified that they are not using any reference framework or standards to integrate their business with the manufacturers. This high percentage combined further with nearly 20% (jointly 93%) of respondents who reported partly using such frameworks and duly highlights a strong gap in the availability or adaptation of standards.

The clear mandate from the industry helped to further specify the goals and contents of the service reference model. The goal here is to provide a standardized framework of collaboration and coordination processes for the integration of BRS providers into fast and flexible manufacturing supply chains in order to gain a competitive advantage for the network itself and its players at large, creating a sustainable win-win relationship. The focus of such a reference model is to:

- Define, analyze, and evaluate business strategy in network setting
- Show “simple picture” of complex environment
- Define common language intra- and inter-enterprise
- Allow different views of an enterprise and its partners
- Map strategy with processes, organizational structure
- Transform high level strategy in operational goals
- Measure actual performance against benchmarks / target setting
- Describe disconnects and conflicting targets
- Develop project portfolio for improvement
- Integrate disparate methodologies (BPM, Lean, Six Sigma)
- Integrate BP and IT

The scope of a reference framework in general is to integrate role-specific reference models to collaborative networks. Whereas a reference model supports companies in measuring, analyzing, and controlling what they do in a standardized way, a reference framework offers recommendations in how to manage and execute such models.

Reference Model and Frameworks

Reference models are generic conceptual models that formalize recommended practices for a certain domain. Often labeled with the term “best practice.” reference models claim to capture reusable state-of-the-art practices. A reference model is a model representing a class of domains. It is a conceptual framework that could be used as the blueprint for system development.

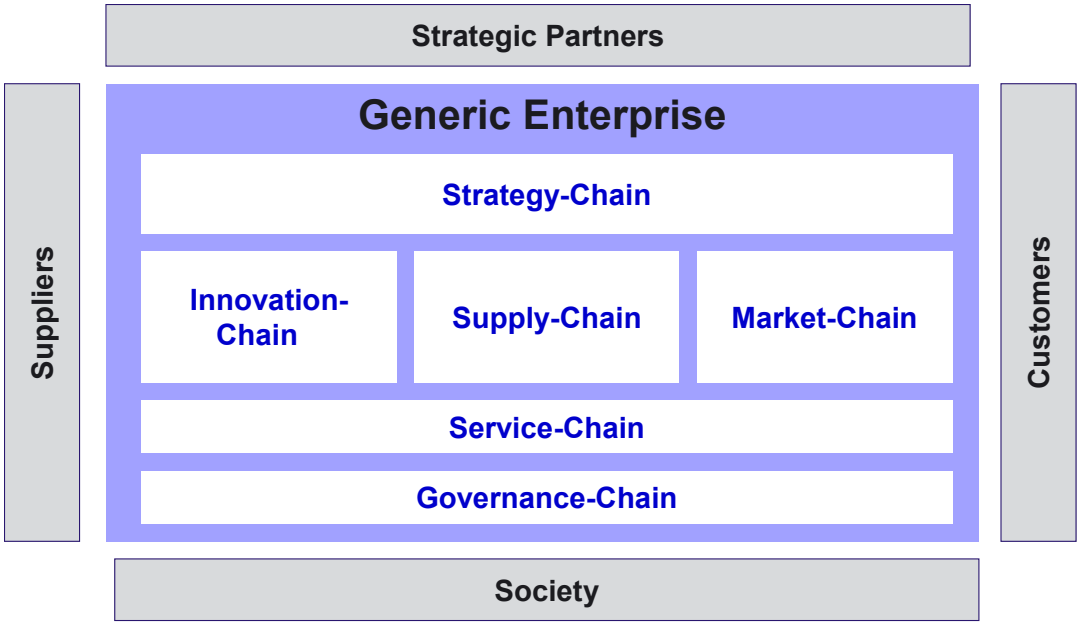

Figure 2. Generic Integration Framework for Network / Enterprise

The reference model IRM follows the structure of other standard reference models like SCOR or VRM; it is a domain specific service chain model with standard process definitions, hierarchical process structures, strategic configurations, standard notation, input-, output-relationships, performance metrics and driver trees, best and good industry practices, as well as features and solutions to support Best in Class (BIC) implementation.

It delivers an analytical toolset that establishes a classification scheme for business processes, using a hierarchy of levels and relationships through inputs/outputs. It establishes a contextual relationship with best practices and metrics to help classify the processes that are most critical to an enterprise.

The corresponding framework contains, in addition, a methodology on the use of the service reference model and the collaboration layer by the industrial service providers and the supply chain partners.

The framework configures and integrates role-specific reference models to collaborative networks. In addition to the models, it contains interfaces to other standard reference models (e.g., SCOR for product manufacturers), a collaboration layer to define collaboration lifecycles, integration architectures, implementation guidelines, organizational models to map responsibilities, business and technical repositories, data structures, lessons learned, use cases, and a road map and master plan to implement, as well as a recommended toolset.

To use reference models, they must be adapted to the requirements of a specific enterprise, which is then referred as an application or business model. Fields of application of reference modeling address all levels and business fields of enterprises. The depicted domains can be very different. They can range from selected functional areas, such as accounting or customer relationship management, to the scope of an entire industry sector, e.g. higher education. The main objective of reference models is to streamline the design of enterprise individual (particular) models by providing a generic solution. The application of reference models is motivated by the "Design by Reuse" paradigm. Reference models accelerate the modeling process by providing a repository of potentially relevant business processes and structures. With the increased popularity of business modeling, a wide and quite heterogeneous range of purposes can motivate the use of a reference model.

Proposed Structure of Service Reference Model (IRM)

Standard process reference models contain several levels of details to enable users to navigate from network strategies to operational goals and to drill down and accumulate performance metrics from high level score-cards to shop-floor measures.

- Level 0: Network- Enterprise-level with standard roles, process domains, and their relationships defining an end-to-end Value Chain. Here, we can see how the individual models such as SCOR and Service models are perceived and also the role foreseen for the InCoCo-S Reference Model, which is visualized as a collaboration model between these two sectors.

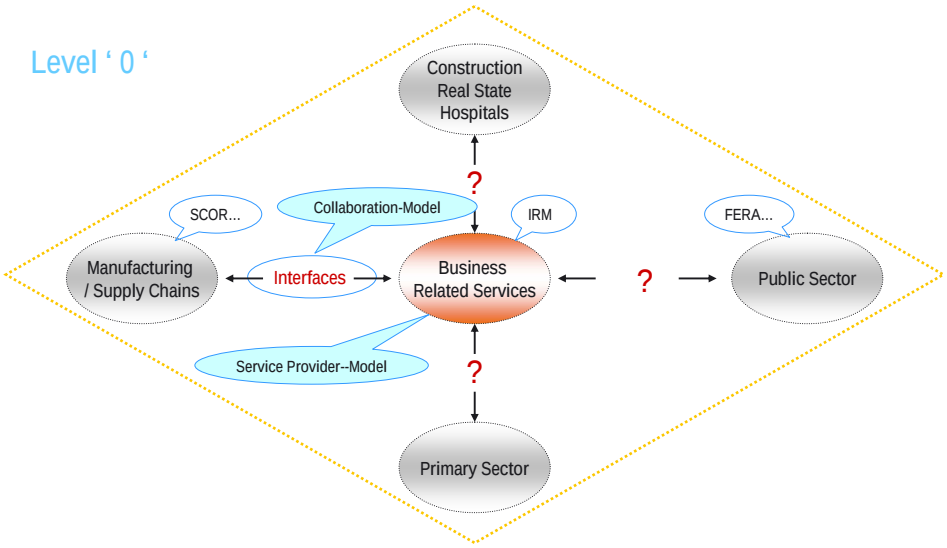

Figure 3. STAR Reference Framework for Services

- **Level 1:** Main business process domain like supply chain (SCOR) or service supply chain (IRM) with process types and categories (SCOR: Plan, Source, Make, Deliver, Return, Enable, or, as for IRM: ***"Adapt, Build, and Operate"*** for services and ***"Outsource, Transfer, and Control"*** for the manufacturing perspective. The Model depicts six management process, enumerated and described as follows:

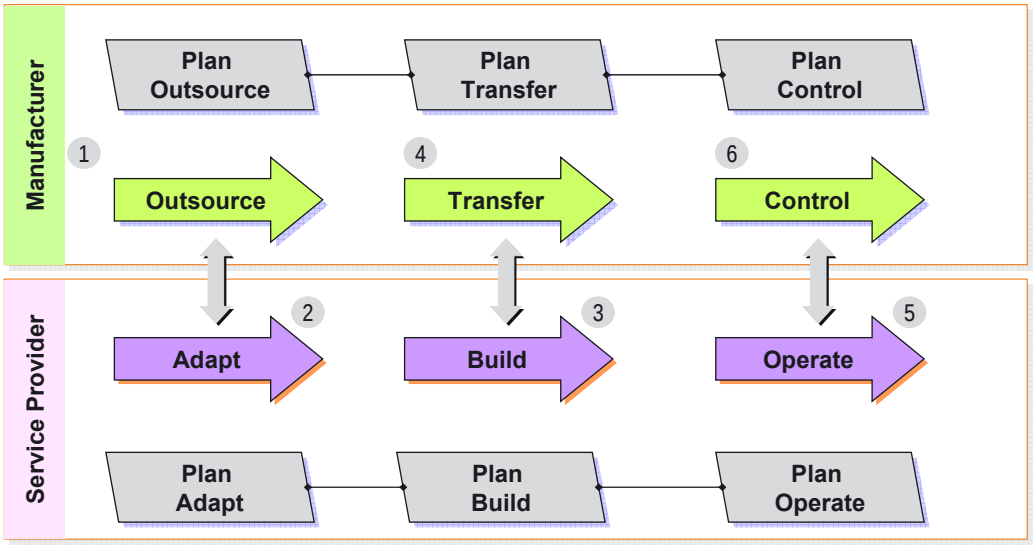

Figure 4. Collaboration Service Provider – Manufacturer

- Outsource (U): the Manufacturer reviews its internal processes, depicts an ideal state, and establishes a partnership with the service provider.
- Adapt (A): the Service Provider reviews the requirements from the Manufacturer, incorporates its experience, and customizes a Service package from its Service Portfolio in order to collaborate with the Manufacturer as a service partner.
- Build (B): the Service Provider, based on the Service Agreement detailing the recently created partnership, prepares a Plan and makes all the preparations needed to perform the Service. This primarily involves the process of setting up the hardware and software, establishing software interfaces, and taking over the functional responsibility from the manufacturer.
- Transfer (T): The Manufacturer also prepares itself to work together with its service partner and facilitates all the resources required to meet the Service Introduction Plan.
- Operate (O): The Service Provider takes the whole responsibility to perform the Service according to the Agreements, monitors its own performance and the performance in the whole supply chain, and executes and controls continuous improvement programs.
- Control (C): The Manufacturer interacts in the operation with the Service provider and controls the activities and the performance of the Manufacturing and decides on further courses of action for the partnership.

- **Level 2:** Customer fulfillment strategies to Plan, Execute, and Support a certain service business process in an industry specific environment. Whereas the SCOR-Model differentiates Make-to-Stock, Make-to-Order, and Engineer-to Order approaches to satisfy customer needs in a supply chain environment, InCoCo-S has defined **5 service clusters** to deliver business related services to supply chain customers.

  The IRM model (using a similar structure as the SCOR Model) also has three types of process hierarchies: a Planning Level, an Execution Level, and a Supporting Level. A **Planning** Process is a process that aligns expected resources to meet expected demand requirements. An **Executing** Process is triggered by Planning processes or an actual demand that changes the state of Services and involves the processes where services are being performed or being prepared. A **Support** Process prepares, maintains, and manages

information or relationship upon which planning and executing process rely in their respective phases.

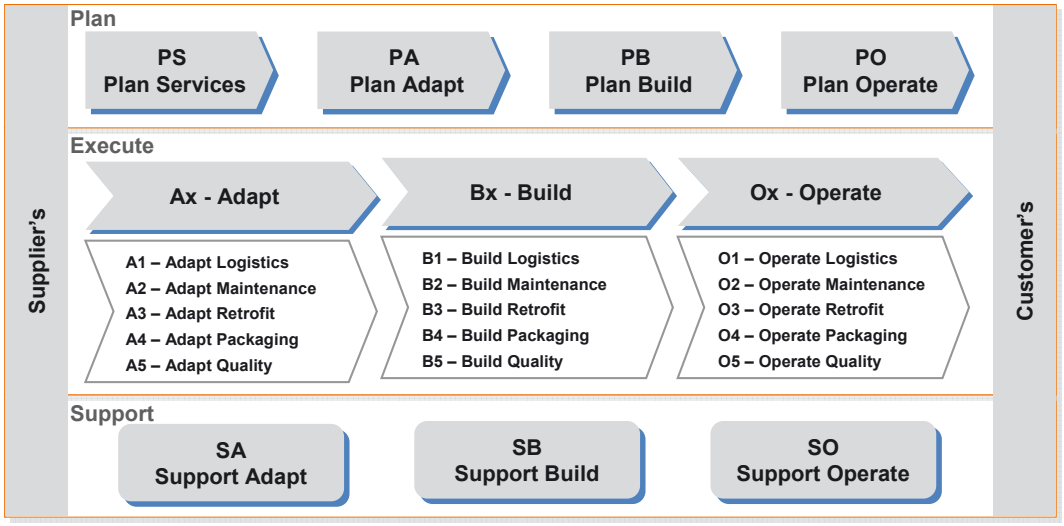

Figure 5. IRM Strategic Level 1 and Level 2 (Configuration Level)

- **Level 3:** Process elements are a decomposition of Level 2 configurations and usually the lowest level of detail in a reference model. Level 3 processes define the transition from a generic reference model to a customer specific workflow. For each of the individual service clusters, the processes are defined at a level 3, giving the whole model a very concrete and comprehensive picture.

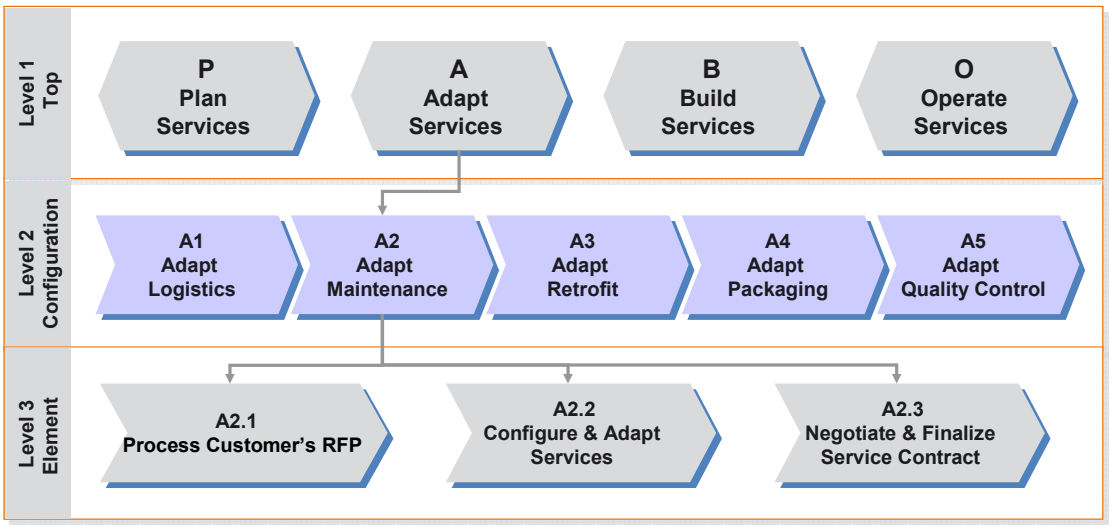

Figure 6. Process Structure of IRM – Level 1 to Level 3

The IRM combines theory and practical knowledge on how manufacturing companies and service providers actually interact and integrates their operations with each other to come out with a gain in efficiency, cost, and performance.

To conclude, IRM presents an extensive process repository, offering industrial service organizations a way to select and configure their processes based on the model. The 45 different process blocks, oriented at either the process categories (adapt, build, operate) or type of processes (plan, execute, support) or the kind of service clusters (logistics, maintenance, retrofit, packaging, quality control), can be selected based on the needs of an individual organization.

Figure 7. IRM Process Repository for Industrial Services

Further, the level 3 processes, which explain in further details the processes, with the associated information flow, performance indicators, good and best practices, offer a plethora of information to help interested service organizations to configure their respective service strategies. Using this IRM model, a pilot use case at SKF has been defined in the domain of maintenance services.

Pilot Use Case SKF

Achieving asset efficiency is a significant challenge. Optimizing the efficiency of equipment has a significant impact on profits – and shareholder value. SKF enables customers to benefit from nearly a century of experience in developing solutions for optimizing machine and process performance. Through the business area called SKF Reliability Systems, SKF offers unique and highly effective methods to help corporations improve asset efficiency and manage maintenance costs more effectively. The goal is to help reduce total machine related costs, enhance productivity, and strengthen profitability.

SKF decided in the middle of 2006 to implement all future interfaces of SKF´s Condition Monitoring Software Suite to ERP and other systems by use of Web Services, which can be orchestrated by use of Service Oriented Architecture (SOA) techniques. The benefit of such an approach is that there is no need to maintain dozens of interfaces between existing programs. Instead, they are implemented into an SOA environment, which can save a lot of costs and frees up budgets for more innovative solutions.

But to achieve a successful approach in the implementation of such a solution, it is essential to drive SOA from the business requirement side – basically, the process management – and that includes all topics around enterprise architecture.

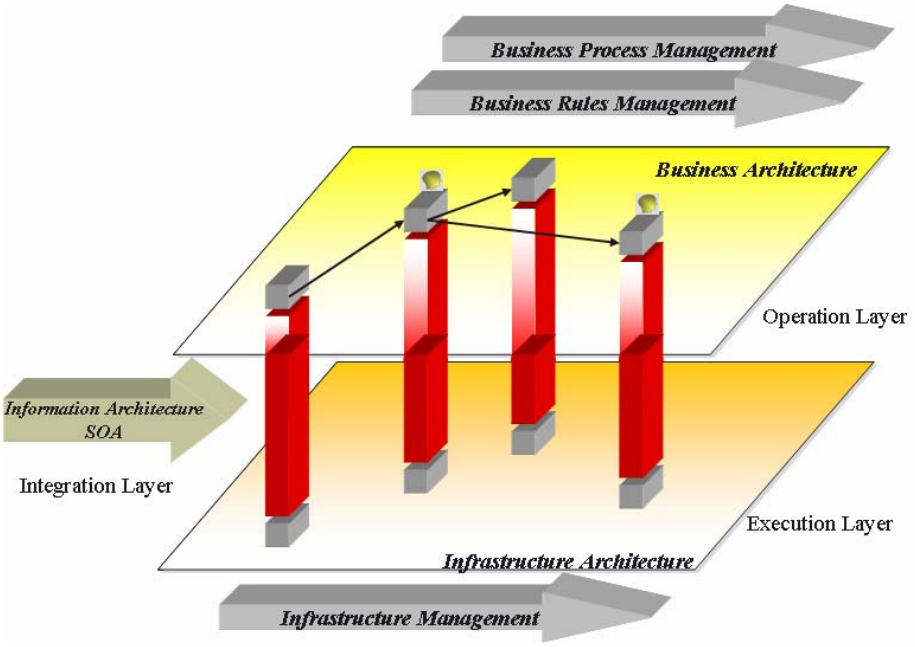

Figure 8. BPM and BRM in a SOA

In general, it can be distinguished between infrastructure-related BPM and business-related BPM. Infrastructure-related BPM covers the IT aspects on the execution layer as business execution engines and all configuration issues.
The business-related BPM is where business processes and scenarios are defined, with the goal of coming up with a blueprint for a specific organization.

Once a blueprint has been developed it can be loaded into different execution environments on the infrastructure layer. Returning to the business (operation) layer, one may measure certain KPIs (key performance indicators), monitor processes, and further investigate where processes can still be improved. Also, additional intelligence can be implemented into the processes.

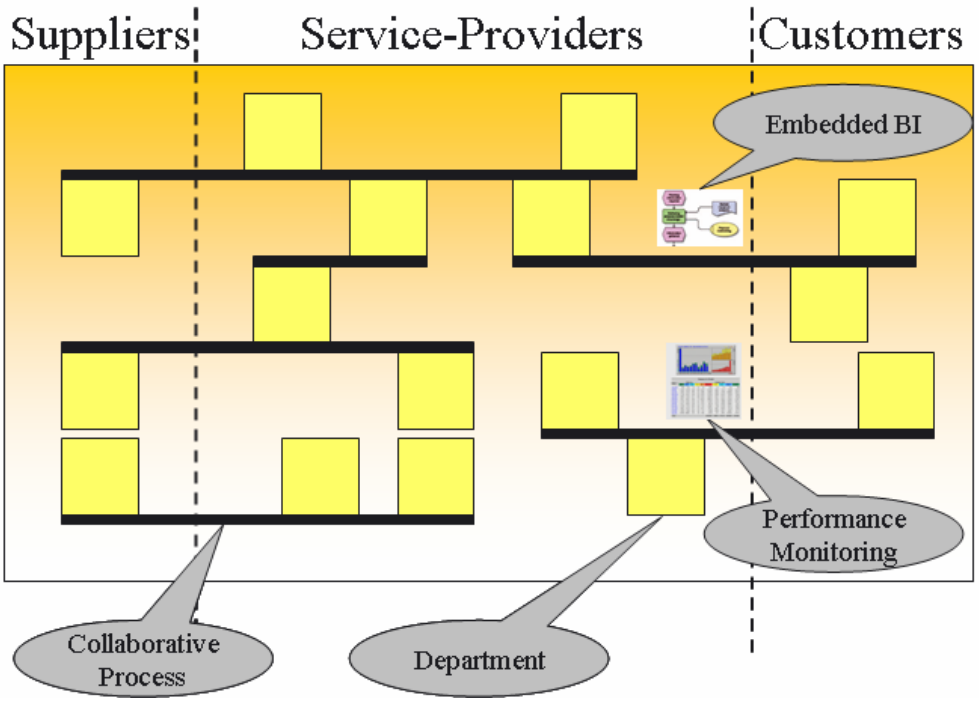

Figure 9. Operation Layer

In these days, SOA is heavily discussed, but there are very few organizations that actually do it. Most of the companies are just now examining the situation. There is a tendency for companies to be technology-driven and start implementing those technologies in an IT sense. But by just implementing SOA technologies, you really don't get any value at all. In order to get any business results based on SOA, it is essential that you know your processes in detail. If you don't know in which way you want to organize your processes, you can't use the flexibility a SOA provides.

SKF is one of the industry partners of the InCoCo consortium and an early adopter of the IRM. SKF has developed its processes for new service business areas by use of the IRM model in combination with the ARIS modeling tool. The IRM captures the view of service supply chain management. The underlying content of the model is currently being approved by the industrial partners of the InCoCo consortium and also being verified by interested companies not belonging to the consortium.

Therefore, the IRM provides a framework that links business processes, metrics, best practices, and technology features into a unified structure to support communication among service supply chain partners. Furthermore, the effectiveness of classical supply chain management can be improved, as now relationships and dependencies towards the service supply chain management can be modeled by the IRM.

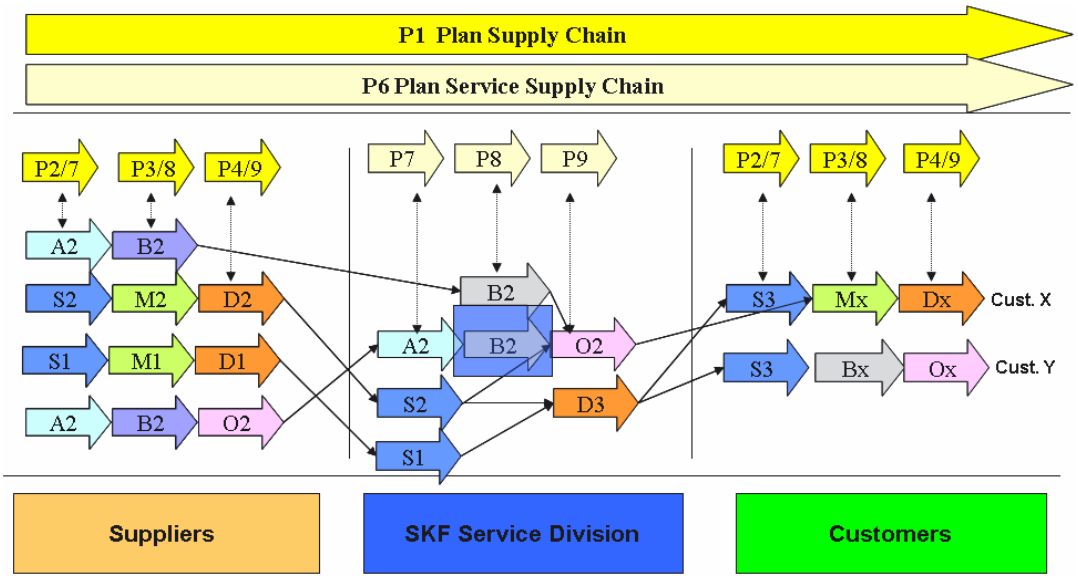

Figure 10. IRM used for SKF Processes

As depicted, the IRM can interact with manufacturing reference models like SCOR from the SCC or VRM from the VCG, especially if classical supply chain processes on the supplier and customer side are affected. In the SKF pilot case, the IRM methodology was extensively used to model and build the service supply chain for SKF. The service elements were mostly modeled using the distinct Adapt, Build, & Operate phase from IRM, while the traditional sourcing and manufacturing activities of the suppliers can be modeled by these, if needed, using processes like Source, Make, and Deliver from SCOR.

SKF recommends from its own experience that before any organization starts with any technology implementation, it should be assured that the processes are well documented and designed. This design can be used to drive the implementation and configuration of the SOA.

From SKF´s perspective, the single steps are as follows:

- firstly, focus on the business strategy
- secondly, focus on the business processes themselves
- thirdly, ensure that process design and documentation are properly conducted
- fourthly, transfer that blueprint to the SOA

Research Outlook and Next Steps

In this article, a new model developed specifically for the industrial services has been presented. The service oriented reference model – IRM (InCoCo-S Reference Model) aims to help the service organizations to map their processes and build stronger synergies with their customers, suppliers, and business partners. The 3 phases of IRM, namely Adapt, Build, and Operate, cover all the interactions with potential customers, from the initial contact to continuous service operations and improvement initiatives.

The processes in IRM have been modeled using a hierarchical structure and focusing on the different types of processes (plan, execute, and support). For common understanding, the process repositories of each of the clusters have been elaborated both graphically as well as with a detailed textual description. Each of the clusters has followed a common structure in terms of first defining the service, giving an overview of service functionality, defining the processes down to a level 3, and presenting potential interactions with manufacturing customers. The interactions

with the manufacturer provide a common view of the interdependency between the processes of service providers and manufacturer.

Currently, within the scope of the project InCoCo-S, we are validating the IRM model with external industrial organizations. Service providers active in the domain of logistics, maintenance, packaging, retrofit, and quality control can make a quick scan of their business processes using IRM. The consortium, in addition, offers a one-time opportunity to model the specific business process of the organization and develop As Is and To Be scenarios as an extended validation activity. Interested organizations are encouraged to visit us on the website and contact the authors for further possibilities.

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