

COLLABORATIVE SERVICE IN GLOBAL MANUFACTURING – A NEW PARADIGM

I. Hartel¹, Y. Kamio², M. Zhou³

¹Swiss Federal Institute of Technology Zurich – Center for Enterprise Sciences (ETHZ-BWI), Zürichbergstrasse 18, CH-8028 Zurich, Switzerland, Email: Ingo.Hartel@ethz.ch; ²Toyo Engineering Corporation, Japan, Email: kamio@ims.toyo-eng.co.jp; ³CSIRO Manufacturing & Infrastructure Technology, Australia, Email: Mingwei.Zhou@csiro.au

Abstract: Small and medium-sized enterprises have to deal with increasing requirements on customer services. Furthermore these enterprises are not able to decrease their service delivery times and costs on their own and so, as a consequence, they have to team up with external partners to build up service cooperations. To support this development a model will be described to enable these enterprises fulfilling services collaboratively by using the basic concept of the virtual organization.

Key words: Collaborative Service, Service Management, Virtual Enterprise

1. INTRODUCTION

Global manufacturers are facing an increasing challenge in offering adequate and timely fulfilment of customer services (see [1]). This is particularly urgent for those small and medium-sized enterprises (SMEs) serving the one-of-a-kind industry, as they find it difficult, if not impossible, to maintain their own worldwide service networks at reasonable costs. One approach is to collaborate by selecting cooperating network partners based on their individual core competencies during the fulfilment of various after-sales services.

However, setting up and maintaining such a network organization, as well as developing and implementing a successful business process for global collaboration, are often beyond the knowledge and capacity of a SME.

Therefore, a reference model including guidelines to form inter-enterprise service collaboration is essential and can be critical for its success.

2. VIRTUAL ORGANIZATION

In the search for organization forms for the twenty-first century, the virtual organization concept is beginning to make headway as a dynamic structural pattern. Under this model, organizational units (also called as virtual enterprises) are created, restricted to the primary business purposes and thus, this structural simplicity allows maximum economic efficiency.

A virtual enterprise can briefly be characterized as a short-term inter-enterprise cooperation where individual enterprises join core competencies in order to establish a value chain configured exactly to meet a specific customer demand. When the customer demand has been fulfilled, the virtual enterprise is decommissioned.

For the one-of-a-kind production, different types of virtual enterprises can be set up based on their deliverables (see [2]). For example, in order to support the operation of a one-of-a-kind product such as a chemical production facility, a virtual service enterprise could be established to offer the plant owner with services such as maintenance or operation support.

This kind of virtual organization usually consists of three main elements: The service network of all potential service members, the virtual service enterprises (VSEs) of selected members, and the services as a product offered by the VSEs. To provide a structural arrangement and to capture the characteristics of these entities, the Virtual Enterprise Reference Architecture (VERA, see Figure 1) is currently being developed in the IMS GLOBEMEN project [3]. VERA is based upon GERAM [4].

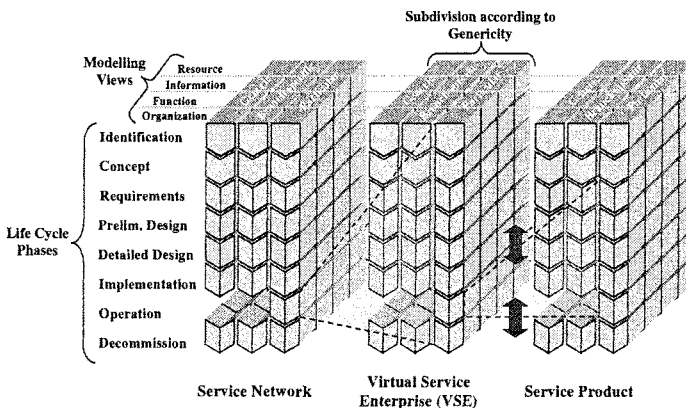


Figure 1. Virtual Enterprise Reference Architecture (VERA)

A **service network** in the operation phase has an array of service products, which they can offer to customers. A **service product** consists of one or many service modules, which targets different customer needs through its single or combined characteristics. A more elaborate description of service products and their configuration out of service modules can be found in [2]. If a customer reports a problem suitable network members will be selected and a **virtual service enterprise** will be set up that can best deliver the service product as defined by the given customer requirements.

3. COLLABORATIVE SERVICE

The reference model for collaborative service introduced in this paper describes the activities that are pertinent during the life-cycle phases of the three different entities described above. These life-cycle phases encompass all activities from identification to decommissioning of the entity (see chapter 3.1). To decrease the apparent complexity the reference model uses the view concept from GERAM that allows the operational process to be described as an integrated model, but to be presented to the user in different sub-sets, so called modelling views (see chapter 3.2).

3.1 Life-cycle

This chapter describes briefly the entire life-cycle of setting up a service network organization and its virtual service enterprises. In the reference model the life-cycle is modelled in various level of detail.

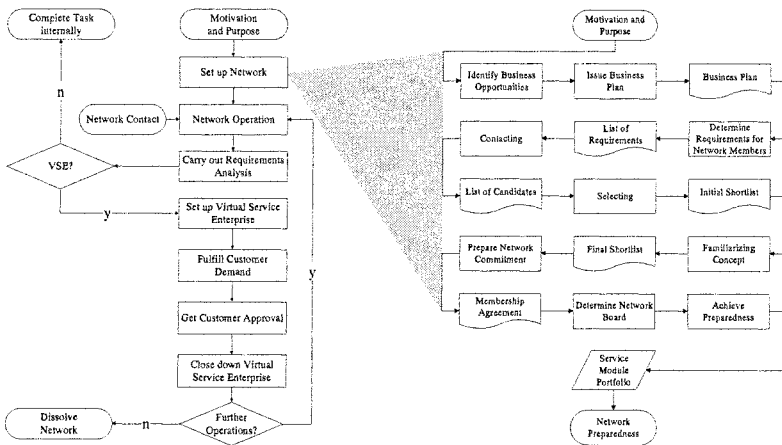


Figure 2. Top-level overview and set up network process [5]

The top-level overview helps to grasp the entire content and illustrates the process of setting up a network organization and its VSEs and finally, fulfilling the customer demand by providing the service product. Based on this the following level shows in detail, what has to be done in the different life-cycle phases. As an example Figure 2 illustrates on the left side, the overview of the business process and on the right side the depiction of the set up network process in detail.

3.2 Modelling views

Modelling views contain a subset of facts present in an integrated reference model allowing the user to concentrate on relevant questions during modelling of its service organization. The following subchapters aim to give an overview of the four different modelling views (organisation, function, information and resource), which are used in the reference model.

3.2.1 Organizational view

This view describes the organizational structure of the relevant entities and the roles that exist in these entities with their responsibilities and tasks. The main organizational entities of a virtual service organization are the production facilities delivered from the one-of-a-kind producers, the service network, the resulting virtual service enterprises and the delivered service products.

Production facilities can be characterized by their locations, type of installed machines and installations, production processes, history of services, and modifications since production start up. The size of the owners may range from SMEs with one production location to large corporations with a number of globally distributed locations. The production facility can be made up of machines or installations purchased from one or more one-of-the-kind producers.

The **service network** consists of independent enterprises that are working together to exploit a particular service opportunity by offering **service products** jointly to the market, based on common interests and partnership-oriented business relations. Network members can be one-of-a-kind producers and a multitude of independent service companies, suppliers, vendors or ICT infrastructure providers. The distinctive features between them are competencies, technical aids, and available ICT, locations, and capacities. In addition the one-of-a-kind producers are characterized by size, branch, and position in the value chain. Thus, networks can be comprised of one-of-a-kind producers of the same or different sizes and in the same or different branches. As to position in the value chain, company activities can

be at the same level (so-called horizontal) or downstream or upstream levels (so-called vertical). Collaboration among companies within the same branch, and thus potential competitors, is necessary when a critical mass is required in global markets in order to gain an advantage over local competitors.

The **virtual service enterprise** is formed of selected network members. Together these network members can fulfil the specified service. The service is divided into different tasks. Each network member in the VSE is responsible for performing a part of these tasks in accordance with its competencies and available technical aids and ICT. Sometimes collaboration is necessary in order to perform a task, such as, for example, when a local service company repairs a machine by installing new spare parts but does not have the know-how to reset machine controls after completion of the repairs. Under the remote direction of the one-of-a-kind producer, however, the service company can do the resetting. Here the network members depend upon modern ICT for coordination. Communication can be very efficient using video conferencing and wearable computers, for example.

The reference model distinguishes seven **roles**, six of them are active and one is auxiliary. The active roles include the customer, the network or project initiator, the network members, the project board, the network board and the audit team. The information system of the network organization plays a supporting role facilitating the information exchange between the active roles. More elaborate description of the roles can be found in [5].

If there is more than one one-of-a-kind producer in the service network, the question of **responsibility for tasks** like network operation, contacts with customers, evaluation of potential new network members, etc. must be clarified. Possible variants are described in [2]. Small and medium-sized one-of-a-kind producers have very oft not conditional on their size the financial and personal resources to manage a service network. If only this type of enterprises are part of the network then it can be useful to outsource management tasks to an external company and financial tasks to a bank or insurance company. Responsibilities might also be divided up according to market or customer segmentation.

3.2.2 Functional view

The functional view represents the hierarchical structure and the relations of functionalities (activities). In functional models activities related to the management and operation of the virtual service organization are represented, as well as support activities. An example of a function model for the VSE entity is illustrated in Figure 3. It is possible, that the same activity has to be fulfilled several times, e.g. in different life-cycle phases of one entity or in life-cycles of different entities.

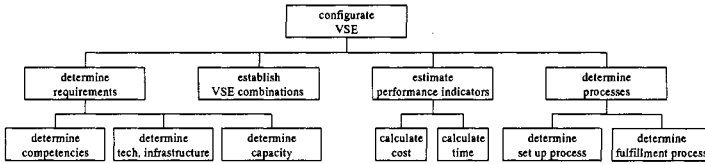


Figure 3. Function model for virtual service enterprise configuration

3.2.3 Information view

The information view is describing the content and flow of information, which is created, shared, used, modified and disposed along the life-cycle of the different entities of a virtual service organization. Junction points of information exchange among the defined network roles are indicated and key information occurring during the set up and operation of a service network and VSEs are structured and illustrated as different information objects. These information objects can be used to support the design of a data schema for an information system. Figure 4 presents exemplary the information exchange between different roles during the set up of the network and the information objects business plan and service module portfolio (P means information provider, R means information receiver).

Service Module Portfolio	Information Objects	Type of Information							Roles					
		Network	Product	Production	Financial	Legal	Others	Customer	Network Initiator	Partner	Project Network Board	Audit Team	Information System	
Configuration	Business Plan													
Components	Executive Summary													
Organisation	Introduction to Business Idea													
Processes	Organisation													
Classification	Network and VE Type													
General Support	VE Characteristics													
Self Support	Corporate Business Processes													
Remote Support	Product													
On-Site Support	Service Module Specifications													
Lifecycle Phases	Service Module Configurations													
Pre-Sales	Service Product Delivery													
Sales	Market													
After-Sales	Marketing Plan													
Specification	Competitive Advantage													
Keywords	Operation													
Description	IT Infrastructure													
History	Communication Settings													
Finance	Investment													
Profit & Loss Statement	Management													
Members of the Network Board	Specification of the Roles													
Service Module Portfolio														

Figure 4. Information exchange and information objects whilst setting up a service network

3.2.4 Resource view

The resource view represents the resources of the network members as they are used in the course of the network and VSE set up and operations. Resources can be for example competencies and know-how to fulfil service tasks, capacity of service technicians, material or machines needed to produce spare parts or specific diagnostic software and hardware. These resources have to be assigned using resource models to the defined activities and organizational entities.

4. INDUSTRIAL CASE STUDY

The proposed reference model is currently being established and exploited in a use case from the GLOBEMEN project. In this case a Japanese one-of-a-kind producer (“OKP1”) develops and sells large chemical plants. For the manufacture of these plants, it has a large network of suppliers and vendors. Worldwide there are 100 of these plants in operation by customers. In the past, OKP1 developed service modules, such as a remote plant monitoring system and a training simulation system, to support after-sales services. However, OKP1 does not have its own team of service technicians. A customer (“C1”) operates several plants in Asia and has its own teams for inspection and maintenance. A Japanese telecom company (“TC”) maintains a communication network in the Asian region. TC offers also services to collect information from production equipment for safe control and use, provides network accounting, collection and authentication functions and a place to register a variety of applications to access remotely.

Below the first steps of modelling the organizational view will be briefly described:

Structure of the service network: The service network is established in the Asian region and made up of OKP1 with selected suppliers and vendors, C1’s service teams and the network infrastructure from TC.

Collaborative service products: The operating service network will provide a wide range of service products, which are configured from existing service modules from the network members. Collaborative service products will be for example:

- *Hosting Service:* Long term data gathering of plant and process data and monitoring using the remote plant monitoring system, which is installed at TC. Suppliers and vendors can also access the remote plant monitoring system and are responsible for observing their specific parts of the plant.
- *Process or Equipment Performance Evaluation:* Based on gathered data from the hosting service an evaluation of the current status of the overall plant or specific equipment will be carried out. For the evaluation a process flow simulator from OKP1 and knowledge about plant operation from C1 are needed. The results of the evaluation will contain recommendations to change current operation condition (e.g. pressure, temperature or flow) or to establish plant services.
- *Plant Services:* These services are maintenance, repair, inspection, etc. and have to be carried out by service teams on-site.

Based on these products an enterprise configuration scenario could look as following: Due to the equipment performance evaluation the requirement

for maintenance on a reactor and replacement of spare parts of the supply pipes is identified. The virtual service enterprise will then take the following configuration: A service team from C1, which has reactor training, goes on-site to the customer. At the same time, a supplier delivers to the customer the pipes it has manufactured or drawn from inventory. During the repair procedures, the member of the service team receives additional required information from engineers at OKP1 using mobile and internet-based ICT.

The benefits of the described type of cooperation are as follows: Through implementing various service modules, OKP1 can actively offer after-sales services and gather valuable experiences for new product design. C1 benefits from collaboration with OKP1, because they will have better utilization of their service team capacities. In addition, technicians from C1 will benefit from enlarged experience through service work at other companies.

5. CONCLUSION

The present contribution introduced a model of how future collaboration in after-sales services in the one-of-a-kind industry might look like. The proposed reference model for collaborative service is intended to provide a guideline to set up an inter-enterprise service organization based on the principles of the virtual organization. During the application of this model, in industrial use cases, it may be adjusted individually, but it still helps especially SMEs to increase the ability of setting up a network organization and of running its virtual service enterprises successfully.

REFERENCES

1. Hartel I, Burger G, Schnetzler M, Rüt C (2001). Company survey "Successful Service Management – Trends and Practices in the After-Sales", Zurich (CH).
2. Hartel I, Burger G, Billinger S, Kamio Y (2002). Virtual organization of after-sales service in the one-of-a-kind industry. In: Camarinha-Matos L M (Ed.). Collaborative Business Ecosystems and Virtual Enterprises, pp. 405–420, Kluwer Academic Publishers, Boston (USA), 631 pages.
3. GLOBEMEN (2000–2002). Global Engineering and Manufacturing in Enterprise Networks. IMS 99004/ IST-1999-60002, <http://globemen.vtt.fi>. The Swiss region is sponsored by the Swiss Commission for Technology & Innovation (CTI).
4. GERAM (1999). Generalized Enterprise Reference Architecture and Methodology. ISO/DIS15704, IFAC/IFIP Task Force on Architectures for Enterprise Integration.
5. Hartel I, Sonderegger S, Kamio Y, Zhou M (2002). The Information Roadmap of Virtual Enterprises. e2002 – eBusiness and eWork Conference, Prague (CS), 16–18 October.