

## REMOTE MAINTENANCE SUPPORT IN VIRTUAL SERVICE ENTERPRISES

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**Abstract:** This paper discusses a scheme that allows all parties involved in the maintenance of a chemical plant: the plant owner (customer), the engineering company, the equipment vendors, and the maintenance firms, to form a virtual service enterprise (VSE) whenever a maintenance service is necessary, in an attempt to provide required services more timely. This paper also discusses the requirements for knowledge management and risk management in such a VSE environment, and proposes a secure hosting service environment that allows all the parties to share information and applications, and to collaborate during plant operation and service fulfilment. To evaluate and demonstrate the feasibility of this scheme, a prototype of the remote maintenance system developed for a fertiliser plant in Indonesia is presented. Finally, a scenario of how to utilise such a remote maintenance system, the possibility of collaboration among VSE partners, and the advantages of utilising the proposed hosting services in VSE are also discussed.

**Key words:** Virtual Service Enterprise, Remote Maintenance, Hosting Service, After Sales Service, Inter-Enterprise Collaboration

### 1. INTRODUCTION

Modern chemical plants are getting more and more sophisticated, and the number of equipment vendors needed for each plant is also increasing. The provision of after-sales services, such as the maintenance of plants and

keeping the plant at a good level of efficiency, safety and reliability, has become an increasingly challenging business opportunity for those engineering companies who constructed those plants. The customers who own and run those plants, on the other hand, are also trying to rationalize their plant operations by out-sourcing their maintenance services in order to concentrate themselves on their core competencies. All these demand for a new business scheme that can provide cooperative service by all parties involved, including the engineering company, the various equipment vendors, maintenance firms, and the plant owner (customer).

This paper attempts to address such issues. We are proposing herewith a remote supporting technology where engineering companies, equipment vendors and customers will be able to co-operate and solve problems quickly by exploiting the latest IT technologies. A case study in a large scale chemical plant has been taken as an example.

## **2. BUSINESS REQUIREMENTS**

Plant owners are endeavoring day and night in order to operate their plants safely and enhance their production efficiency. However, the engineering companies who built the plant, and various vendors who provide equipment for the plant are getting more and more internationalized. It would be very hard, if not impossible, for any of these business partners to provide a win-win solution separately and independently. It would be necessary for them to work out a cooperative ways among themselves.

The business requirements from each party are described in more detail below.

### **2.1 Requirements from customers**

Inherently, customers as plant owners usually maintain their own operation department or service department in an endeavor to operate their plants in an optimal manner. However, the systems have become much complicated due to the enhanced functions of plants and environmental considerations, which require the service personnel to have a higher level of analysis and judgment capability. In addition, while the service departments need a certain level of manpower for periodical inspection, such manpower may become redundant for daily routine inspection. Because it is unsustainable to keep a maximum required size of service personnel in house, the plant owners will have to find out ways to keep it minimum and to source out necessary work when required.

## **2.2 Requirements from engineering companies**

Engineering companies have been traditionally concentrated on the so-called EPC (Engineering, Procurement and Construction) business sector, and minimize the involvement small and lingering after sales jobs whenever possible. However, due to the recent severe competition for new projects in the global market, and increasing demand from customers for complete solutions, the engineering companies are expected to extend their services to cover the entire life cycle of the plants and to keep a good relationship with customers.

However, customers are distributed throughout the world, it would not be cost effective for engineering companies to extend their support services world widely all by themselves. Therefore, engineering companies are looking for local partners to extend their support services. As the equipments used in the plants are procured from vendors scattered world widely, linkage with these equipment vendors is essential for servicing such components.

## **2.3 Requirements from equipment vendors**

Vendors have recognized importance of maintenance service of their products and, therefore, have established maintenance service network systems by using manpower or telephone line systems. However, once their products are included in complicated systems such as plants, the effect of maintenance services by vendors alone would be limited and linkage with system analysis or simulation will be indispensable. Furthermore, it will be inefficient for each vendor to construct own service network. Hence, cooperative actions with engineering firms or other vendors will become necessary.

## **3. MODEL OF VSE [1],[2]**

A virtual service enterprise is a temporary business entity established from a network of partners aimed to provide the after-sales services to a customer. Each partner is an independent entity that is equipped with its own unique capabilities and competencies, assuming responsibility to perform the allocated work. For example, when an engineering company, a group of equipment vendors and maintenance firms, and a customer (factory) organized a VSE using a hosting service (see Section 4.2), equipment in the plant made by various vendors can receive services by means of remote monitoring systems, some minor hitches could be rectified through remote maintenance. Furthermore, periodical repairing tasks can now be planned

based on a more accurate judgment: when a material repair work (such as replacement of components) is necessary, the customer can order parts via Web system, and maintenance firms can schedule in advance to perform repairs and replacement of equipment on time. The engineering company can also carry out simulations of entire plant systems using actual data collected and will be able to provide the customer with valuable advices such as optimized operations. A conceptual image of a VSE is shown in Figure 1.

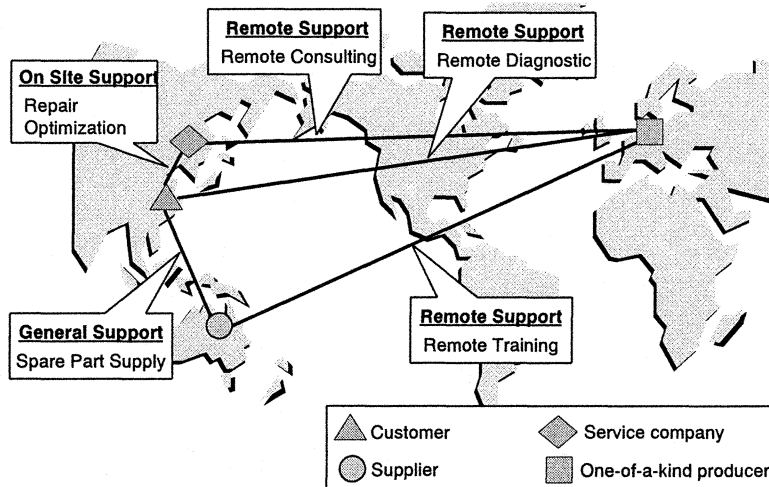


Figure 1. Example of a virtual service enterprise

## 4. ICT ENVIRONMENT FOR VSE

### 4.1 Remote Plant Monitoring System (RPMS)

Plant operations are usually controlled by the DCS (Distributed Control System), from which plant information, mainly the operational data, can be downloaded and forwarded to a data server through Internet connection.

Figure 2 illustrates our proposal on how relevant partners can share the information. As the plant operates continuously, its operational behavior does not change suddenly during normal operation. Therefore, the plant data can be transmitted on a daily basis at the least busy time zone of the network. Furthermore, only part of the information needs to be accessed by each partner. As shown on Figure 2, a list of data items, entries on P&ID diagrams and trend graphs have been made available. The time and frequency of data transmission may be adjusted according to the customer's requests or the engineering company's judgment.

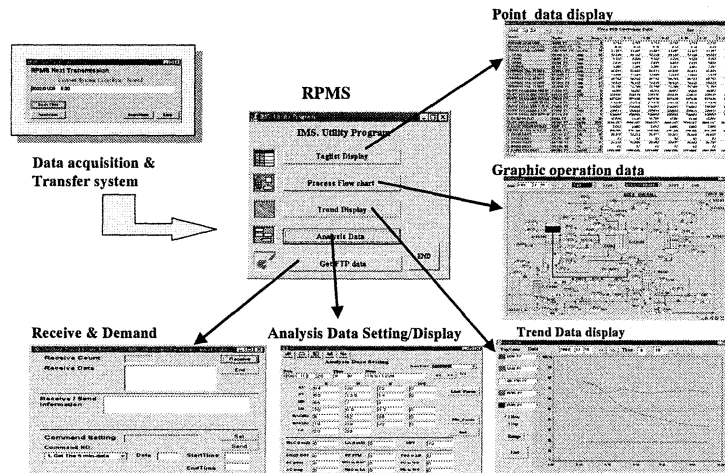


Figure 2. Remote Plant Monitoring System

## 4.2 Hosting Service

Normally, a virtual enterprise (VE) or a project team is organized when constructing a plant. An engineering company usually plays the role of a prime contractor, interacting with both the customer and the equipment vendors and coordinating the technical issues and work schedules.

This arrangement is convenient for the customer because the interaction between the equipment vendors is simplified and no day-to-day coordination is necessary. This is convenient for the equipment vendors too, because they no longer need to coordinate with each other on an individual basis.

After the construction of the plant was finished, and the manufacturing facilities were commissioned, the engineering company had successfully completed its commitment, and the responsibility for the plant was passed on to the customer (owner). Normally, a service department is setup by the customer to carry out all service and maintenance work. As we discussed above, this is a costly burden on the customer.

Naturally, we need to consider why not extending the VE or project team arrangement successfully used during the construction phase into the maintenance phase. The merit would be that all the parties including the customer and equipment vendors get benefits as in the construction phase. We have adopted a hosting service, as shown in Figure 3, as an IT infrastructure to facilitate the VSE. The core of the system is a data center which links the customer (factory owner), the engineering company, the equipment vendors, servicing or maintenance firms. Through this service, the customer can execute the service and maintenance agreements with each

equipment vendors and the engineering firm. The management of data center security, services and computer maintenance will be carried out by an independent data center company. The data center company also manages all service applications for all registered companies. Conventionally, the customer needs to ask the engineering company or the equipment vendors to send in their engineers to do the repairs and maintenance of equipment installed at each plant. This has been a costly and time consuming task, and if not handled promptly, may interrupt the normal production in the plant. However, by exploiting the above mentioned hosting service, a more cost effective and speedy maintenance service could be expected. In addition, each vendor can provide more efficient after sales activities.

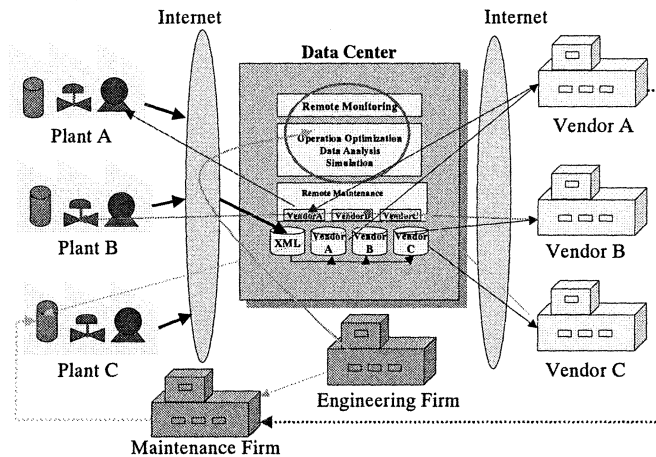


Figure 3. Hosting Service

## 5. INDUSTRIAL CASE STUDY

Toyo Engineering Corporation (TEC) as an engineering company has over 40 years history and has successfully constructed many chemical and petroleum plants all over the world. In particular, TEC has the license for urea processing, with which the company has built more than 100 plants and enjoys about 25% share of the world market. TEC has so far provided after sales services such as technical support, training simulator development and turn around (T/A) support. In order to expand the service base, the firm has decided to develop a business model for after sales services of urea processing plant, and invited one of the customers as a partner to jointly develop the new process. The first parts of the business model will be briefly described as follows:

**Structure of the service network:** After a review of techniques and tools that TEC and this customer can offer, it was found that we are in a reciprocal position. (For example, TEC owns design know-how and tools while the customer owns operation and maintenance know-how of plants.) It was also made clear that by combining the know-how, we would be able to offer more useful services. So we planned to construct a service network with TEC and the customer as the core, and establishing a VSE that best complies with requests of other urea plant owners and to provide best services. The other partners invited to the service network include the equipment vendors and maintenance firms.

**Collaborative after sales service scenarios:** A prototype developed is shown in figure 4. The hosting server is connected to Internet, and accessible from outside by using applications such as SecurID. Also it should be mentioned that the application developed can be operative on thin client PCs by using SBC (Server Based Computing) tool such as “Go Global”. The data pertaining to the operation sent from plants are accumulated in the hosting servers through the data servers and utilized for various services such as plant monitoring, preventive maintenance, trouble shooting of complex units, total plant system simulation, equipment performance evaluation, system performance evaluation, training.

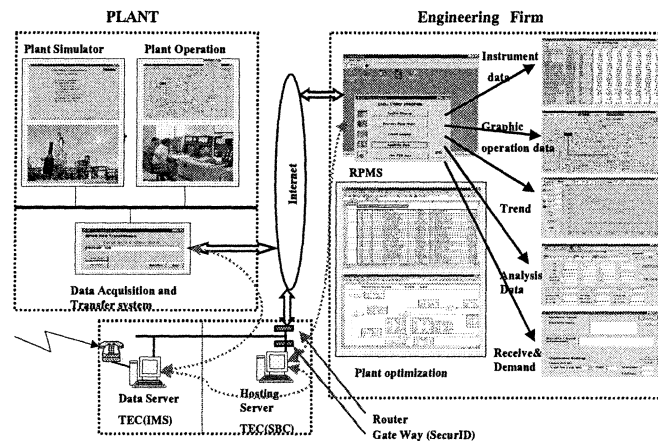


Figure 4. Prototype system

Conceivable examples of the services that use the above are: plant monitoring (basic), periodical training, performance evaluation of equipment and plant, and scenarios combining various trouble shooting measures.

By such set up as mentioned above the benefits are: Partners who participated in the service network can play the roles as VSE members without any additional need for ICT infrastructures. Also, by sharing data and IT infrastructures, and by reciprocating each other the technologies and

tools, each partner will be able to provide services that were impossible by individual effort.

## **6. CONCLUSION**

In this paper, we take a chemical plant as an example, and proposed a business model of collaborative after-sales services in "one-of-a-kind" industry and designed a prototype. Although we recognize that more specific aspects of business are yet to be studied in more detail, we believe that the methodology as introduced herein can be commonly applied to large-sized and complicated facilities where many business entities are involved.

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