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## VIRTUAL ENTERPRISE MEMORY MANAGEMENT SCHEMA (V.E.M.M.S.)

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**Abstract.** Knowledge is one of the most important assets of organisations. It is well known that an advanced knowledge management requires what is called an organisational or Corporate Memory that is the central repository of all the knowledge relevant for an organisation.

It has been proposed that one of the major managerial and organization changes required in the new competitive environment will be the formation of Corporate Memory in Virtual Enterprises. In virtual enterprises, several designers in different fields and from different enterprises collaborate to build a product. The Virtual Enterprise is an organization with a temporal organizational structure. In fact, once the project is completed, the Virtual Enterprise is dissolved. The deal in such organization is to keep the volatile knowledge. This paper suggests a management schema to define, construct, distribute, use, evaluate, maintain and evolve effectively a Corporate Memory for a Virtual Enterprise. To achieve that, systemic methodologies are used and relevant conclusions are given.

**Keywords:** Corporate Memory, Virtual Enterprises, systemic methodologies

## **1. INTRODUCTION**

A virtual enterprise is a temporary alliance of companies for the lifetime of a common project. As defined by Rolstadas [7], the virtual company consists of a number of units geographically dispersed but managed as a total unit, although the sub units may be under separate management.

A virtual enterprise (VE) has a relatively short life. Two or more enterprises may join together temporarily to build a product. When the production is completed, the VE has no further use and is broken up. Other VEs may be more permanent, forging their relative strengths together to face a growing market opportunity. Another kind of VE is formed when a set of enterprises benefits from using each other products or services in carrying out their own business.

A Corporate Memory (CM) can become a powerful tool for the proper operation of a VE. Nagendra Prasad and Plaza [4] (p.40-1) define Corporate Memory as 'the collective data and knowledge resources of a company including project experiences, problem solving expertise, design rationale'. In [10] (p.42-1) CM is defined as an 'explicit, disembodied, persistent representation of knowledge and information in an organization'.

There is an increasing industrial interest in the capitalization of knowledge. It is essential that VEs build and maintain a Corporate Memory for the following reasons:

- Enhancing information sharing and dissemination among VE's members.
- Supporting the VE's strategy.

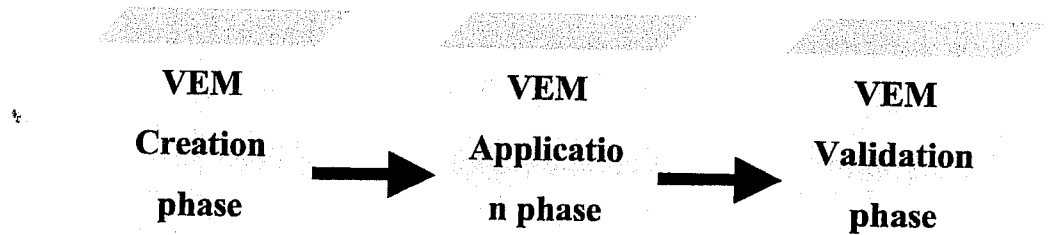
- Exploitation of experience from past projects.
- Avoidance of the loss of know-how of specialists.
- Ability to learn and train the employees in the VE.

In this paper a Virtual Enterprise Memory (VEM) management schema is proposed, called V.E.M.M.S., and consists of three phases. Each phase is analytically described. In concluding, the whole process is unified under the philosophy and principles of Total Systems Intervention methodology [1], [2] and relevant conclusions are illustrated.

## **2. PROPOSITION OF THE VEM MANAGEMENT SCHEMA (V.E.M.M.S.)**

It is proposed that V.E.M.M.S. consists of 3 phases as shown in Figure 1:

1. VEM Creation phase, including two elements namely Needs Detection of VEM and Constuction of VEM.
2. VEM Application phase, including two elements namely Distribution of VEM and Use of VEM.
3. VEM Validation phase, including three elements namely Evaluation of VEM, Maintainance of VEM and Evolution of VEM.



**Figure 1. VEM Management Schema**

### **3. VEM CREATION PHASE**

In this phase the two elements of Needs Detection and Construction of VEM are considered. Needs detection of VEM is to determine the type of CM needed. Types of CM are explained below. Construction of VEM is to build a VEM following specific building techniques.

Successful CM development must be focused on the situations of use and the needs of users. Detecting the "right" needs is not a simple task. CM designers have to identify as much as possible; who the users are; which tasks they have to perform and under which circumstances; what knowledge types they need to memorize and retrieve (for achieving the tasks); what tools they use. The CM types take into account the diversity of knowledge found in a company. There are several typologies in CM literature. According to [6] there is:

➤ **Technical memory.**

Capitalization of employees' know-how.

➤ **Organizational memory.**

Past and present organizational structures of the enterprise.

➤ **Project memories.**

Capitalization of lessons and experiences from given projects.

According to [9] there is:

➤ **Profession memory.**

Referential documents, tools and methods used in a profession.

➤ **Society memory.**

Organization, products, activities, suppliers, customers, sub-contractors.

➤ **Project memory.**

Project definition, history, activities, results.

In the case of VE the above typologies are inadequate to describe the situation. This is because there is no society memory nor an organization memory in a VE. A project is performed by a number of designers belonging to different enterprises. This organization differs from a project to another. So in the case of VEs there is mainly a project-oriented memory. Considering these characteristics we can define the following typology of CM, which is applicable to a VE.

➤ **Profession memory.**

Capitalization of the knowledge in a profession.

➤ **Project memory.**

Definition of the project, history of propositions, solving methods, project activities.

The next stage is the Constuction of VEM. There are several techniques adopted to build a CM depending on the available sources: human specialists, existing paper-based or electronic documents such as reports or technical documentation, existing databases, case libraries, dictionaries, etc. There are different approaches for the construction of a CM proposed by [4], [5], [6]:

➤ **Document-based Corporate Memory.**

A document-based CM relies on the principle that all existing documents of the firm can constitute the CM. But those documents are not well indexed or they constitute a personal bibliography for each expert of the firm. So the construction of such a CM begins by indexing all reports, synthesis documents or references used by the different experts. The main need is assistance in preparing, storing, retrieving and processing documents.

➤ **Non-computational Corporate Memory.**

A non-computational memory is made of paper-based documents on knowledge that had never been elicited previously. The memory is composed of knowledge described in existing documents and interviews of experts, or elaborated from observations of experts' activity.

➤ **Case-based Corporate Memories.**

The use of a case base for representing the CM is dedicated for the following aims: (1) avoid the scattering of the expertise by concentrating knowledge of all experts in dedicated cases, (2) allow a continuous evolution of the CM thanks to the progressive addition of new cases. A VE may have a collection of past experiences (successes or failures) that can be represented and compared. Case-based reasoning allows to reason from experiences and cases already encountered, in order to solve new problems. Improving representation of the cases and indexing of the case base is important for the enhancement of case retrieval.

➤ **Knowledge-based Corporate Memory.**

Knowledge engineering is used for building a CM based on elicitation and explicit modeling of knowledge from experts. It can also be used for a formal representation of knowledge underlying a document. There are knowledge engineering methods such as COMMET and CommonKADS [8].

In order to build a profession memory of a VE a non-computational base, a document base, a knowledge base or a combination of these three can be used. In order to build a project memory of a VE a non-computational base, a document base, a knowledge base, a case base or a combination of those can be used. The critical point is how to make the choice of the most applicable technique. A systemic approach is suggested because soft systems thinking focuses managers' attention on the different assumptions, beliefs and worldviews involved in a problem situation. Mitroff and Mason's

Strategic Assumption, Surfacing & Testing methodology (SAST) is proposed at this point [1]. Sast is designed to surface conflicts among employees in an enterprise and to manage them as the only way of achieving a genuing synthesis. Sast is a soft methodology which tries to bring synthesis through conflicts. SAST methodology has four stages:

- **Formation of groups.**
- **Assumption formation.**
- **Debate.**
- **Composition.**

In this methodology, the participants will be the CM designers, members of the actual enterprises that consist the VE, such as managers, technical leaders and other specialists. Of course there should be a systemic analyst to co-ordinate the whole application of SAST. If the departments of the VE are geographically dispersed, then the solution video-conference is suggested as a solution for the application of SAST. The questions asked during the Assumption formation phase are proposed to be:

- **The knowledge already existing in the VE.**
- **The kind of knowledge, which is necessary for the construction of the CM.**



➤ **The intended use of the CM after its construction.**

After the decision of which techniques or combination of techniques should be used, the Creation phase is concluded by building the CM.

#### **4. VEM APPLICATION PHASE**

In this phase we take into consideration the two elements of Distribution and Use of VEM. Elements of the CM must be distributed to the adequate members of the VE. VEs can take advantage of the remarkable possibilities of access to data, to information and to knowledge provided by Internet. Distribution can rely on a knowledge server on the Web. Different kinds of elements can be accessed through Internet/Intranet: documents (classic electronic documents, HTML documents), databases, knowledge bases, case bases, articles of electronic journals, etc. Therefore several kinds of knowledge servers can be used: document servers, knowledge base servers, database servers, journal servers or digital libraries. However problems may appear such as confidentiality, security and reliability of accessed information.

From the VE's view distribution may be:

➤ **Passive.**

The user can search by himself needed information where it is available

➤ **Active**

Knowledge distribution can be systematically decided and taken in charge by an adequate person or service of the VE.

## **5. VEM VALIDATION PHASE**

This phase consists of Evaluation, Maintenance and Evolution of VEM. There are two kinds of evaluation. Evaluation by users (with criteria based on users' satisfaction) and strategic evaluation by managers (with criteria based on return on investment). There are two viewpoints of VEM evaluation that should be noticed:

### **➤ Financial viewpoint.**

From a Financial viewpoint, the aim of the CM is to improve the enterprise competitiveness and to maximize the profits.

### **➤ Technical viewpoint.**

From a technical viewpoint, the aim of the CM is to transfer the know-how inside the VE. An effective transfer depends on an effective use of the CM.

For maintenance and evolution of the CM, it is necessary to take into account the results of the evaluation of what already exists. In this case we are concerned about modification of obsolete knowledge and problems linked to addition of new knowledge. A given person of a VE cannot be alone responsible for evaluating, maintaining and evolving the VEM. As in the Creation phase the opinion of many different people in a VE should be taken into account for better results. The techniques used

to maintain and make evolve the CM depend on the kind of CM constructed in the Creation phase.

For the Validation phase, the Interactive Planning (IP) methodology is suggested because its philosophy incorporates the elements of evaluation and evolution as used in the Validation Phase. The principles of Ackoff's IP are shown in [1]. IP is a dialectical methodology, which has five phases:

- **Mess formulation.**
- **Goals designing.**
- **Designing of means.**
- **Designing of resources.**
- **Designing of implementation and control.**

In this methodology, the participants will be the CM designers, members of the actual enterprises that consist the VE, such as managers, technical leaders and other specialists. As in implementation of SAST, there should be a systemic analyst to co-ordinate the whole process. The aim is to evaluate, take decisions about maintaining and evolve the CM. This can be achieved by considering what would happen if the VEM stayed as it was, without evolving (Mess formulation phase). Then with the aid of the other phases of IP, actions will be designed for proper maintaining and evolving of CM (This is the main reason IP is used in this case). Again if the departments of the VE are geographically

dispersed, then the solution video-conference is suggested as a solution for the application of IP.

## **6. UNIFICATION UNDER THE TSI SCHEMA**

Total Systems Intervention or TSI represents an approach to planning, designing, problem solving and evaluation [1], [2]. The process employs a range of systems metaphors such as machine, organic, neurocybernetic, cultural and political. These metaphors encourage creative thinking of the managers so as to confront the difficult issues that appear. The three phases of TSI are:

➤ **Creativity.**

Systems metaphors are used as organising structures so as to help managers think creatively about their enterprises.

➤ **Selection.**

An appropriate methodology is chosen to suit particular characteristics of the organization's situation as revealed by the Creativity phase.

➤ **Implementation.**

A systems methodology or a combination of systems methodologies is applied in order to reach specific solutions to the existing problems.

In this case, the philosophy and principles of TSI are the major factors for evolving the VEM. The three phases of the VEM management schema are followed in a repetitive manner until the VEM

created is satisfactory. CM structures are created (Creativity phase) and the best structure is chosen. This is the phase of Selection that TSI defines. Then it is tested so as to verify that the choice was appropriate (Implementation phase). All these steps are followed in a repetitive manner until the desirable outcome is reached. So, the VEM management schema of Figure 1 can be extended to the one of Figure 2.

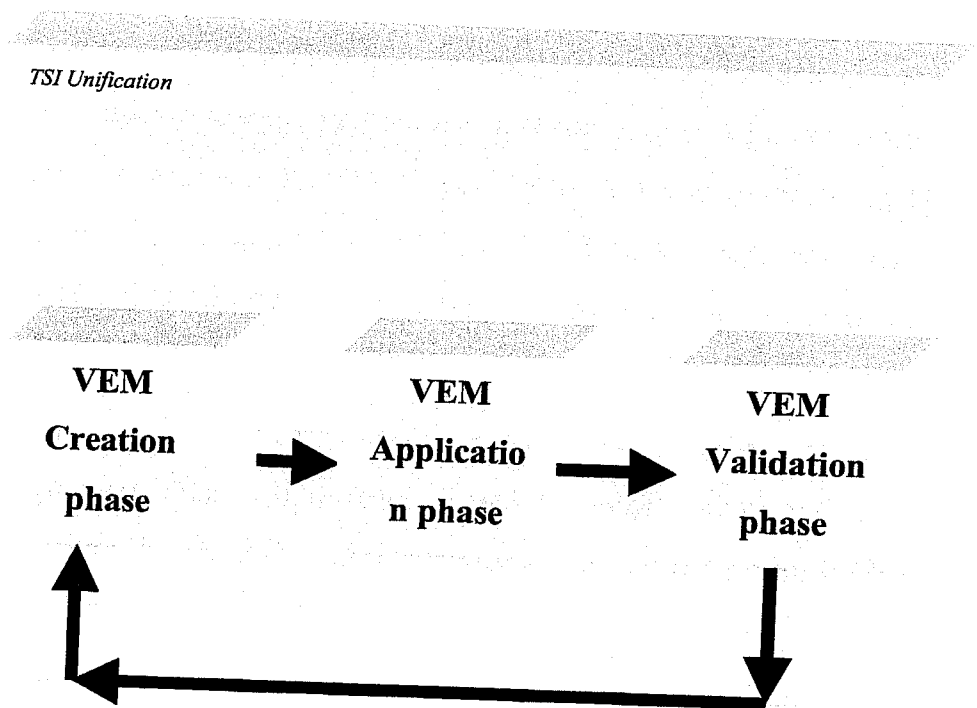


Figure 2. VEM Management Schema under TSI Unification

## 7. CONCLUSIONS

The concepts of VEs and of CM are presented in this paper. A new virtual enterprise memory management schema called V.E.M.M.S. is presented as a proposition to the emerging need of building the

adequate CM in a VE. The schema consists of three phases, Creation, Application and Validation. A systemic approach is proposed for the Creation phase, where SAST is applied and for the Validation phase, where IP is applied. The whole schema is unified under TSI philosophy and principles. The three phases of the schema are followed in a repetitive manner until the creation of the adequate VEM. The TSI Unification is an extremely important factor for the whole process.

At this point, it must be mentioned that SAST and IP are systemic methodologies and such methodologies cannot always give the desirable results. Good faith from all the participants is a key element for the goals achievement of SAST and IP. Mitroff and Mason have reached to the conclusion that SAST cannot be practically proven [1]. The principles and the philosophy of SAST and IP are the only guarantee for their success.

The specific management schema takes into account both human and technological factor. It can be proven a reliable way of storing, distributing and using the knowledge of a VE. A VE must have an adequate CM in order to follow the needs of the market, in a quick and efficient way.

V.E.M.M.S. is now applied in a project which implements a virtual enterprise that constructs International E – Taxation mechanisms of E – Commerce. This application implements a simulated way of conducting e-commerce transactions and taxing each e-commerce company with the right amount of tax. The CM constructed in such a virtual enterprise is critical to its success. Weaknesses and strong points of V.E.M.M.S. which will be noticed will be published in a case study of the whole project.

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