

IS/IT STRATEGY OF A VIRTUAL CONSTRUCTION MANAGEMENT SERVICES COMPANY

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ABSTRACT

A virtual management services company (VCMSC) is a flat, pooled, dynamic competitive network of specialty system contractors (SSCs) that reconfigure around a leading member whenever an opportunity arises. The geographically dispersed members of a VCMSC rely on the information and communication technology to facilitate their information exchange and communication. The management of an ideal VCMSC is based on its flat structure. Its functions (units) are outsourced fully by collaborating with a competitive network of SSCs. Seven sub-management systems are designed to manage (i) project owner relationships, (ii) project offerings and bidding, (iii) project design and engineering, (iv) project procurement, (v) construction, execution, and control, (vi) commissioning and after sales, and (vii) network nurturing. An IS/IT strategy must enable the focal VCMSC to find effective ways to be flexible enough in its dynamic environment and changing networks and to integrate all the members of a network into one business entity. In practice, the IS/IT strategy of a VCMSC involves the use of the Internet as the base for networked communication, the integration of the compatible software/applications by all members of the competitive network, the sustaining of the operability of the systems, and the training of project participants. In turn, an information system is designed in order to understand, produce, and submission of the information inherent in these business processes. Inter-firm communication is based on a repository where the VCMSC's specific data/information is held. This mechanism reduces information redundancy and enables the centralized re-use of information.

KEY WORDS

building, construction management, information system, IS/IT strategy, special systems contracting, virtuality.

INTRODUCTION

The paper is part of the ongoing research program for **the development of new concepts and systems** for managing a virtual construction-related company. The program is carried

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out at the Helsinki University of Technology in the unit of Construction Economics and Management (TKK/CEM). The program is financed by the Finnish Funding Agency for Technology and Innovation (Tekes). Prior this paper, the team has conceptualized the virtuality and the VCMSC to a modest extent in the focal context (Kiiras and Huovinen 2004, Alsakini 2004, Alsakini et al. 2005). Thus, a **virtual construction management services company (VCMSC)** is a dynamic competitive network of collaborating special system contractors (SSCs) that reconfigure around a leading member whenever an opportunity arises (Alsakini 2004, Alsakini et al. 2005, Salmikivi 2005). Naturally, the key opportunities of a VCMSC are herein related to offering construction management services to targeted clients, i.e. owners and capital investors in (inter)national building markets.

In general, leading companies guide their virtual networks both on a short and long-term basis. Members are more or less geographically dispersed firms, organizational units, teams, or individuals (Saabeel et al. 2002). Each member concentrates on those parts of the value chain with which it achieves the maximum added value. The driving forces towards a virtual company are changing market conditions and the fast development of information and communication technologies (Coulson and Kantamneni 2003, Franke 2000). The latter instigate organizational change, i.e. leading project-business companies improve their flexibility to meet changing market conditions (Venkatraman and Henderson 1998).

Virtual firms need also define the information system (IS) strategies and implement them with the aid of information technology (IT). IT is increasingly playing an integral part within the strategic planning agenda of many large contractors and consultants. Betts (1999) has envisioned that there will be a significant move towards strategic IT planning in the construction sector. An IT strategy must match the focal firm's management, organizational solution, and business processes.

The aim of this paper is to review the generic IS/IT strategies of firms in the context of construction, introduce the concept of a VCMSC and its management system as well as define the corresponding IS/IT strategy and information systems as follows. Herein, the IS and IT aspects are combined from the strategy design view.

NEEDS FOR IS/IT STRATEGIES IN CONSTRUCTION-RELATED FIRMS

In the context of changing environments with clients that are increasingly sophisticated concerning quality and performance, construction-related firms will have to be forward-looking to survive. Tactical considerations will have to be replaced with the strategic ones. IT is becoming an integral part within the strategic planning of large enterprises. Overall, there is a move towards strategic IT planning in the construction sector (Betts 1999).

Construction-related firms can identify IT-enabled strategic initiatives for developing their future businesses. All IT development should be business-driven. IT should play a role in and be integral with the most construction industry activities and business processes. As illustrated in Figure 1, **an IS strategy** (1) brings together the business aims of a company, (2) provides an understanding of the information needed to support those aims, and (3) facilitates the implementation of information systems to provide that information (Betts 1999).

The implementation of **an IT strategy** requires that construction-related firms consider the following procurement-related issues: (1) planning, selecting the software and solutions, rolling out the systems, and supporting them, (2) implementing the strategy and process

change, setting up the project team, seeking the integration, sequencing, defining timescales and resources as well as searching for the applications, and (3) specifying the systems, choosing between the bespoke systems and packages as well as selecting the suppliers of the software development processes, (4) auditing the skills, preparing the data, training and consulting the users as well as establishing the help desks for the user groups (Betts 1999).

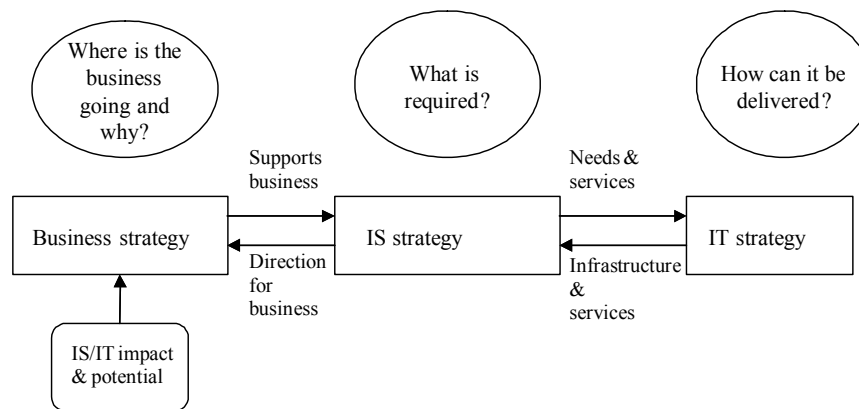


Figure 1: Business strategy, IS strategy, IT strategy, and their relationships (Betts 1999: 146)

MANAGEMENT OF A VCMSC AND ITS BUSINESS PROCESSES

In the context of CM services, individual practitioners are needed to perform specialized CM services for owners in advanced building projects. A vast range of expertise is required for performing all the CM services and the demand for the timely CM performance on projects precludes the performance of the complete CM services by an individual firm (Haltenhoff 1998).

From the management point of view, a VCMSC can typically (a) specialize in offering CM services for the most attractive owners and capital investors in the case of advanced building projects, (b) assume a flat organization where the middle levels of management are removed and the prior internal staff are pooled and encouraged to act as the entrepreneurs in a VCMSC's projects, (c) outsource functions (units) such as cost estimation, building design services, and procurement, (d) establish a dynamic competitive network where several SSCs supply their products, functional elements, or services under the guidance of the leading partner (Kiras and Huovinen 2004, Alsakini 2004, and Alsakini et al. 2005).

The management of a VCMSC consists of **seven business processes**. Consequently, the structure of the management system must include the seven sub-systems as follows (Alsakini et al. 2005).

(i) **Project owner relations management system (PORMS)** enables a VCMSC to enhance the quality of its services through the pre-emptive expert relationship building with the targeted existing and potential new clients (owners and capital investors) by generating and updating a list of the most attractive clients.

(ii) **Project offering and bidding management system (POBMS)** enables the leading member of a VCMSC to collaborate with its competitive network of the SSCs. Project scopes

need to be large and versatile enough to become a viable target for this virtual specialty network. The leading member prepares work scope breakdown and generates a list of bid packages, buys a bill of quantities and a cost estimate, distributes bid packages to the networked SSCs for the bid preparation. This process should enable the VCMSC to generate the most attractive solution to the client.

(iii) **Project design and engineering management system (PDEMS)** is designed to improve constructability by providing the networked SSCs with the platform to contribute early enough to the detailed design of the project packages allocated to them. A **product model** is the core of this system through which project stakeholders can have the real-time access to the most recent design documents.

(iv) **Project procurement management system (PPMS)** provides the SSCs with the internal arena to compete effectively in order to come up with the best integrated offering. The successful bidder will in turn take part in the detailed design or do it altogether and provide the tailored solutions as part of their bid packages.

(v) **Construction, execution, and control management system (CECMS)** provides the leading member or the CPM team with an advanced planning system in which the workplaces and the coarse general planning are combined, the detailed activity planning is completed just before the beginning of each activity. With the aid of **CECMS**, the leading partner can also procure safety and quality management services from specialized actors from the market. Site management and engineers are bought from the expert pool project by project.

(vi) **Commissioning and after sales services management system (CASSMS)** enables the leading member to provide the client with the long-term facility management (FM) services (system). The VCMSC does not provide itself the facility management services. Instead, it can plan and prepare the contract of the FM package for the client.

(vii) **Network nurturing management system (NNMS)** enables the leading member both to develop the competences of the network and renew its membership. The leading member may choose the core VCMSC team project by project based on “fit-for-purpose” strategy, i.e. the required expertise and competences are determined and the necessary functional areas are specified for the project in hand.

IS/IT STRATEGY OF A VCMSC

The IS/IT strategy is herein defined to support the business strategy and processes of the VCMSC. The IS strategy should answer the question: what is required? and the IT strategy should answer to question: how it can be delivered? (Betts 1999). In practice, the planning of a VCMSC's information system will be combined with the selection of the IT software that together will enable the production of the information needed for the management of the VCMSC's business processes.

In general, there are two key questions when IS/IT strategies are defined for networked organizations, i.e. (1) how to be flexible enough for the dynamic environment and changing networks and (2) how to integrate all the members of a network into “one” business entity.

Herein, **the IS/IT strategy of an VCMSC** is defined in the pragmatic terms as follows: to determine the IS requirements inherent in a VCMSC's business processes, select and buy the well-known commercial software/applications that match these requirements, distribute

them to a VCMSC's competitive networked partners as well as nurture the staff pool and the network of the SSCs by IT training. The purchasing of all the software/applications should solve the flexibility problem. In turn, the distribution of the software/applications and the training of all the members to use the same applications should solve the integration problem.

When a VCMSC is procuring an IS, the aim is to find the best match between the competitive advantages and business process needs vis-à-vis the alternative IS packages. In addition, the total purchasing cost needs to be estimated in terms of the original price of the software, the hardware implications, the IS/IT in-house staff needs, and the process changes required to deploy the new systems (Sun and Howard 2004).

IS/IT SYSTEM OF A VCMSC

When firms collaborate with each other under a virtual enterprise umbrella, there is a need to have mechanisms through which information may be exchanged and shared. Currently available commercial information and communication systems are primarily focused towards internal use within organizations and their supply chains (Kazi et al. 2001). The current information solutions do not appropriately address the requirements and desired functionalities of dynamic virtual enterprises. The challenge is to provide construction participants with effective access to project information regardless of its form, format, and location, and with increased flexibility to support smooth co-operation between non co-located teams, and the co-ordination of their work and activities.

The IS/IT system required to facilitate the realization of the business strategy of a VCMSC outlined as: flat, pooled, outsourced functions, and competitive networked organization is based on using the standard WWW, and a private network Intranet, as well as a computer network Extranet. With an Intranet, using standards such as WWW servers and browsers, within an organization, the VCMSC's employees can find, use, and share documents and communicate behind a firewall without allowing access from the outside. On the other hand, Extranet is used to allow controlled access from the outside by trusted customers and/or networked partners to the VCMSC's database for specific business purposes via the web.

IS/IT SUB-SYSTEMS FOR A VCMSC'S SEVEN MANAGEMENT SUB-SYSTEMS

Herein, the IS/IT sub-systems that will facilitate the performance of a VCMSC's seven management sub-systems are defined as follows.

(i) **Project owner relations management system (PORMS)**. A VCMSC enhances the quality of its services through the pre-emptive expert relationship building with the targeted existing and potential new clients (owners). This information sub-system facilitates the performance of the PORMS by providing simple CRM information required for the generation and updating of a list and contacts and a register of the most attractive clients by using one of many viable spreadsheet programs.

(ii) **Project offering and bidding management system (POBMS)**. The leading member of a VCMSC collaborates with a competitive network of SSCs. Large and versatile project scopes set the distinctive requirements for the virtual, seamless, and reliable preparation of the best offerings. This information sub-system of the VCMSC is designed to support the

performance of **POBMS** by providing the leading member with the information needed for deciding upon the work scope breakdown and preparing a list of bid packages based on the original product model prepared by the building designer. Based on the work breakdown, the leading member may buy a bill of quantities and a cost estimate from an expert consultant(s) via Internet. The leading member distributes the bid packages to the networked SSCs for the bid preparation via Internet as well (Figure 2).

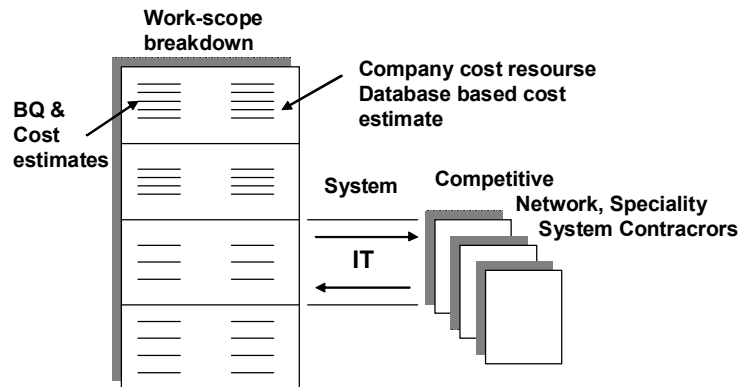


Figure 2: IS/IT sub-system of a VCMSC to facilitate the project offering and bidding management system (POBMS)

A VCMSC procures a BoQ and a cost estimate from expert consultants from the market. In turn, this information sub-system of POBMS includes a cost estimation program/software that links a BoQ with the unit cost resource database of the VCMSC and/or the standard cost resource database. This allows to produce one or several updates of the cost estimate according to the unit costs for the comparisons of the sub-offerings submitted by the SSCs with a VCMSC's cost estimate.

(iii) **Project design and engineering management system (PDEMS)**. Constructability of a VCMSC's complete offering is improved by providing the networked SSCs with a platform to contribute early enough to the detailed design of the systems or the project packages that are allocated to each of the SSCs. This information sub-system combines or links the engineering analyses and the CAD documents. During the process, a full product model is designed, i.e. it combines both the architectural model and the building simulation models. The CAD software/application enables to produce a 3D model of the building as well as the building engineering applications (i.e. the engineering software in structures, environmental design, and facility management services) with the intention to speed up the calculation process and the building simulations as well as predict the building (product) performance over its life-cycle. The leading member establishes a **product model** as the core of a PDEMS through which the stakeholders can have real-time access to the most recent design documents. The product model enables the effective exchange and change of project information. The designers get the real-time feedback regarding the design changes and the adaptations from the network of the SSCs. The latter are responsible for performing their specific project packages and, thus, they review the design layouts and identify any conflicts between design, engineering, and construction (Figure 3).

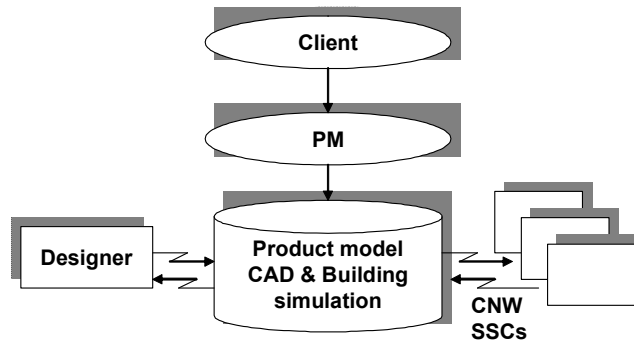


Figure 3: IS/IT sub-system of a VCMSC to facilitate the project design and engineering system (PDEMS).

(iv) **Networked project procurement management system (NPPMS).** The leading member of the VCMSC is procuring from the market those processes and services which are not part of its core activities and competences. This information sub-system includes a list of the SSCs with which it holds a long joint work history. The sub-system includes a list of the processes and services to be procured. The process and service documents provide the basic information regarding the performing organizations as well as their profiles and work histories with the VCMSC in question. During a bidding process, the leading member will select from within the list a number of the SSCs whose work histories and profiles match the specialty systems, expert processes, and services needed in the project at hand. The leading member's team is sending the bid packages to the selected SSCs for the preparation of their bids and the SSCs send them back to the leading member via Internet.

(v) **Construction, execution, and control management system (CECMS).** This management sub-system consists of (i) the planning and scheduling system and (ii) the cost control system. In turn, the information sub-system is designed as a **process model** to provide the information on the construction, procurement, and site activities as well as their dependencies, durations, and costs. Through the process model, a master plan is produced in terms of the main systems or packages to be performed by the SCCs. For the control purposes, each SSC plans its activity plan/schedule and integrates them into the real-time master schedule. An activity plan is prepared by presenting each activity in a rolling window in detail just before it starts to show what sub-system and work will be executed on site and how (Figure 4). The cost information is fed into the process model based on the actual expenditure on site by the SSCs and subcontractors.

(vi) **Commissioning and after sales services management system (CASSMS).** The leading member provides the client with a facility management (FM) system based on the procurement of the FM services. A VCMSC does not itself provide the FM services. Instead, it plans and prepares the FM services contract for the client. This information sub-system facilitates the CASSMS by using the information generated through the six other processes and IS/IT sub-systems collectively such as using the profile directories of SSCs to find a match between the required performance and the commissioning and after sales services required for the targeted project. The VCMSC will hand over the applied and updated product model to the client for the basis of the facility management of the finished building.

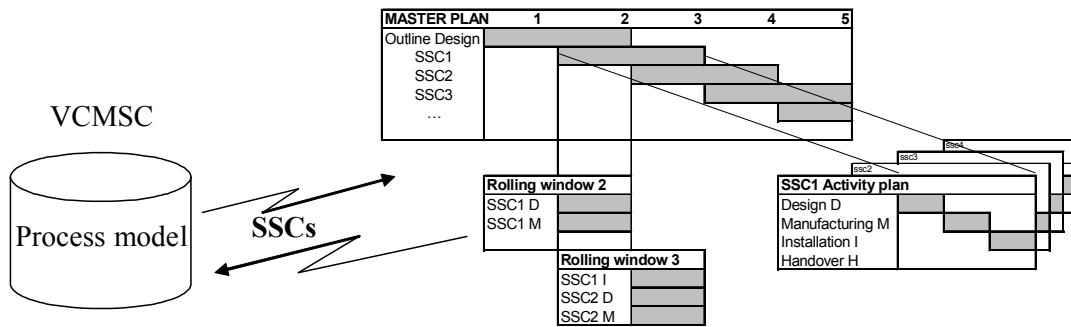


Figure 4: IS/IT sub-system of a VCMSC to facilitate the construction, scheduling, execution, and control management system (CSECMS)

(vii) **Network nurturing management system (NNMS).** The NNMS enables the leading member of a VCMSC both to develop the competences of its network and renew the membership of each of the SSCs. This IS/IT sub-system facilitates the performance of the NNMS by providing information to a VCMSC for the partner search by developing the directories of the companies/organizations where the information regarding their profiles (e.g. specialty systems, competences, skills, performance history, and in-house resources) are represented. The profiled information is related to the current and past SSCs that have participated in the past projects as well as the new company profiles from the generic catalogs (e.g. as part of the industry information). The leading member may choose the core VCMSC team project by project based on a “fit-for-purpose” strategy from these directories, i.e. the required expertise and competences are determined and the necessary functional areas are specified for the project in hand.

CONCLUSIONS

In short, an ideal VCMSC with its theoretical structure and management sub-systems implies the effective use (and development) of advanced, flexible information systems and information and communication technology. The latter are the key enablers for a VCMSC’s high performance with its geographically and technically dispersed members. The business strategy and goals of a VCMSC cannot be achieved without having an IS/IT strategy that is based on (i) using the Internet as the basic tool for the communication, (ii) using the compatible software/applications among all the members/project participants for the seamless integration, supported by the leading member of the VCMSC as part of the overhead of the fixed project cost, and (iii) maintaining the operability of the information sub-systems by providing the IT training to the pooled staff for the applications in use.

The management and the distribution of the digital project information (DPI) generated by the IS/IT sub-systems include three components of (1) the fully digitalized information extracted from both a project’s product and process models prepared for design, planning and control purposes. These product and process models are established in order to enable the

integration strategy and the information sharing, exchange, and interoperability between different software/applications and the competitive network members of the VCMSC, (2) a centrally accessible information storage, a project databank, the management of the design and building phases in projects, the supply of the most recent data in real time for the project teams, detailed log files and event reports as well as lower information processing and delivery expenses, and (3) the networks connecting the users to the information storage and transferring the digitalized information via the Internet and Intranet/Extranet.

In a VCMSC setting, effective inter-enterprise communication is achieved through the use of **an executive information system (EIS)**. The latter is considered as a repository where a VCMSC's data/information is placed. This mechanism reduces information redundancy and enables the centralization and reuse of information. In turn, the information generated during the project development is stored in **a digital project information system (DPIS)** of a VCMSC and an authorized access is granted to the participants during the project development, respectively.

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