Towards a Software Solution for Inter-Enterprise Delivery Management

Roelof J. van den Berg,
Baan Development B.V., The Netherlands (email: rvdberg@baan.nl)
Herbert Wubben,
7B1 ICT Solutions, The Netherlands (email: hwubben@7b1.com)
Arian Zwegers,
Baan Development B.V., The Netherlands (email: azwegers@baan.com)

Abstract

The concept of the virtual enterprise (VE) provides a good starting point to truly increase productivity in business operations, especially in domains for one-of-a-kind production. But tools to support many of the life cycle phases of the VE are not yet available. This paper describes the background of a tool, developed in the GLOBEMEN project, to coordinate the production and delivery phase of a VE. The paper gives some specifics of inter-enterprise delivery management, describes the architecture of the tool and illustrates its use in practice with a short case study.

1. Introduction

The “new economy” hype gave rise to quite a number of concepts that were used in pretentious and premature ways by those whose fate depended on a widespread belief in a productivity miracle that did not happen. At first glance, the notion of the virtual enterprise (VE) is one of the most suspect among them. Yet, while a significant part of the rhetoric of this most recent of ages of great expectations has already been drawn into the dark depths of oblivion, the concept of the VE stands a good chance of eventually becoming solidly established in management theory and the day-to-day practice of the business world. After all, the body of thought behind it, ranging from fields like computer science [1, 2] to management and economics [3-7] and sociology and cognitive psychology [8-10], convincingly outlines a novel way of organizing inter-enterprise cooperation. It shows how modern information and communication technology (ICT) can already leverage a superior match between a market opportunity and the provision of resources, especially in the business domains for one-of-a-kind production (OKP), e.g. shipbuilding, most parts of the aerospace and defense industry, and most types of construction. The canon concerning the VE provides a solid conceptual basis to truly enhance business productivity.
In a VE autonomous companies contribute distinct competencies to a temporary inter-organizational cooperation and tailor a value chain to meet the exact requirements of a specific business opportunity. Ideally, world-class competencies can be assembled for each market opportunity [4-7]. The VE is supposed to behave as one unified company although it is composed of competencies from various, geographically dispersed partners. Thus, business processes are not carried out in isolation by single companies, but must be dynamically configured and coordinated to serve the common mission of the VE partners [11]. Dynamic, collaborative relationships are thus at the heart of the VE. In addition, the quick acquisition of complementary competencies allows a highly agile response to changing market demands and pursuit of business opportunities with a short life-time. Clearly, successful implementation of the VE requires flexibility in terms of ICT infrastructure and advanced cognitive and social abilities of the people in the participating enterprises [12-14].

Not all agree that the ambitious technical requirements are inherent to the VE. They argue that the VE \textit{avant la lettre} originated in times long before the recent hype that pushed it as a theoretical phenomenon. According to them already the Etemenanki of Babylon was built through a VE, somewhat along the same type of reasoning that makes Henry Ford the first business process reengineer. We consider modern ICT a \textit{conditio sine qua non} to create a true VE [15]. The above description of the VE should have made clear that although in theory one could create one based on paper and telephone communication, modern ICT is crucial to make a VE efficient, competitive and thus feasible. In fact, even ‘modern ICT’ needs to be pushed to a higher level before it can support a full-fledged VE. In that sense, the above description of the VE with its emphasis on dynamic exploitation of market opportunities makes it first of all a lighthouse for ambitious ICT applications, a destination instead of a milestone already reached. After all, many important life cycle phases of the VE are not yet supported by

\begin{figure}[h]
\centering
\includegraphics[width=\linewidth]{virtual_enterprise.png}
\caption{The Virtual Enterprise}
\end{figure}
commercial products. One of the areas that is hardly addressed by the currently available tools is inter-enterprise delivery management. This business area is the focus of this paper. The next section briefly describes what is meant by the term. The subsequent sections are devoted to the ICT support for inter-enterprise delivery management.

2. Inter-enterprise delivery management in a VE

In a VE, the scope of a delivery project is unique due to customer specific product requirements. As the VE is conceived in a context of (world-class) specialisation, fulfillment of the scope is typically achieved by distributing activities over multiple enterprises. This distribution of project activities is subject to the dynamics of required and available capabilities and capacities of each enterprise; trade-offs must be made for each individual project [11]. Delivery processes in such unique environment cannot be managed adequately by supply chain tools as used in repetitive industries, e.g. conventional interorganizational workflow management systems [16] or approaches assuming relatively stable supply chains as described for the high-tech industry in [17]. Traditional techniques to synchronize supply and demand [18] do not apply to this case, because production is not repetitive in a VE. Instead one needs to coordinate the cooperation of the enterprises in the VE as if one were building a completely new business from scratch, spanning the delivery process from customer contract to final handover of the delivery or even provision of after-sales services. In the GLOBEMEN project, the aim of workpackage 2 (inter-enterprise delivery management) was to facilitate the collaboration between enterprises in a VE along those lines. Workpackage 2 had to result in a prototype that could support business processes for collaborative project management. Research should lead to:

1. More reliable project plans
   Via a shared model of project activities and requirements,

2. Better project monitoring
   Via on-line access to project status, with real-time notification of events and “alert” conditions and with impact evaluation for deviations based on changes of downstream activities,

3. A decrease in project risk
   Via clear visibility of the status of activities for all partners in the VE,

4. Higher flexibility and efficiency
   Via a faster response to customer change requests, through better leveraging of partners from the network potential and accelerating and controlling the flow of information during the project lifecycle.

Based on these requirements, a detailed prototype specification was made.
3. Overview of the C-project architecture

One of the assumptions concerning the VE is that it can be activated in a short period of time. This implies that the VE is based on lean ICT, which can be implemented quickly. This means that from an architectural point of view only what needs to be shared should be shared. The specific, internal parts of the ICT provisions, e.g. an ERP system implemented at the site of one of the partners in the VE, should be left to the scrutiny of that individual enterprise. Such enterprise-internal systems are not dedicated to the VE. The lean application on top of it, dedicated to the VE, should maximize the exploitation of these generic ICT systems already available in enterprises and from it create an information flow specific for the VE. Based on this line of thought a prototype, C(ollaborative)-Project, has been designed to be accessible with an Internet browser. It also has the possibilities to be easily integrated with existing applications that execute the intra-company processes. C-Project will not replace the pre-existing applications, but will offer functionality to link up the different enterprises involved in project networks to support and enhance the inter-company processes. C-project is independent of any enterprise-internal back-end system and can even be used in a “stand alone” mode, without any link to e.g. ERP systems. Furthermore, C-Project is a multi-tiered application. This means that different enterprises in various levels in the project value chain can use the same application, thus creating maximum visibility to each other. While most of the current offerings for collaborative work are based on enterprise-centric applications, C-project is inherently network-centric. Enterprise-centric applications essentially can only distinguish between what is inside and outside the enterprise in terms of people, processes and products. Obviously this makes for difficult inter-enterprise applications, where the underlying systems should be able to deal with entities that are outside the enterprise, but inside the extended enterprise (and thus “inside” to some extent). The powerful modelling engine that forms the basis of the C-project prototype is able to deal with the nuances of such business relationships and the corresponding needs to share some of the data available in the enterprise, but certainly not all. See [19] for more details on the modelling engine behind C-project. Based on the approach described above we can identify the following system components: the Enterprise Network, the Enterprise Relationship Modeler, the C-Project Application, individual partners’ enterprise systems, and an interoperability layer with the adapters to these latter systems.
The **Enterprise Network** component contains information about a group of enterprises (the network) with their individual capacity and competencies for any (potential) VE. See [12] to find out what information on competencies of other firms could typically be stored and [13, 20, 21] for various ways to assess the validity of claims about the quality of potential partners. Functionality in the prototype includes displaying competences of the members of the network and their availability at a given moment in time, as presupposed in the selection approach for VE partners [11]. In addition, documents such as general agreements, procedures and so on can be stored for later use during the setup and operation of a VE. The functionality of this component is not related to a specific VE.

The **Enterprise Relationship Modeler** is where all enterprises and their relationships in one or more VE are modeled based on Work Breakdown Structures, Organisation Breakdown Structures, Project Network Diagrams and Bills Of Materials (BOM). This model forms the basis for all other business process support and services provided by C-Project.

The core **C-Project Application** consists of a number of services offered to the enterprises with a specific task in one or more projects. Examples of these services are:
document sharing, collaborative project scheduling and progress tracking. Which service will be available to whom depends on his role in a VE, as modelled with the use of the Enterprise Relationship Modeler.

The *interoperability & communication* part of C-Project consists of an interface to the Internet and possibly standard integration products. Via an Internet browser it will be possible to get basic access to the C-Project Services only. For more sophisticated use and high volume transactions, adapters could be made based on standard integration tools such as described in [22; 23].

### 4. Trial application

The case concerns the construction of a new office building (‘building’) for a company called ABC International (the customer). The main contractor for this project, SkyHigh Construction Plc., will design and construct the ‘skeleton’ of the building and subcontract the construction of its ‘foundation’ to RockSolid Building Company. This company will subcontract the ‘design’ of the foundation to Archimedes Engineering and the production and delivery of the ‘concrete’ to Kricon Supplies. The work breakdown structure for this project is illustrated in Figure 3.

![Figure 3: work breakdown structure](image)

The details concerning deliverables and agreements with regard to this work breakdown structure can be stored in C-project. An interface with MS project exists to simplify uploading of project details. In this example, the main contractor hosts the C-Project application. It is also possible to run C-project via an application service provider (ASP) and have each of the participants in the VE concentrate on their core competence. In that
case, each one of them is only user of the application against a certain fee. The host of
the application controls the access rights for the other partners in the VE and the
customer. For its immediate (the so called first tier) business partners this control is
direct. For the others it is indirect, i.e. the direct partners of the host have the possibility
to adjust access rights within the limitations set by the host. In this case, SkyHigh
Construction could for instance give designated staff at ABC the possibility to check
progress on the main deliverable ‘building’ and give certain people at RockSolid the
possibility to update and/or check information concerning the ‘foundation’. RockSolid in
turn could provide its subcontractors with access rights to information about deliverables
that are relevant for them. Of course it is possible that one person has several roles in the
value chain of the VE, e.g. John Doe at RockSolid is main contact point for SkyHigh but
also the project leader for the work with Archimedes Engineering. The application
separates people/names from roles and can provide different views depending on the role
perspective an individual user wants to take on the available information. During the
course of the project, the status of the project will be updated. This could be done
manually by authorized people in the VE or through a dedicated link with pre-existing
systems in the participating enterprises. For instance, SkyHigh could get much of its
information on the foundation from the ERP system of RockSolid. With each change in
the available information in C-project, an automatic warning will be sent to those who
need to know (and only to them). Unlike traditional supply chain applications, C-project
will give SkyHigh visibility on status information beyond RockSolid. It could for instance
show that the production of concrete is delayed due to quality problems. This multi-tier
orientation of the application will make it much easier for the main contractor to notice
exceptions anywhere in the project almost as they occur and react more swiftly to keep
the project on track.

5. Conclusions

By definition, the VE needs ICT support that is open and easy to set up. One way to
achieve this is by linking up existing intra-enterprise applications via modelling
technology instead of hard coded integrations, and adding a minimal layer of
functionality dedicated to the VE. The C-project prototype shows the feasibility of this
approach in the domain of inter-enterprise delivery management. At this moment, the
functionality of the application is quite limited, but on the basis of the powerful modelling
engine below it, it can be easily extended with additional features. Feedback from the
field shows how this type of application really addresses a need for network-centric,
multi-tier delivery management.
References


