Evaluation of Benefits and Advantages of the Virtual Enterprise approach adoption for Actual Business Cases

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Abstract
The present paper aims at providing an assessment of the benefits and advantages induced by the adoption of the VIVE Virtual Enterprise methodology, as obtained in the IST-2000-26002 ACTIVE Project. This has been done by defining and measuring a suitable metrics set for three different business cases, selected from fast-growing and dynamic industrial sectors. Benefits from the methodology user point of view are classified in terms of improvements of overall business parameters, project conduction efficiency parameters and measurements relevant for the ease of method implementation.

The availability of the results in three business cases is intended to stimulate the creation of additional Virtual Enterprises having similar characteristics or operating in the same market sectors.

Keywords
Virtual Enterprise, Business Integrator, Virtual Enterprise benchmarking framework, Overall Business Metrics, Effectiveness Metrics, Approach Implementation Metrics

1 Introduction

One of the most significant competitive factors for the European Industry is constituted by the capability to establish reliable and optimised co-operative networks, especially at peer-to-peer level (Virtual Enterprises).

A number of initiatives, aimed at contributing to the definition of advanced, co-operative business schemes between Companies, have been launched by both the European Commission and National Bodies, in order to capitalise on the new opportunities offered by the Information and Communication Technology, and especially the Internet.

Even though there is a general perception that a number of advantages and benefits can be achieved through co-operation, a clear evaluation of them, based on consolidated, well established metrics set, is missing. The purpose of the present work is to describe the benchmarking framework utilised to assess Virtual Enterprise performance within the IST-2000-26002 ACTIVE Project, in order to promote the wide adoption of VE approach from the point of view of a potential user.

2 Existing Theories and Work

The work presented is built upon the results and findings obtained by CE Consulting in previous RTD initiatives like the VIVE and BIDSAVER EC Projects. CE Consulting developed its own business model for Virtual Enterprises, characterised by:

- The identification of a new entity, the “Business Integrator”, in charge of assessing the business opportunities and building up and managing the Virtual Enterprise, by deploying and adapting Virtual Enterprise consolidated data and process modelling
methodology and techniques and by selecting suitable ICT platform, enabling the co-operation. The “Business Integrator” is the facilitator of the set-up of Virtual Enterprise and the co-ordinator of its operation. The Business Integrator coaches the SMEs, through continuous management and consulting support, and shares the entrepreneurial risks and revenues with all partners;

- A range of Internet based co-operative environment solutions and relevant operating procedures, suitable for covering the needs of very different Virtual Enterprises typologies, that allows the VE partners to identify and assign the tasks each must perform to work efficiently, and that provides integrated communication, document management and management systems from a central server.

The effort performed in the ACTIVE project was to identify a reference benchmarking approach to evaluate the advantages in adopting the CE Consulting VE approach. This was done by adapting metrics definition techniques from available literature (see ref 1 & 2, just for reference) to the specific business model (which is quite innovative and original). Approaches adopted in multinational corporate contexts (like the 6 Sigma Programs inside Motorola and General Electric) have been also considered to derive the specific VE benchmarking framework.

3 Research Approach

Within the IST-2000-26002 ACTIVE Project, CE Consulting has developed a benchmarking reference approach, specific for Virtual Enterprise performance evaluation. The objective is to deliver assessment tools to entrepreneurs, which are suitable for increasing their motivation to adopt a Virtual Enterprise collaboration scheme.

The benchmarking approach includes three different categories of business metrics:

- Overall business case metrics, relevant to the assessment of the benefit induced by the VE approach in terms of global business parameters such as schedule, Time to market, Product development cost, Project Costs, Investments required, Increase of company’s revenues and so on. Overall business case metrics address the basic question “Why should the VE approach be adopted for a specific business case?”.

- Approach effectiveness metrics, aimed at monitoring the achieved level of interoperability among VE partners, assessed through the evaluation of performances parameters of a number of basic co-operative processes, enabled by Internet ICT infrastructure. Approach effectiveness metrics address the basic question “Does this approach work in practice?”.

- Approach implementation metrics, suitable for evaluating time and cost of implementation (personnel training, change of internal, consolidated procedures), impacts on human resources, ease of applicability of the VE approach. Approach implementation metrics address the basic questions “How long will this approach take to be implemented?” and “How much will it cost?”.

4 Selected business cases

The VE benchmarking approach has been applied within the ACTIVE Project framework to three different business cases, selected from market sectors (electronics, energy and telecommunications) characterised by rapidly growing economic prospects and by huge dissemination potential. A six month period of operations of such cases has been performed, in order to measure the prescribed metrics. A brief outlook of the business case is provided hereafter, together with the history and genesis of each business case.
4.1 The Kuba case

The first business case is relevant to the constitution of a Virtual Enterprise for the design, engineering and production of a flat panel active array antenna, to be used for satellite television (analogue and digital) reception. The acronym KUBA stands for Ku band antenna. The genesis of such a business case may constitute a real general example on how a Business Integrator could support industrial partners in the definition and development of initial business ideas. As a matter of fact, Space Engineering is an engineering company, specialised in the Radio Frequency design of on-board satellite equipments. Top European satellite designers and manufacturers are among their current customers. Space Engineering was willing to re-deploy their vast knowledge and know-how in the design of RF equipment also outside mere space applications, by delivering a new typology of consumer antenna, with better performances with respect to currently used parabola toolsets. At the same time, they lacked production and marketing capabilities, required to bring the concept to the market. They gave a mandate to CE Consulting (Kuba case Business Integrator) to explore any possible ways of commercialising the concept. CE Consulting then approached PTI, a customer of CE Consulting and one of the first members of the VIVE Interest Group, specialised in the marketing of telecommunication products who, in turn, involved Moulded Circuit Limited (in charge of the concept engineering in terms of material technologies and manufacturing processes) and LGJM, a Swedish consulting company in charge of the mechanical design of such an antenna. All the five partners agreed to bear their own costs afforded in the development of the product, and to be paid accordingly from the revenues of the antenna sales. Relationships among the partners are regulated by a Frame Contractual Agreement and, from an operative point of view, by a Steering Committee chaired by the Business Integrator, who is the Agreement administrator.

4.2 The SCOP case

The second business case concerns the set-up of a Virtual Enterprise operating in the small heat and power (CHP) co-generation. The acronym SCOP stands for Small Cogeneration Plants. The key feature of CHP market is the efficient exploitation of fossil fuel energy, an energy efficient and environmentally friendly approach. A CHP plant has to compete with the power produced by large scale plants which benefit from the scale factor in plant and operation costs. Furthermore CHP stations, particularly those in the range of 3-10 MW electric power, require multidisciplinary skills (machinery, heat exchange, electrics, C&I, civil works) resulting in complex plants even if they are of a small size.

Therefore, an organization able to produce CHP plants is required to have skills typical of large engineering companies but, in order to compete in price with large scale centralized power stations, has to be very lean and has to support very low overheads. In a context of the electric market liberalization, there is a potential in the CHP market for Small and Medium Enterprises, which still need to start a co-operation in order to jointly afford the market and to win the competition with the Large Enterprises.

An initial cooperation was already in place among the Partners of this Virtual Enterprise, one of which (Ulstein Italia) was in contact with CE Consulting and registered to its Interest Group. This initial cooperation was however characterised by the following issues:

- Lack of contractual commitment among the partners, and consequently, of a joint integrated approach to the market;
- Lack of common product models and processes;
- Lack of Internet advanced coordination tools.

The need to start a co-operation had its basis on the fact that none of the companies had enough resources and all the necessary skills to deliver a CHP plant as a whole. Therefore, each partner had the perception that market conditions required a new co-operative approach, based on
optimised utilisation of common resources and the exploitation of the Internet technologies, as tool for the proper resources coordination.

The three VE partners (Ulstein Italia, providing the plant engine, SCE providing all the auxiliary systems and Coteco, providing the control system) involved then CE Consulting to act as Business Integrator, with the main objective of delivering an integrated approach to the supply of CHP plants in a mature, competitive market.

The ViVE approach fits well to the CHP projects development although one of the main characteristics of these projects is the individuality, with the result that each plant is, up to a certain extent, tailor-made to the customer’s needs, on the other hand, the plant model and the basic structure is repetitive and can be reproduced for other projects.

All the CHP projects have a common scheme; this requires the establishment of a know-how structure and the definition of the processes to be implemented, whose costs can consequently be mortgaged in several projects. Such a case should then inspire all the managers working in similar contexts, characterised by the need for formalising existing forms of cooperation by means of common market approach and sharing operational and management practices. The potential for a successful replication of such a case is therefore enormous.

4.3 The CTS case

The third Virtual Enterprise operates in order to evolve/qualify commercial components to make them available for low-cost commercial space missions. The acronym CTS stands for Commercial off The Shelf components.

Looking at the satellite market, there is a emergent scenario in which the most important driving force behind the design of scientific and commercial communications satellites is not the desired science or the most advanced technology, but simply the budget with which the sponsoring organisation has to work with.

The engine of the initiative was, in this case, IMT, an Italian company active in qualification and procurement of aerospace equipments for major companies. IMT intended to design and develop an industrial nanosatellite in the 50 kg range for scientific applications. As such a market is a niche one (and, additionally, influenced by the cost of the units), they planned to achieve their objectives by making maximum use of Commercial Off-The-Shelf rather that High-Reliability (Hi-Rel) components. The concept foresaw adopting such components properly modified or suitably upgraded to withstand the rigors of the space environment.

The viability of the concept, essential to keep the costs down was initially proven by means of extended tests on industrial PC boards already developed by IMT under contract from ESA/ESTEC.

The company could not afford the single-handed development of a satellite as a whole for several reasons, the most important were:

- The budget; as they could not sustain the economic effort required to develop the satellite on their own;
- The consortium structure, as the challenging target of IMT could not be achieved by adopting conventional customer-supplier relationships with other partners because of lack of funding and initial investment required.

IMT already knew the partners (ALTA Industries, providing commercial electronic components for upgrading and Eurosolare, producing solar panels for civilian applications), which they wanted to involve in the venture. CE Consulting (who carried out joint initiatives with IMT in the frame of the Italian SMEs association in aerospace) was then involved in order to formalise consortium roles and procedures.
5 Results

The VIVE methodology was applied to all the three business cases, in order to formalise the relationships among participating partners from an operational and legal point of view. All the three Virtual Enterprises were characterised by the finalisation and signature of a Frame Contractual Agreement, demarcating mutual responsibilities, internal and external liabilities and management instruments, by the definition of a common business plan, a common data model in terms of documentation and Work Breakdown Structure and by a set of common shared processes for facilitating the management. Virtual Enterprise web sites (based on commercially available ICT tools, namely BSCW and MS Project) were also established, to provide a common coordination and management infrastructure.

An adequate testing period (6 months) was performed in order to check Virtual Enterprise operations capability and to assess their ability to achieve co-operation targets. The testing scenarios were based on actual VE activities and operations, managed according the principles, rules and tools provided by CE Consulting.

The benchmarking framework for evaluating Virtual Enterprise performance, was established in advance of the testing period, indicating, where applicable, the reference value of specific metrics evaluated from partners current business practices and/or from conventional approaches to cooperative business (temporary consortium of companies, supplier/customer relationships and so on).

The results of the assessment and evaluation of the metrics are grouped and discussed according to metric typology.

5.1 Overall business case parameters

Overall business case parameters were evaluated by comparing the business objectives contained in the updated issues of Virtual Enterprise business plan with the values derived from available market knowledge (i.e. external to the Virtual Enterprises) before operations executions. In the case of unavailability of such values, consistency with the original target set in the first issue of the business plan was also evaluated.

In all the three business cases, a significant reduction of the level of investment required to pursue the business opportunities in a conventional manner was achieved. In the KUBA case, the investment associated to the partner most financially exposed was reduced by nearly 50%, while the sum of the individual investments of each partner was about 20% lower than the sum required to lead the overall project. A similar situation for the CTS case, where a reduction of 15% of the overall investment level was assessed. The reduction of the overall resource level is due to the fact that in a peer-to-peer relationship only the costs are budgeted (partners will be paid from product sales revenues) and that, additionally, such a kind of partnership facilitates cost reduction exercises at the initial stage.

As far as the SCOP case is concerned, the most appropriate financial parameter was not the reduced level of investment, but the reduction of the financial exposure of Ulstein Italia towards their Customers. This parameter was in fact reduced by 25%, which is the average amount of the contribution of the other two partners in a typical project (this would release additional financial resources to finance the acquisition of additional projects). Another significant SCOP metric is the optimisation of the project cash flow, with the consequent reduction of 1% of the financial cost and increase of about 25% of the project operating margin.

For all the three business cases, the process of finalisation of the Virtual Enterprise Frame Contractual Agreement (which also implied the definition of all VE operating procedure and targets) only took few weeks since the starting points were FCA templates, previously set up by CE Consulting in the frame of other EC initiatives. The improvement with respect to the constitution of a new legal entity, specifically dedicated to the identified business opportunities,
is apparent, since it would normally take from 4 to 7 months to prepare an adequate business plan, to present it and get approval of guarantees by the sponsors/banks and to define all the sub-contracts with suppliers. The time saved by creating a Virtual Enterprise can be estimated as 50% of the overall time to be dedicated to the set up of a new venture (it is worth noting that each Virtual Enterprise has no additional legal entity).

For the Kuba and CTS cases, a reduction of the time to market (evaluated with respect to the standards of major players in the sector like Ericsson and Motorola or with respect to the initial business plan) of about 25% was achieved. For the SCOP case, the parameter which was considered was the lead time, which was now consistent with market requirements but which can be improved by 10% for future projects (thus shortening the supply time from 10 months to about 9 months, which is a significant competitive advantage for the SCOP VE). This was estimated further to an optimisation exercise which was performed on the common WBS model, set up and tuned during the experiment. Consistency (deviation less than 5%) to product development costs (CTS and Kuba) and project budget has been also achieved.

Finally, as far as the increase of partners’ revenues is concerned, projections of individual partners’ prospects, obtained by assuming current balance data and updated figures from the last version of the business plans, showed a minimum increase of partners’ revenues of 25%. This is due to both the re-deployment of the technology matured in other sectors (Kuba and CTS cases) and to the improved co-operation efficiency, induced by the adoption of the Virtual Enterprise scheme.

5.2 Operations effectiveness metrics

The level of operations of the Virtual Enterprises, enabled by the availability of an Internet based platform, was monitored through a number of basic co-operation processes. The effectiveness of VE operations was evaluated by means of a dedicated set of quantitative parameters, measured through the log files available from the ICT supporting infrastructure. A list of co-operative management and concurrent engineering processes was defined for each virtual enterprise, to represent the main interactions among VE members. A number of metrics were extracted in order to monitor the state of each process.

Process lists include, among others:
- Request for information;
- Change management;
- Documentation approval;
- WBS modification management
- Non Conformance Report;
- Review Item Discrepancy;
- Punch list management.

Execution time for each of the considered processes was found to be in line with respect to the target values, obtained by the evaluation of current business practices inside the industrial partners and process cycle time was improved by 15% to 30%, depending upon the specific parameter considered. Partner visibility on the overall project conduction was greatly improved. The traceability of the process status was judged by the partners to be excellent in comparison to current, conventional scenario of cooperation.

The evaluation of the parameters associated to the basic co-operation processes demonstrates an improved level of efficiency with respect to conventional ways of co-operation and, particularly, a more effective traceability of all the events with a consequently more agile decision process.
5.3 Approach implementation metrics

The metrics relevant to approach implementation ease were evaluated by means of dedicated questionnaires, distributed to all the partners of the three Virtual Enterprises, relevant to parameters reported in the following table.

<table>
<thead>
<tr>
<th>Metric Typology</th>
<th>Results</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of the ease of VIVE adoption</td>
<td>Qualitative</td>
<td>Good</td>
</tr>
<tr>
<td>Ease of use of the adopted set of tools</td>
<td>Qualitative</td>
<td>Good</td>
</tr>
<tr>
<td>Adequacy of the approach to cooperation requirements</td>
<td>Qualitative</td>
<td>Good/Excellent</td>
</tr>
<tr>
<td>Adaptability of legal scheme used</td>
<td>Qualitative</td>
<td>Good</td>
</tr>
<tr>
<td>Improvement of working conditions</td>
<td>Qualitative</td>
<td>Good</td>
</tr>
<tr>
<td>Level of commitment of partners working in a VE context</td>
<td>Qualitative</td>
<td>Fair/Good</td>
</tr>
<tr>
<td>Time necessary to implement the new methodology (VE’s model)</td>
<td>Quantitative</td>
<td>1 month</td>
</tr>
<tr>
<td>Training time required to familiarise with the method and the ICT tools</td>
<td>Quantitative</td>
<td>2 days</td>
</tr>
</tbody>
</table>

Table 1: Approach implementation metrics.

For each of the qualitative parameters reported, a number of dedicated questions were identified and submitted to partners. For qualitative metrics, a range of four different values were set (Poor, Fair, Good, Excellent).

The overall outcome from the experiment was extremely positive. Partner personnel involved in VE operations perceived that this approach was quite easy to deploy and adopt especially thanks to the extra effort of the Business Integrator, in terms of use of the proposed templates, definition of VE’s models and finalisation of VE processes. The approach was judged as extremely effective from a co-operation point of view. Motivation, commitment and level of involvement are high in a Virtual Enterprise, due to the decrease of conflicts, the increase of trust among partners and the possibility of retrieving project information in real time.

Finally, it was also observed that the impact of companies’ current practices is limited to the co-operation procedures, leaving almost all the internal processes unchanged. This results in a reasonable implementation effort of the VE approach, within the time and effort expectations of most of the European SMEs. A two day training session was sufficient to put all the partners in a position to achieve a sufficient initial understanding of VE Procedures, while an average familiarisation time of 1 month was sufficient to reach the full operability in a VE context. To this end, the role of the Business Integrator in VE model assists in facilitating the adoption of the new practices, reducing the transition time required for a full implementation.

6 Conclusions

The experiment performed in the frame of the ACTIVE project was aimed at evaluating the benefits induced by the adoption of the VIVE Virtual Enterprise approach, in the frame of actual business cases.

The initial important conclusion is that the adopted approach was essential to reach the signature of Virtual Enterprise Frame Cooperation Agreements for all the three cases, thus creating the conditions for pursuing the selected business opportunities otherwise out of the partners’ individual reach. In this respect, it is worth noting that in the meantime all the three Virtual Enterprises have reached tangible results (the realisation of an antenna prototype for the Kuba case, the delivery of a complete plant for the SCOP partners and the initial realisation of upgraded components for the CTS case).
The evaluation of the VE performance was performed through a dedicated reference benchmarking framework, specific to the Virtual Enterprise business model and compared to current business practices. The results are reported in the following table.

<table>
<thead>
<tr>
<th>Metric Typology</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual reduction of investment</td>
<td>Up to 50%</td>
</tr>
<tr>
<td>Overall reduction of investment</td>
<td>15%-20%</td>
</tr>
<tr>
<td>Reduction of financial exposure of VE partners</td>
<td>By 25%</td>
</tr>
<tr>
<td>Increase of project profitability</td>
<td>By 25%</td>
</tr>
<tr>
<td>Reduction of time required for co-operation contractual formalisation</td>
<td>By 50%</td>
</tr>
<tr>
<td>Reduction of time to market</td>
<td>By 25%</td>
</tr>
<tr>
<td>Reduction of lead time</td>
<td>By 10%</td>
</tr>
<tr>
<td>Increase of individual users revenues</td>
<td>More than 25%</td>
</tr>
<tr>
<td>Improved efficiency of co-operation processes</td>
<td>15% - 30%</td>
</tr>
</tbody>
</table>

Table 2: VE results.

The evaluation of the metrics parameters confirms that the CE Consulting VE approach introduces several benefits and advantages from the overall business parameters’ point of view that can be efficiently operated by the ICT platform concepts developed and that does not introduce significant gaps or major impacts on companies’ current ways of working.

The main results of the work performed within the ACTIVE project framework are:

- Quantitative validation of the CE Consulting VE business model
- Availability of three business cases in different strategic industrial sectors, which constitute a reference (and a stimulus for emulation) for all the entrepreneurs willing to expand their business through optimised, advanced co-operation schemes.

The dynamics of all the three business cases’ aggregation suggest that there is the need to create a number of additional entities providing the “Business Integrator” servicing, which could provide the VE members with all the necessary, external effort to make the huge number of potential co-operative SMEs network stable and competitive.

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