View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Research Papers in Economics

Low-cost broadband connections: a key factor for SME virtual organizations

V. A. Angelis, O. Sakellarides, G. Dounias, and I. Koufodontis
University of the Aegean
Business School
8, Michalon Str.
82100 Chios
Greece
e-mail: ikouf@aegean.gr

Abstract

In an open global market, SMEs are facing new challenges while trying to compete with large worldwide corporations. The forming of innovative alliances, known as virtual organizations (VO), is one of the most interesting proposals to achieve competitiveness and exploit strategic advantages. However, besides the obvious positive potential of innovative actions like VOs, there are several drawbacks, especially when SMEs are involved in such projects. VOs have very high needs for IT and communications; in fact they rely so much on them that the forming of a VO is only possible with the development of an extensive information and communication infrastructure.

A lot of innovating management, re-forming and re-structuring is involved in joining several independent companies into a new virtual schema and several cultural, economical and legislative problems must also be overcome. In this paper we focus on the technological needs, and in particular, the need for an organization-wide data sharing and communication network. The high cost involved with the investments necessary in IT and communications technology make the effort harder for SMEs, even if it was to be assumed that they could manage the other important aspects of forming a VO. Along with the cost of computer equipment and specialized software, networking cost has until recently been a particularly prohibiting factor for SMEs even on the most advanced business sectors.

A new term, the “virtual organization technology threshold” is introduced, defined as the minimum of IT and communication technologies necessary to form a “true” virtual organization, in its pure and functional form described and widely adopted by the scientific community. The investments needed for IT and communications to form a VO are analyzed and compared to the related investments of conventional SMEs in EU. The evolution in the cost, focused around the networking tools, is then examined to extract useful information about the feasibility of such specialized investments compared to the overall investment and turnovers of typical SMEs. We then argue that a recent development, the price drop and wide spread of broadband connections can act as a “key factor” that could make the difference in lowering the “threshold” and increasing the possibilities for SMEs to compete successfully by utilizing technological advantages and innovations that have until now considered to be more suitable for larger enterprises.
The findings presented here are based on extensive research work of the authors related to virtual organizations, performed during the period 1997-2006.

Keywords: virtual organization, new technologies, communication, networking, broadband, innovative management

Introduction

In a global economy that becomes everyday more competitive and demanding, SMEs are continuously facing new challenges. Their once safe and unrivalled positions in small local markets are now more than ever threatened by the invasion of "outsiders", mostly large enterprises with wide geographic spread. By using the advantages that modern IT and communications technologies can offer, big companies are not only trying to get a foothold on local markets, but also aiming – and often succeeding – in dominating them.

To defend their position, SMEs can choose to fight back using the same weapons, which is possibly the most realistic approach and strategy to use in the information age. However, SMEs don't start from a strong position. The proportional cost of investments in new technologies is often too high compared to the same cost for a larger company. Also the actual tools are usually designed by- and for the large competitors and therefore it's questionable how useful they can be for an SME; or if they will have the opposite effect of further strengthening the already big ones.

One form of action for the SMEs against the described disadvantages is the development of alliances and partnerships. One of the most advanced strategies based on cooperation is the forming of virtual organizations (VO), an innovative organizational form which again was originally implemented in large corporations.

It has been argued that participating in virtual enterprises can be an excellent path for SMEs to follow, in order to remain competitive by using some of their natural advantages, such as their uniqueness, to enhance their place by adopting a more aggressive market oriented strategy [Coulson-Thomas 1996]. But it has also been argued that the high cost of obtaining the necessary technology along with the specialized know-how, discourages or even prohibits SMEs from making the necessary decisions and moves.

Participating in a complex and demanding form of cooperation such as the virtual enterprise can be very demanding: new environment, new business processes, and new technologies. It involves developing a completely new organizational structure that has many barriers to overcome mostly in terms of management and technology [Wagner et al 2004]. Even though an innovative approach can have some great benefits, it must still be a feasible option in terms of cost and benefit for the companies involved. A VO is very demanding in terms of necessary IT and telecommunications infrastructure; in fact only with the extensive use of innovative technologies it is possible to form a VO [Miller et al 1997].

Since for a variety of reasons no specific data about the investments and revenues of virtual enterprises is widely available, an alternative approach is suggested, involving the introduction of a new term, the "virtual organization technology threshold" used in forming a VO. This threshold is defined as the minimum of IT and communication technologies necessary to form a "true" virtual organization in its pure and functional form described and adopted by the scientific community. Below this threshold, we are no longer talking about a

VO; above it the extra investment must justify the decision based on a further cost/benefit analysis.

The necessary investments to overcome the “technology threshold” are compared to the standard investments in technology made by a typical SME. The relative difference between these two, proportional to the total investments and turnover of SMEs, will be used as an indicator of the feasibility of participating in a VO.

Focusing solely on the technological aspect and the relevant costs involved, the technology needs are broken into three main parts:

a) Computer equipment and maintenance
b) Software tools
c) Communication equipment and cost

This paper further focuses in the last part, and specifically in the cost of developing and maintaining the necessary intra and external telecommunication network needed for extensive data transfer, one of the basic requirements of a VO.

There are several standards and demands in the networking: it must link all the organizational units, it must offer real time communication ability and it must be fairly reliable and secure. Until recently, the building of a VPN with the use of dedicated leased lines was the most feasible way to fulfil the needs [Fowler 1999]. However, because of the high cost, this solution was mostly available to larger companies that could handle the large cost (and the know-how) involved. The turn towards Internet based technologies allowed during recent years the development of some very interesting projects, aimed specifically towards SME VOs. Implementing cheap and effective IP technology and standard tools like XML they provided an alternative solution to the tools necessary for integration [Katzy et al 2001], [Roberts et al 2003].

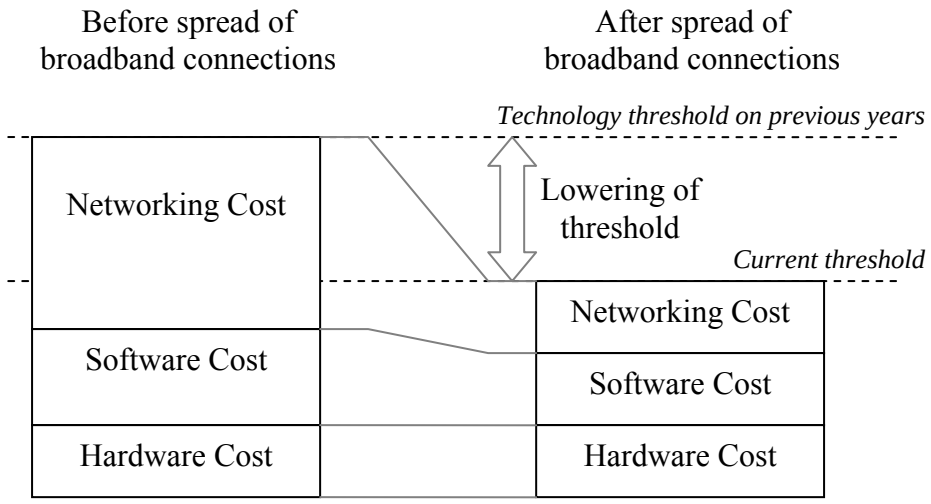
Of course the use of public networks had a significant positive impact in the cost and connectivity; but there is still always the need to connect to the communication network core, regardless of the means or technologies used. A recent technological development that is considered to be of great importance for VOs and SMEs in particular is the spread of broadband connections in most parts of the world.

It is suggested here that the sharp drop in broadband connections’ prices during last years can have a significant impact in the “technology threshold” of a VO, lowering it enough to make VO projects much more feasible than they were just a few years ago.

This is even truer for areas with disadvantages, in particular for areas with geographical isolation and limited spatial continuity [Angelis 1994]. The use of broadband connections would not only allow these regions to improve their accessibility but will also make it possible for companies located in these areas to overcome isolation and reach new wider markets.

Therefore, the availability of low cost and adequate performance networking through the utilization of broadband connections and internet technologies is presented as an important “key” factor for forming SME VOs.

This basic argument is illustrated in the following schema:



The text is divided into four sections. In the first section, the "technology threshold for virtual enterprises" term is defined. In the second one, two different approaches for calculating the costs for information technology and communications when forming a virtual organization are presented. In the third section, the methodology used is outlined and further explained, including virtual organization structure, functions, and formation analysis process. The fourth section presents the findings and conclusions of the analysis and calculations.

I. Defining the "technology threshold"

The definition of a term such as the "technology threshold" is a complicated process because of the many aspects involved. For example, we are talking about "networking cost". But what is the form of this network, what are its functions and how does it support the integration of a virtual organization, as it is supposed to do? [Camarinha-Matos etal 2004]. We can not estimate any cost unless we define this factor, as well as all the other factors of our basic equation. The formula calculating the total cost is the following:

$$TC = C_n + C_s + C_h$$

where:

TC = Total Cost of technology for a virtual organization

C_n = the networking Cost

C_s = the software Cost

C_h = the hardware Cost

Again the cost as factor for creating a virtual organization is only one part of a larger equation, directly related to the feasibility of any such project. It has been mentioned earlier that the "technology threshold" describes the minimum use of technology necessary to support a

virtual organization. To define this minimum, a complete analysis of the formation of a typical virtual organization is performed, as part of an overall feasibility study. The components of this study are as follows:

feasibility ?	*functional*	The operational model → simulation developed
	technical	Analysis of the technology needs
	financial	Analysis of the cost

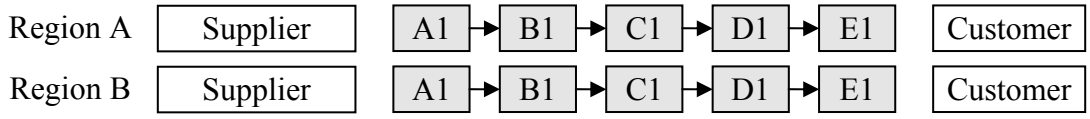
What are the main characteristics of a typical virtual organization? The basic ones, acceptable by most researchers[1] can be divided into three categories, all supported by the extensive use of information technology and communications:

- structure
- functions
- management

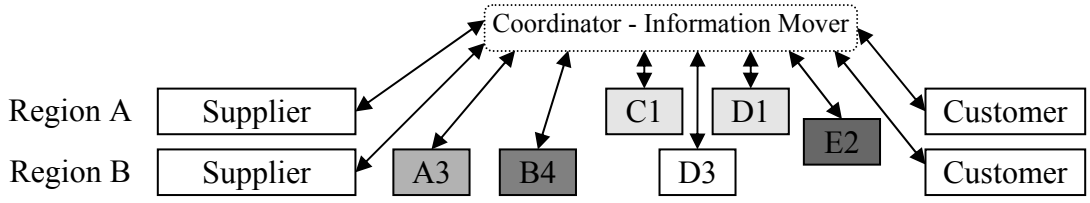
Supported by IT & Telecom

A typical structure, such as the one proposed by P. Sieber [Sieber 1997] is used as basis. Sieber describes the transformation in five phases, of which only the first and the last one are shown here.

Phase 1 (initial) - Conventional Enterprises



Phase 5 (final) - Virtual Enterprise

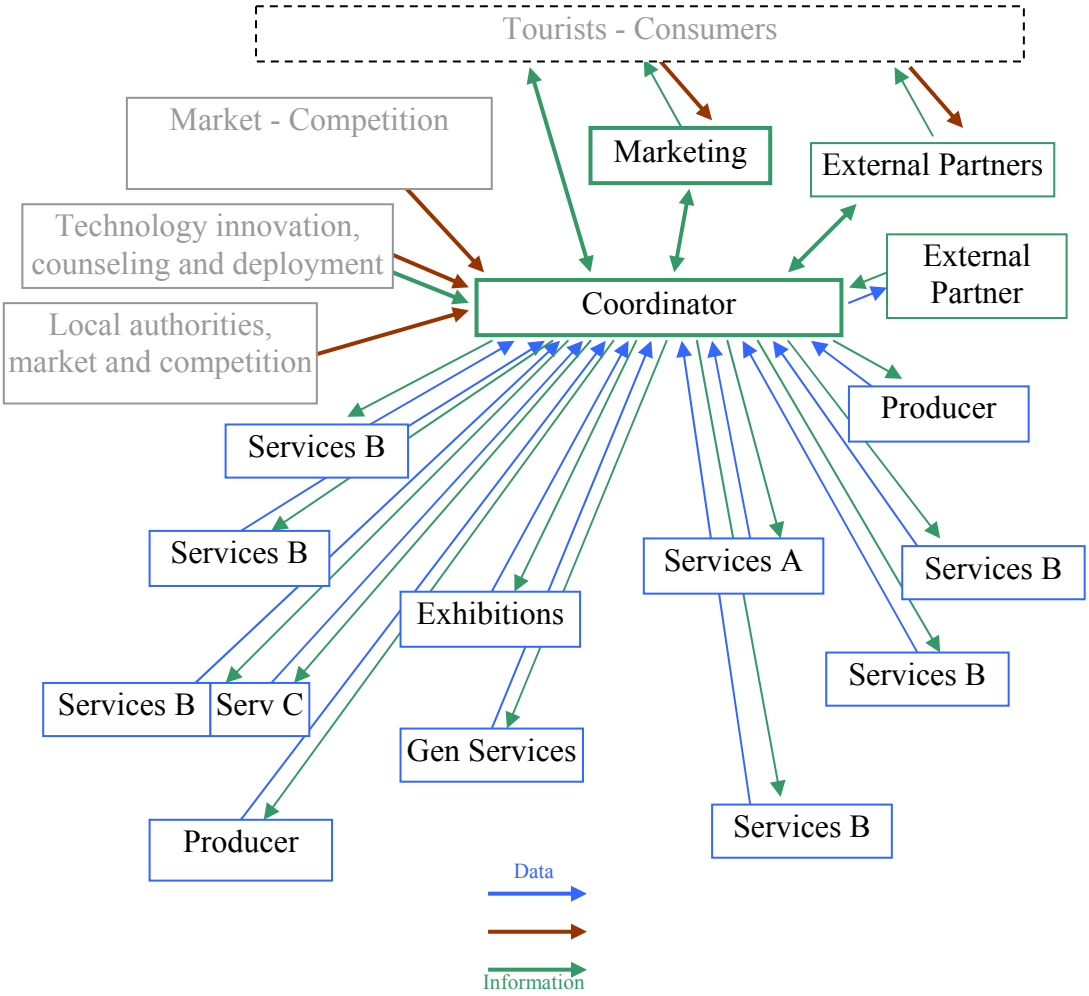


A1, A2, B1 etc are operational units. Different shades correspond to autonomous entities (i.e. independently owned companies).

[1] However, some researchers argue that in fact there is no universally accepted definition of a virtual organization. For example, Kasper-Fuehrer and Ashkanasy have collected and compared most well known definitions to prove this [Kasper-Fuehrer etal 2004]

A model of a virtual organization of SMEs in the tourism sector has been developed [Sakellarides etal 2000] as a tool to define a frame for the structures and functions.

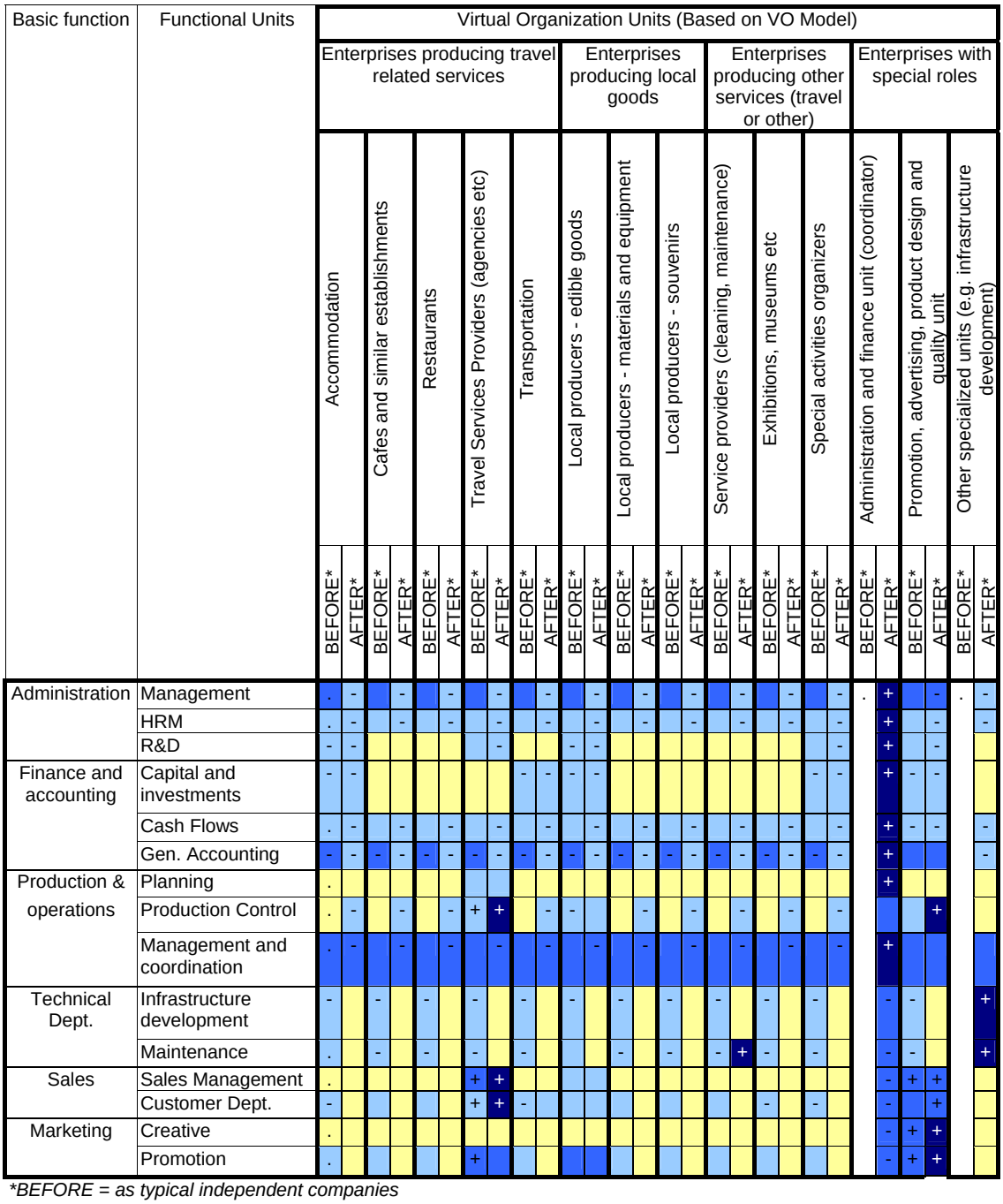
Model of Virtual Organization for SMEs in the tourism industry



The business functions of a conventional enterprise are based on the work of H. Koontz and C. O' Donnel [Koontz etal 1976], Drucker [Drucker 1993] and Ghoshal [Ghoshal etal 1995], and further enhanced to correspond to the rapid changes of the information age and the emerging of innovative organizational forms [Afsarmanesh etal 1997]. The following (simplified) schema shows an intermediate phase of the analysis, with the differences between conventional and virtual enterprises. It is part of an extensive series describing the transformation.

Figure

Transition from conventional to virtual organizational form

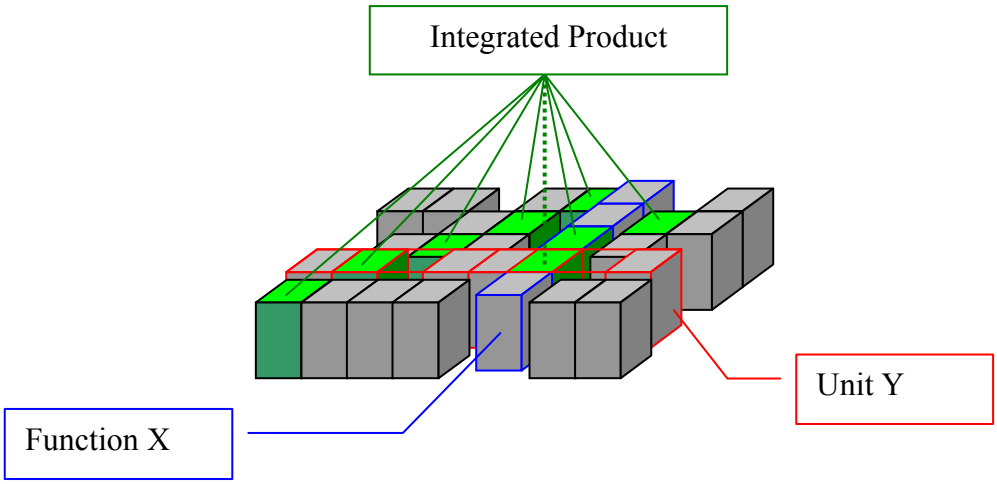


BEFORE = as typical independent companies

AFTER = as units of the VO

Also, it is important to remind that the production process takes place in several independent units, each contributing a unique part of the final product. Therefore a multi-dimensional analysis (as already suggested by the previous figure) is necessary for any calculation related to the specific model of VO. The next figure illustrates this.

Figure
The Integrated Product of the VO



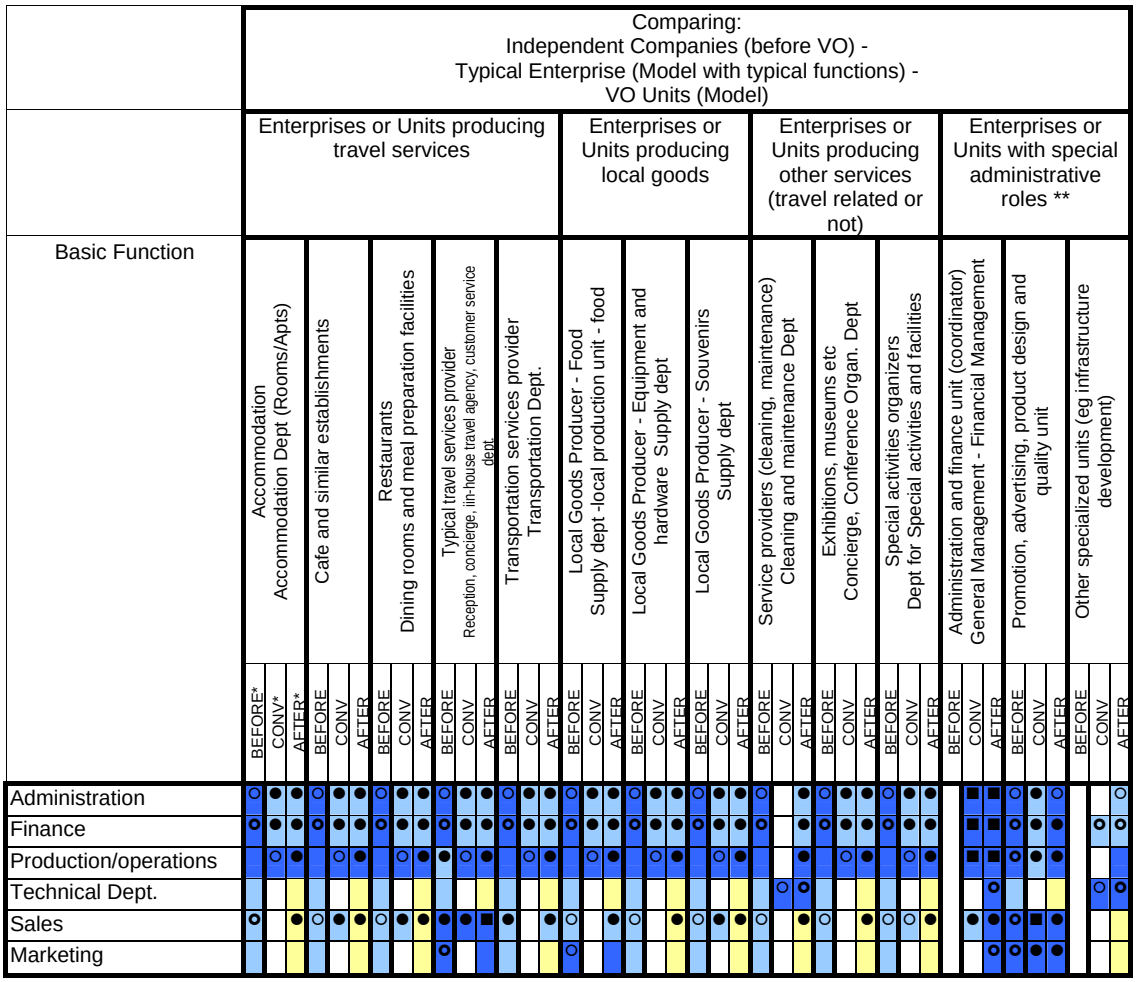
Since we need to compare conventional and virtual organizations, the transition from the one form to the other is analyzed around the information technology and communication needs. As a result it is possible to observe the differences in needs to support all business functions in both forms. This is the final step before attributing costs to each cost-center in which the use of information and communications technology is considered a necessity.

II. Calculating the costs

Two different approaches can be used to estimate the IT & telecom costs. The first one is to calculate the cost for each independent unit of the VO. The second one is to calculate the cost for a conventional enterprise with size, structure and activities comparable to that of the virtual organization we are examining and add to the sums the extra costs caused by the specific organizational form and needs of the VO. The schematic results of this approach are presented in the following schema:

Figure

ITC needs in different organizational forms: a comparative view



* Before = As independent enterprises

* Conv = Conventional enterprise

* After = As units of the virtual enterprise

** The general and financial administration of the conventional enterprise have been combined to be comparable with the virtual enterprise. Also in both case many additional services can be outsourced.

Procedures supported by IT

- ■ Central Server
- ● Workstation (networked)
- ⭘ Workstation (autonomous)

Procedures supported by other means

- □ Central records
- ○ Point of data collection

ACTIVITY

Normal deployment

Only the basics/necessary

Little or no deployment

Calculating the costs with either approach is not an easy task. Often it is difficult to find the exact figures, while other times the data is available for a specialized or a narrow sector of activities. Even when we do have the complete figures and can calculate an average cost, it does not mean automatically that this cost corresponds to a typical “average” virtual enterprise. Any VO is formed by enterprises of many sectors making the calculations of the cost for each unit a very complicated task. However, when using the second approach this is not necessary, as we only need to calculate the difference caused by their participation in a different - innovative - organizational form. The cost formula described earlier can be used not only to calculate absolute costs (in monetary units) but also to estimate the relevant costs as regards to the total operating and other figures of the enterprises. If we consider this extra cost (related to and caused by the virtual form) as an investment in research and development, we can then compare it to available statistic data and therefore estimate the feasibility by using available recent data from various sources. For example, according to Eurostat, companies in Europe spend around 1,3% of their total revenues in R&D, though in some countries this percentage is dramatically lower (less than 0,2%, e.g. Greece). But R&D is more often directed towards improving the production processes and it is unclear how much of this is directed to innovations in IT and communications. Also the use of the term “innovation” is sometimes confusing because it is applicable only for certain periods of time. Therefore we would call innovative a company that invested in web presence and simple online sales ten years ago, but not anymore. On the other hand, the amounts invested in private sector R&D give us an indication of the willingness to invest in things that the companies consider as “innovative” for their specific activities or industry sector.

After filling the available information and data into the transition and operating models, the needs in information technology and communications are further analyzed.
The initial cost formula described above is expanded to include additional cost factors. When applying the generic cost formula to the organizational and functional models that we are using, the formula takes the following form:

Total cost of IT &Telecom in VO *is equal to* cost I + cost IIa + cost IIb *where*:

(I) is the Networking cost = cost by connection × (number of units + 2)
(IIa) is the IT cost a: software cost = (cost of basic installation in product i + cost of installation of client i × number of units) + cost of network securing
(IIb) is the IT cost b: hardware cost = cost of coordinator server + (cost of unit’s basic system × number of units)

As result of the analysis, the contributing factors and the redefined total cost for the technology threshold is as follows:

Variables	
U	Number of typical units participating in VO
U_S	Number of special units
C_{NC}	Cost of individual network connection
C_{NE}	Cost of equipment for local and external networking for each installation
$C_{SA(i)}$	Cost of software application i, is the one of the basic functions (administration, financial, production, sales)
C_{SC}	Cost of connection software
C_{SS}	Cost of security software
C_{HS}	Cost of coordinator server(s)
C_{HT}	Cost of unit's basic terminal (including peripheral equipment)
C_N	Total networking cost
C_S	Total software cost
C_H	Total hardware cost

$$C_N = C_{NC} + C_{NE}$$

$$C_S = \frac{(C_{SAi} + C_{SC} + C_{SS})}{U + U_S}$$

$$C_H = C_{HT} + \frac{C_{HS}}{U + U_S}$$

The total cost $C_T = C_N + C_S + C_H$ is the investment threshold for use of information technology in a typical SME that wants to participate in a virtual enterprise as a production oriented unit. Obviously for the companies or the parts of the companies that want to have special roles there are different demands but the basic infrastructure cost can still be divided equally between all units. The calculated amounts are the annual costs, including all expenses like networking charges, software licenses and equipment depreciation.

III. Methodology Outline

Before the presentation of the findings, a further explanation is necessary to describe briefly the methodology, the sources and the assumptions made while calculating the cost for each basic contributing factor.

The following two basic assumptions are made and used consistently throughout the analysis:

a) The willingness and capability of the companies for investments in new technologies is tied to their history and position in industry and market. Therefore it is not assumed that any potential member of a virtual team, even when guided by visions and high expectations, would invest amounts and efforts that are in a completely different scale than previously.
b) When participating in collaborative organizational forms, the companies adopt not only to the operating terms and conditions agreed between the members, but they also participate in the necessary infrastructure development expenses by sharing the costs, according to predefined agreements.

Also, other main considerations about the typical or legal form of the cooperation as presented by various researchers are taken into account [Scherer 1997], [Berwanger 1999], [Quirchmayr 2002] et al.

Again the analysis is done separately for the functional - technical part and the financial one.

1) Functional - Technical Analysis

(a) Software

All major platforms developed by researchers and all suitable commercial collaboration tools presented between 1995 and 2004 are compared and examined. Special attention is given to systems specifically developed for SMEs, such as the European FETISH-ETF system [Nicolai etal 2002] [Giorgetti 2002]. The functionality and suitability of selected platforms is evaluated according to white papers and system descriptions available. These specialized software tools are used in the core of the business operations (administration, production, sales, and finance). They are supported by standard software applications for front or back office operations [Manheim etal 1999].

Besides the need for a specialized core platform to support the VO, there are two more important software related issues. The first one is the necessity of using standards in information encoding. An example of this (related to the model we are using) are the OTA

standards [s: OTA 2004]. The second one is the absolute need of data exchange, not only inside the VO but also with the market [Kutvonen etal 2005]. In this case, XML is proposed as the most suitable data exchange standard; it's is easy to use, flexible and it has the widest acceptance by the industry [Svirskas etal 2003].

(b) Hardware

There is no evidence indicating that use of standard computer equipment is not enough for any virtual organization. Even though the analysis covered possibilities like automated data collection methods that would need specialized and expensive equipment, these are very rare for SMEs and not always cost effective. Basic workstations for all units and standard low cost servers for the unit holding the main system database, supported by standard peripheral equipment are considered adequate.

(c) Networking

Real time data exchange needs and a system that will work 24/7 are the mandatory requirements for any VO [s: OECD 2005]. In simple terms, any unit or functional part of the company needs a permanent, reliable and fast connection to the core system. However building an adequate intranet or VPN, along with the necessary external connections, does not need any specialised connections. This is particularly true after the introduction of broadband connections, including all major technologies (xDSL, cable, WiFi etc). Even though leased lines have still some advantages, they are no longer the only (expensive) option.

2) Financial Analysis

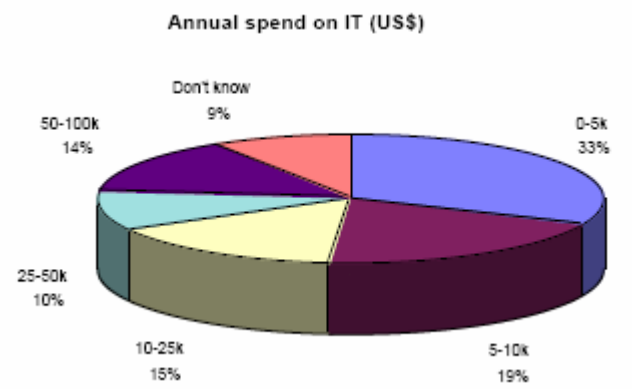
(a) Software

For calculating the cost of the software tools, an average cost for using major core platforms accompanied by supportive application for general or special uses was estimated. This included around 80 commercial platforms as well as some research funded solutions (including for example in the travel sector the projects HARMONISE, CRUMPET, PALIO, ODIN, Enjoy Europe, VEGA [Suter 1999] ProdNet [Camarinha-Matos etal 1998] etc, some of them being integrated into the aforementioned FETISH-ETF platform). An extensive compiled list was used as the basis for the commercial solutions, with further additions including major platforms like SAP, BizServer, iway, JINI and other solutions, even though some of these are directed towards large corporations and not SMEs. The variety of the available systems and the differences in pricing schemas (i.e. packages with specific number of users, connections etc) allows for very rough estimation of an average cost. The combination of the basic core platform with the standard applications and some specialized components (mainly data security related), creates several categories directed towards specific industry sectors. Again, for consistency, only the ones suitable for the discussed model were selected.

(b) Hardware

Since statistical data was widely available and with good detail, information provided by various sources, including OECD, INSEAD and various other international and national agencies was used, main reference source being Eurostat reports and statistics. This data was compared to the estimated hardware needs as calculated in this analysis and found to be consistent with every day's practice in European SMEs. Again data is analysed for a period covering last ten years (1995-2004) to be able to compare and join the figures with the other factors (software and telecommunications) and to isolate the pure hardware investments. An interesting aspect is the (partial) financing of such investments by EU programs, significantly lowering the investment cost. This is another reason for the coverage of large time period, because many recent figures exclude a significant percentage of the equipment cost because it is not paid by the companies. Some typical base figures are presented in the following diagrams.

Figure
SME Annual Expenditure for IT in the past



Source: The European Small Enterprise Information Technology Study, INSEAD, 1998

Figure
ICT usage in EU

Table 6.1: Proportion of enterprises using ICT, (%)

	EU (1)	BE	DK	DE	EL	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	UK	NO
Proportion of enterprises using computers, beginning 2002																	
All sizes	**94**	:	98	95	88	95	:	95	95	97	94	93	84	99	99	89	95
SME	**94**	:	98	94	88	95	:	95	95	97	94	93	84	99	99	88	95
Large	**100**	:	100	100	99	100	:	98	100	97	97	100	99	100	100	100	99
Proportion of enterprises that used the Internet during 2001																	
All sizes	**81**	:	95	84	64	83	:	83	74	79	85	85	69	96	95	54	82
SME	**81**	:	95	83	64	82	:	82	74	78	85	84	68	96	95	53	82
Large	**98**	:	100	98	96	98	:	96	95	96	95	100	98	100	100	86	96
Proportion of all employees using a computer connected to the www (Internet) at least once a week, beginning 2002 (2)																	
All sizes	**27**	:	50	27	23	19	:	26	21	26	:	29	19	51	51	:	51
SME	**26**	:	48	27	20	20	:	25	19	30	:	31	18	50	52	:	46
Large	**28**	:	52	27	27	19	:	27	23	21	:	27	21	52	51	:	56

(1) Excluding BE, FR, NL and UK.
(2) FI, excluding part of NACE Group 74.5.
Source: Eurostat e-commerce survey 2002.

Source: Information Society Statistics, ISBN 92-894-6429-1, Office for Official Publications of the European Communities, (Eurostat) 2003 (last avail at end of 2004)

(c) Networking

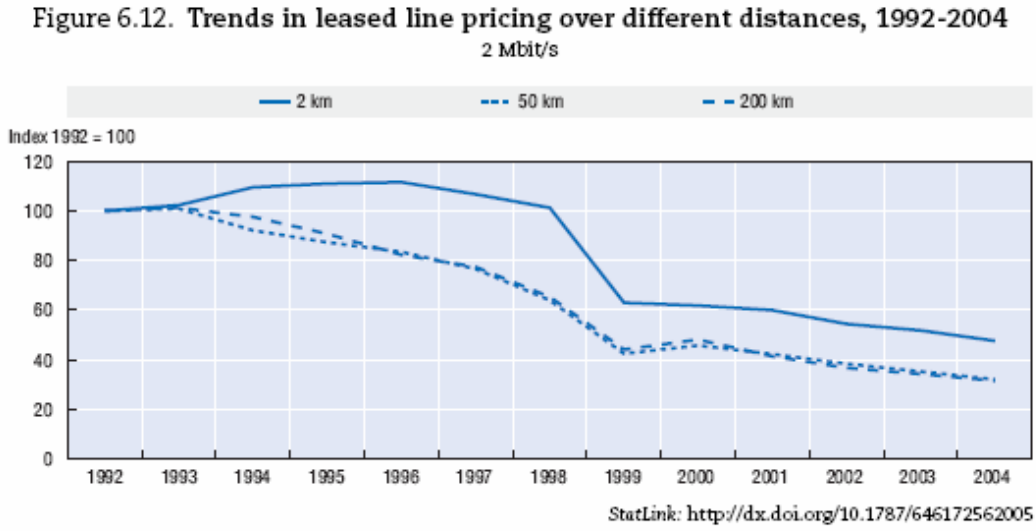
Telecommunications are divided into two basic categories: Data exchange and voice communication. Networking is examined in the first category. The second one, mainly conventional communication forms over PSTN or mobile networks, is only examined as part of an integrated system including emerging technologies such as VoIP in terms of using the advantages of the computer data network to reduce overall communication costs.

Two main solutions for networking are analyzed: leased lines and xDSL. This is the section where most radical changes have occurred during last years and therefore it is the reason this paper focuses to the broadband connections.

Again, data from various sources and for a time period covering last 10 years (1995-2004) is combined to extract useful values and to present the main trends in the usage of high speed connections, essential for any virtual organization.

Starting with leased lines, it is interesting to note that while the cost has been dropping significantly, the changes are still quite slow; mainly because of the nature and specific target group of this technology which are the larger corporate and institutions. The introduction of DSL technology caused a big drop in pricing just before 2000 but after the “adjustment” it did not continue to drop so much the following years. The following diagram shows this clearly:

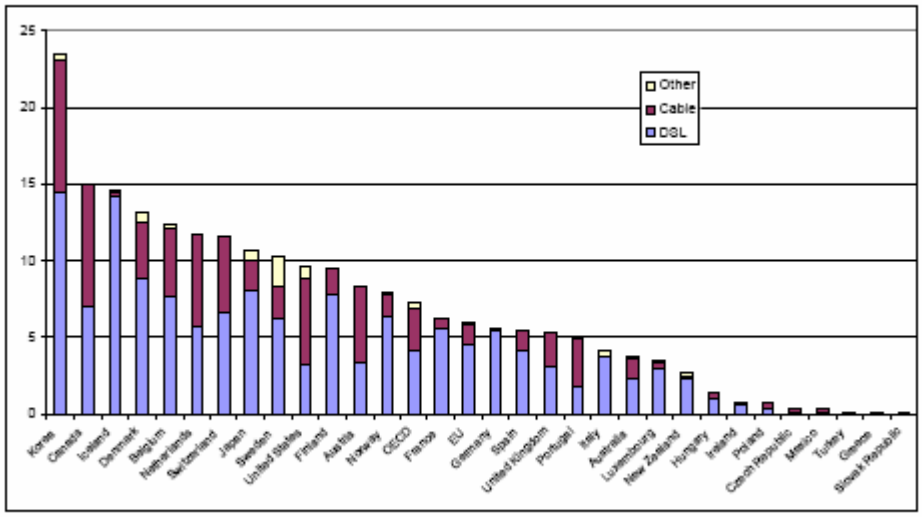
Figure 6.12. **Trends in leased line pricing over different distances, 1992-2004**



Source: OECD 2005

Cable and DSL are then most common solutions for broadband connections. However the range of adoption varies greatly as the following diagram shows:

Figure 10. Broadband subscribers per 100 inhabitants, June 2003

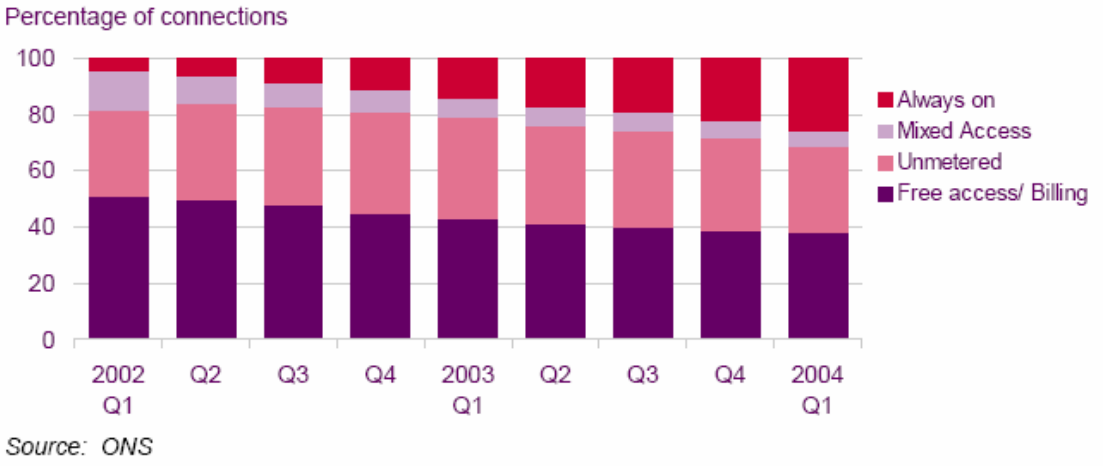


Source : OECD, 2004.

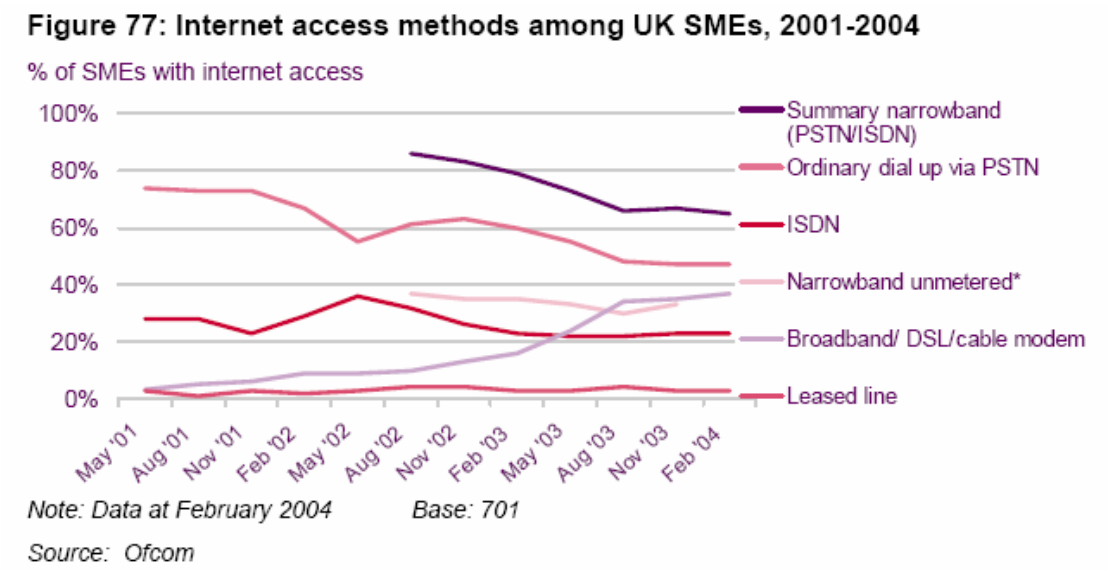
Source: ICT, E-BUSINESS AND SMEs, OECD, June 2004

The demand for “always-on” types of public network connections and the prevailing trends are clear in the following two figures. The specific data is from UK (presented here as an example). The first figure includes households while the second one focuses in SMEs.

Figure 74: Proportion of internet subscriptions by connection type, 2002-2004



Source: The Communications Market 2004 - Telecommunications (UK, end of 2004)



Source: The Communications Market 2004 - Telecommunications (UK, end of 2004)

The following table shows the overall trends of various forms of networking in OECD countries.

Table

Access trends in OECD countries

	1997	1998	1999	2000	2001	2002	2003	CAGR (2002-2003)	CAGR (1998-2003)
Standard analogue access lines	507	511	521	519	515	509	503	*-1.22*	*-0.33*
Total access lines	517	525	542	547	547	544	538	*-1.09*	*0.49*
Total channels (64kbit/s voice equivalents, excluding DSL)	533	550	581	599	605	606	600	*-1.02*	*1.74*
DSL lines	0	0.027	1	5	15	28	47	***62.67***	***140.71***
Cable modem subscriber lines	0	1	2	8	15	23	31	***36.88***	***114.92***
Total fixed access paths (channels + DSL + cable modem)	533	552	584	613	637	659	679	*3.11*	*4.25*
Mobile subscribers	170	246	360	511	610	672	741	*10.32*	*24.73*
Total access paths (total channels + DSL + cable modem + mobile)	704	797	944	1124	1247	1331	1421	*6.75*	*12.25*
DSL lines as percentage of total access lines	***0.0***	***0.01***	***0.1***	***1.1***	***2.9***	***5.3***	***8.8***		

Note: figures are in millions (rounded)

Source: OECD 2005

The following excerpt from most recent OECD annual Communications Outlook (2005) describes accurately the prevailing trends.

"The scope and quality of Internet experience and the full adoption and integration of e-commerce depend upon bandwidth and "always on" access. By the end of 2003, there were almost 84 million broadband Internet subscribers in OECD countries – up from 15 million at the end of 2000, or by 77% per annum. Over the period from 2000 to 2003, the number of broadband subscribers using DSL connection increased from less than 6 million to more than 47 million (100% per annum) and the number using cable connections increased from 7.6 million to more than 31 million (60% per annum). Hence, the share of DSL subscription increased from 39% of all broadband connections in 2000 to 57% by the end of 2003, with DSL subscriptions surpassing cable during 2001."

Besides the availability and increase in the use, the price has also dropped sharply in DSL connections as the figures suggest.

Apart from the detailed OECD data [s: OECD 2005], two good examples from different countries are presented in the following tables, one from Europe (Greece) and one from Asia (India). The second example data includes all available service providers in the selected country (Greece).

Table
Example of broadband connection price trends in India

Excerpt from the Report presenting the table:

"The monthly tariff for Broadband connection (>=256 Kbps download) for an average usage of 50 hrs has reduced significantly during the year as following:"

	Dec'03	**Mar'04**	**Mar'05**	**% Reduction during 2004-05**	***% Reduction during 2003-05***
Average monthly tariff for 256 Kbps download connection for 50 hrs usage (in Rs.)	1800	1000	500	-50 %	*-72%*
Average monthly tariff for 100 Kbps connection for 50 hrs usage (in Rs.)	700	500	300	-40 %	*-57%*

Source: TELECOM REGULATORY AUTHORITY OF INDIA PRESS RELEASE - No. 32 / 2005 (April 2005)

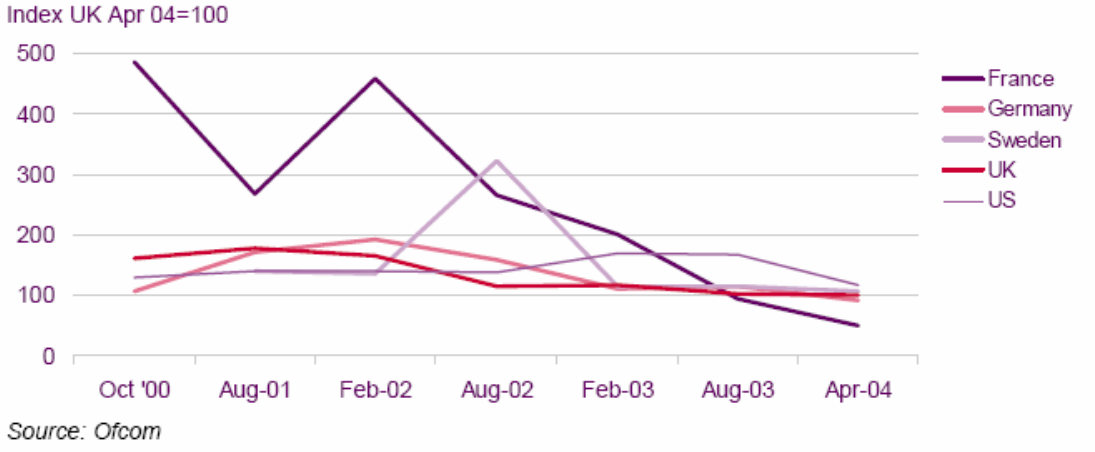
Table
Example of broadband connection price trends in Greece

Provider	Monthly Charge		Change
	26/6/2004	29/4/2006	
384 Kbps			
A.C.N.	61,23	40,22	-34%
FORTHnet	58,87	39,03	-34%
H.O.L.	66,07	43,91	-34%
OTEnet	65,18	41,41	-36%
Q-Telecom	58,99	48,67	-17%
Tellas	64,88	35,58	-45%
Vivodi	51,79	29,75	-43%
512 Kbps			
A.C.N.	104,89	59,26	-44%
FORTHnet	106,07	55,69	-47%
H.O.L.	111,5	58,19	-48%
OTEnet	111,2	59,26	-47%
Q-Telecom	106,19	77,23	-27%
Tellas	105	45,1	-57%
Vivodi	99,11	31,89	-68%
1024 Kbps			
A.C.N.	187,49	94,96	-49%
FORTHnet	188,67	81,87	-57%
H.O.L.	211,21	103,41	-51%
OTEnet	194,98	86,63	-56%
Q-Telecom	200,59	146,25	-27%
Tellas	197,04	71,28	-64%
Vivodi	260,41	36,65	-86%

Source: Greek ISPs, June 2004, April 2006

However, in major Western countries the changes are not as dramatic, mainly because of the much lower introductory pricing of the DSL services.

Figure 39: Trends in international comparison of business broadband prices, 2000-2004



Source: The Communications Market 2004 - Telecommunications (UK, end of 2004)

Overall, price drops have been significant and several European initiatives are covering part of the - already low - connection cost, making the final cost even lower. But the most important development is the actual availability of the low cost broadband connections. For example, in Greece ADSL was not yet available until 2 years ago. If a SME wanted to participate in a virtual enterprise or any other innovative partnership that requires an “always-on” type of connection, the only option would have been a leased line with a - forbidding for most cases -monthly cost of several hundreds or even thousands of Euros (depending on the distance and provider’s infrastructure).

IV. Final Calculations - The Findings and Conclusions

Based on the approaches explained above, the final calculations not yet presented are the differences in cost for the three technology factors (hardware, software, and network) between a SME participating in a virtual organization and an equivalent conventional enterprise.

a) Hardware cost

The cost is different only as regards to the need of centrally located servers, controlling the core systems of the virtual organization. This is true when comparing the independent VO units to conventional SMEs but when comparing the whole to a conventional company of the size of the VO, there may not be any significant difference. Even when present, this additional cost is estimated to be less than €200,00 annually, for each partner, when divided equally among the members of the VO.

b) Software cost

Compared to a conventional enterprise, the partners of a VO will only have to invest more in the software needed to support and coordinate the main production and the sales. Divided among them, the amount should not exceed few hundred Euros annually, by current (based on 2004 data) market standards. If we want to make the comparison at a unit level, then the cost will equal to C_s and will be calculated as described in the formula. How much could this cost be? Examining it in investment capital terms, it should not be proportionally greater than the investment a comparable conventional enterprise would do, possibly in a larger scale. If we use an indicator such as C_s/IC, where IC the invested capital, we would not expect this to be much worse in the case the VO, since the total cost is again divided among all the participating units.

c) Network cost

The networking cost is significantly different between conventional enterprises and units of virtual enterprises, because of their specific structure and needs. But while this proportionally significant difference was important until recently, this is no longer the case. Even though the proportion remains, the cost is now very low in absolute terms and is practically less than €100,00 - €400,00 Euros annually. All trends indicate it will drop even further while the quality and availability of the service will continue to improve.

This is a breakthrough improvement, since only a few years ago, the minimum cost would have been in the €10.000,00 - 20.000,00 range annually, over 20 times as much as it is today.

If we compare this past figure alone to the total annual expenditure of SMEs in new technologies (which is less than €10k for the majority) it would mean that participating in a VO would demand a doubling or tripling of the amounts spent, making it a very difficult decision and a questionable investment.

Combining the calculations of the analysis, the figures suggest that in some cases the difference between going virtual and remaining conventional could be as little as 5 or 10% in terms of additional annual cost. The accuracy of such figures is by default questionable; however the calculations give us an interesting indication of the relative cost. Why is this so important? The companies that want to participate in innovative forms of cooperation need to know estimates of the additional costs because eventually they will need to cover these by the improvements in agility, production and sales that will increase their profits. And while they could realistically expect to improve their performance by a reasonable amount, it could be difficult to prove feasible to try to cover costs that will be double or triple than they were previously.

Based on the above presented analysis and facts we suggest that emerging of new low-cost broadband connections plays a major role in allowing SMEs to take advantage of the new technology tools and remain successful and competitive. By significantly lowering the investment costs in information technology and communications, it makes easier for smaller companies to participate in innovative partnerships such as the virtual organizations.

These developments are giving new tools and options for SMEs around the world, allowing them to compete more equally in an open global market. As stated in the beginning, the use of broadband connections would not only allow underdeveloped regions with limited spatial continuity to improve their accessibility but will also make it possible for companies located in these areas to overcome isolation and reach new wider markets.

References

[Afsarmanesh etal 1997]
Afsarmanesh H., Camarinha-Matos L.M., Federated Information Management for Cooperative Virtual Organizations, Proceedings of DEXA'97, Springer-Verlag, Toulouse, Sep 97.

[Angelis 1994]
Angelis V., Spatial discontinuity and economic development of island regions. The case of N.E. Aegean. Studies in Regional and Urban Planning, Issue 4, pp 17-31, 1994

[Berwanger 1999]
Berwanger, Elizabeth, The Legal Classification of Virtual Corporation According to German Law, Organizational Virtualness and Electronic Commerce, Proceedings of the 2nd International VoNet – Workshop, Zurich, September 23-24, Simowa Verlag Bern, 1999

[Camarinha-Matos etal 1998]
Camarinha-Matos, L. M. ; Lima C. ; Osrio A. L., The Prodnet Platform For Production Planning And Management In Virtual Enterprises, 1998

[Camarinha-Matos etal 2004]
Camarinha-Matos L.M., Afsarmanesh H., Ollus M. (eds) Virtual Organizations : Systems and Practices, [hard cover]&gdf 2004

[Cassedy 2002 r207]
Cassedy, Kathleen, CASE STUDY: Club Med, ATME 2002 Conference Report, 2002

[Coulson-Thomas 1996]
Coulson-Thomas C., Into The Big-Time: How smaller companies are uniting as "virtual corporations", Quarterly Enterprise Digest 4, 1996

[Drucker 1993]
Drucker P., Management: Tasks, Responsibilities, Practices, ISBN: 0887306152, Collins, 1993

[Fowler 1999]
Fowler, Dennis, Virtual Private Networks: Making the Right Connection, ISBN 1558605754, Morgan Kaufmann, 1999

[Ghoshal etal 1995]
Ghoshal S., Bartlett C.A., Changing the Role of Top Management: Beyond Structure to Processes, Harvard Business Review 73, 1995

[Giorgetti 2002]
Mauro Giorgetti, FETISH T6 Project Manager, Technical Papers, 2002

[Kasper-Fuehrer etal 2004]
Kasper-Fuehrer E.C., Ashkanasy N.M., The Interorganizational Virtual Organization: Defining a Weberian Ideal, Int. Studies of Mgt. & Org., vol. 33, no. 4, W03, pp. 34–64, ISSN 0020–8825, 2004

[Katzy etal 2001]
Katzy, B.R., Dissel, M.C., A toolset for Building the Virtual Enterprise, Journal of Intelligent Manufacturing, Volume 12, Issue 2, pp. 121-131, 2001

[Koontz etal 1976]
Harold Koontz, Cyril O'Donnel: Management: A System and Contingency Analysis of Managerial Functions, McGraw-Hill, 1976

[Kutvonen etal 2005] Kutvonen L., Metso J., Ruokolainen T., Inter-enterprise collaboration management in dynamic business networks, International Conference on Cooperative Information Systems (CoopIS 2005), Agia Napa, Cyprus, November 2005

[Manheil etal 1999]
Manheim M.L., Watson-Manheim M.B., Managing Virtual Work: Integrating Reflection and Action through Appropriate Software Support, e Journal Of Virtualness, 1999

[Miller etal 1997]
Miller, Holmes E., Engemann, Kurt J., The Role of Information Technology in Managing Virtual Organizations, Fourth International Conference on Social Values; University of Oxford, England, 1997

[Nikolai etal 2002]
Nicolai Andrea etal, FETISH Public Report 2002/5

[Quirchmayr 2002]
Quirchmayr G., Milosevic Z., Tagg R., Cole J., and Kulkarni S.,
"Establishment of virtual enterprise contracts," in Database and Expert
Systems Applications : 13th International Conference, vol. LNCS 2453, pp. 236–, Springer-Verlag, 2002

[Roberts etal 2003]
Roberts, B., Svirskas, A., Yancheva and S., Ignatiadis, I., Service Oriented Architecture, Open Source Software and ebXML as the Foundation for the Virtual Organizations of SMEs. CollECTeR (LatAm) conference. Santiago, Chile, 2003

[Sakellarides etal 2000]
Sakellarides, O., Koufodontis I., New Technologies and Virtual Enterprises in Tourism in Insular and Mountain Regions: A Proposed Model for their Organization and Function, International Conference "Tourism on Island and Specific Destinations", Chios, Greece, 2000

[Scherer 1997]
Scherer R. J, Legal framework for a virtual enterprise in building construction, Proc. ICE'97 Int. Conf. Concurrent Enterprising, Nottingham, Oct 97.

[Sieber 1996]
Sieber, P.,Virtuality as a Strategic Approach for Small and Medium Sized IT Companies to Stay Competitive in a Global Market, Proceedings of the Seventeenth International Conference on Information Systems, Ohio 1996

[Sieber 1997]
Sieber, P., "Virtual Organizations: Static and Dynamic Viewpoints." Virtual-Organization.net Newsletter 1(2), Bern, 1997

[Suter 1999]
Suter B., The VEGA Cooperation Platform: Providing Real Support for Virtual Enterprises, e Journal Of Virtualness, 1999

[Svirskas etal 2003]
Svirskas A. and Roberts R., Towards Business Quality of Service in Virtual Organizations through Service Level Agreements and ebXML. 10th ISPE international conference on concurrent engineering: research and applications. Madeira, Portugal, 2003

[Wagner etal 2004]
EC-Report: Wagner et al., Europe, Competing: Market Prospects, Business Needs and Technological Trends for Virtual, Smart Organisations in Europe, 2004

Other References and Information Sources

Except for the specific sources mentioned within the text, data from the following sources has been used in the presented part of the analysis.

[s: OECD 1999-2006]

OECD public reports and statistics including, but not limited to (selected recent sources listed):

- ICT, E-BUSINESS AND SMEs, OECD, June 2004
- Networks, Partnerships, Clusters And Intellectual Property Rights: Opportunities And Challenges For Innovative SMEs In A Global Economy, OECD, June 2004
- Financing Innovative SMEs In A Global Economy, OECD, June 2004

- OECD Input To The United Nations Working Group On Internet Governance (WGIG), 2005
- OECD Communication Outlook, 2005

[s: OTA 2004]

OTA white papers and technical documents, including complete coding schema, 2004

[s: Eurostat 1997-2006]

EC public reports and statistics including, but not limited to (selected recent sources listed):

- e-commerce and the Internet in European Businesses, ISBN 92-894-6219-1, Office for Official Publications of the European Communities (Eurostat), 2003
- Information Society Statistics, ISBN 92-894-6429-1, Office for Official Publications of the European Communities, (Eurostat) 2003 (last avail at end of 2004)
- Business demography in Europe Results for 10 Member States and Norway 1997-2000, ISBN 92-894-5708-2, Office for Official Publications of the European Communities, (Eurostat), 2003
- Statistics on science and technology, ISBN 92-894-4446-0, Office for Official Publications of the European Communities, (Eurostat) 2003
- e-Commerce and firm performance: An assessment using multiple survey sources and linked data, ISBN 92-894-7246-4, Office for Official Publications of the European Communities (Eurostat), 2004
- Innovation in Europe: Results for the EU, Iceland and Norway, ISBN 92-894-7262-6, Office for Official Publications of the European Communities, (Eurostat), 2004
- Report on Internet Access Costs Via a Standard Telephone Line, ADSL, and Cable Modem, European Commission Directorate General for Information Society (prepared by Teligen), 2004
- Report on Telecoms Price Developments from 1998 to 2005, European Commission Directorate General for Information Society (prepared by Teligen), Dec 2005
- Community surveys on ICT usage in enterprises and households, 2006

[s: INSEAD 1998]

Various data and reports, including:

- The European Small Enterprise Information Technology Study, INSEAD, 1998

Other information, data and statistics sources include:

UNESCO, World Bank, ITU, WITSA, FCC, IEEE, IETF, FTAA et al, websites of EU and other funded research programmes (mentioned in text) , websites of software and systems developers (namely Microsoft, LOTUS, Novell, HP, SAP, ORACLE, SUN, Blue Ridge Networks, CSCI, MegaPath Networks, Virtela, ClearPath Networks, INetU, Verio, AT&T, Intel, Qwest, XO, 3com, Worldcom, Genuity, Sprint, Avaya, Cisco, Nokia, Nortel, iway, bea et al, websites of working groups and groups of experts (standards developing), and various statistics and data collecting and analyzing entities, including CNNIC, Ofcom, Nielsen//NetRatings, Computer Industry Almanac, IDATE Reports, RAND et al.