Cost-Benefit Analysis of Videoconferencing and Telepresence Systems in Virtual Project Environments: a Holistic Approach

D i p l o m a r b e i t

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1 Introduction

1.1 Motivation

"Yes, that's right: videoconferencing is the next new thing — for the third or fourth time since 1964.This time it's for real, though."

Johna Till Johnson, 2009

Enterprises of the 21st century are severely exposed to ever changing economical, ecological and societal conditions, while the global economy crisis causes additional competitive pressure. As a consequence, enterprises seek for opportunities to cut costs but also to increase productivity and flexibility more than ever. Ecological issues are of growing importance and may raise further challenges, as the Copenhagen Climate Conference showed. Increasing competition for high-skilled employees and geographic dispersion of resources force enterprises to change or even replace traditional structures and hierarchies.

A strategy to cope with these challenges is the implementation of virtual project teams (VPT).[1] Organizational structures are moving towards project-oriented environments and enable enterprises to rapidly respond to changing situations. In the course of this, the concept of virtuality allows for combining resources and pooling competencies independently of spatial and organizational barriers. Knowledge and information as two key factors of production are in the focus of virtual project work. The availability of information is a major point on the success of projects, which are subject to budget, time and quality constraints.[2]

Virtual project environments require sophisticated collaboration technology to support interpersonal communication, cooperation and coordination. One class of e-collaboration tools that have raised interest of executives over the last two years are videoconferencing and telepresence systems (VTS).[3] Due to technological advancement, these systems are predicted to become one of the essential issues for business decision makers after several drawbacks in the history of videoconferencing. GARTNER'S '2009 Hype Cycle' identifies video telepresence on the transition of 'inflated expectations' to the 'trough of disillusionment'. A broad mainstream adoption of this technology is expected within the next two to five years, as videoconferencing quality is improving at decreasing costs.[4] Further video-related collaboration concepts such as web conferencing and desktop-videoconferencing are also taking hold. Business travel reduction and improved decision-

1 Cf. Dubé/Paré (2004), p. 2 and Keiser (2002), p. 19.
2 Cf. Pergamon Flexible Learning (2005), p. 1.
3 Cf. Davis (2008) and Johnson (2009).
4 Cf. Chilton/McHaney (2008), p. 696 and Gartner (2009).

making are identified as two major drivers for VTS adoption[5]: "*time and costs play a major role in the existence of globally acting companies*".[6]

An examination of VTS in the context of virtual project environments is suggestive as the main field of application for videoconferencing is associated with cooperative working of dislocated persons.[7] A lack of personal (face-to-face) contacts induces new challenges for management of project teams. Team attributes such as trust, identity and mutual understanding base on interpersonal relationships requiring frequent and rich communication.[8] Ensuring the availability of (tacit) knowledge and information is a major point on rich collaboration technology in virtual projects. VTS seem to be appropriate to mitigate problems arising from geographical dispersion and to comply with needs of VPTs.

The question arises, how the value-added of VTS implementation can be determined and how different systems can be appraised. A holistic approach to cost-benefit analysis in this specific setting fills a gap of research. Existing papers focus on other aspects of VTS or findings need to be reexamined due to technological advancement.[9] A detailed analysis of factors influencing the materialization of benefits and the height of costs for recent VTS has not been developed yet. Increasing interest in videoconferencing technology demands for a framework supporting economically reasonable decision-making on related investments, though. The development of a holistic approach to the cost-benefit analysis of VTS for virtual project environments is the subject of this paper.

1.2 Goal, Research Questions and Limitations

Implementation and utilization of videoconferencing technology in enterprises is bound to high initial investments and recurring costs. A comprehensive ex ante reflection of costs and benefits of VTS investments is often neglected, since it requires considerable effort. As the demand for videoconferencing technology and the prevalence of project-oriented structures increases, the need for a holistic analysis model facilitating the appraisal and selection of system alternatives also gains importance.

The goal of this work is to identify costs and benefits linked to the implementation and utilization of VTS in virtual project environments and to aggregate these costs and benefits to a holistic analysis model. In this process, determinants and influencing factors of costs and benefits are examined, while constraints arising from project work are considered. The final result of this work is the development of a web application supporting economically reasonable selection of VTS alternatives.

5 Cf. Davis (2008).
6 Chilton/McHaney (2008), p. 696.
7 Cf. Meyer et al. (2008), p. 158.
8 Cf. Chilton/McHaney (2008), p. 697.
9 For example Agius/Angelides (1997), Gerfen (1986), Lautz (1995) and Meissner (2002).

These objectives are derived from the research questions that can be formulated as follows:

(1) What are the costs and benefits related to VTS implementation and utilization in virtual project environments and which factors have an impact on these?

(2) How can a phase model for a holistic cost-benefit analysis be developed and implemented as a web application?

The focus of this work is not on the development of new metrics to convert potential qualitative benefits to monetary factors. A solution of the 'business value of IT' problem is not the claim of this work, as many authors have done research on this topic before and the problem remains unsolved. Many benefits derived from IT systems (e.g. VTS) have a broad indirect impact on business goals and are hard to quantify.[10] In contrast, determination of costs is easier compared to benefits. This work suggests a framework to evaluate system alternatives on a qualitative level and offers an approach to relate qualitative VTS evaluation to monetary figures, i.e. cost reduction, productivity increases and market-side effects.

1.3 Structure of work

The goal, research questions and limitations of this work have been clarified in the previous sections of *chapter 1*. An integration of the research topic in an economical, ecological and societal context has also been conducted. In order to provide a theoretical background on related concepts, *chapter 2* comprises definitions and basic aspects on 'Projects and Project Management', 'Virtual Project Teams', 'E-Collaboration Tools' and finally on 'Techniques for Analyzing Costs and Benefits'. *Chapter 2* builds the theoretical frame for the development of a cost-benefit analysis, which is subject to *chapter 3*. The first section determines the structure of the analysis including all framing components and phases. Moreover, analysis techniques are discussed and selected. To substantiate literature research and to identify further aspects of costs and benefits, an empirical study was conducted as a part of this work. Quantitative results are presented in this section, while a qualitative discussion is conducted in each analysis phase. The following sections of *chapter 3* are subdivided into four phases: 'Cost Analysis', ' Benefit Analysis', ' Risk Analysis' and 'Conjunction of Partial Analysis and Interpretation'. Phases 1, 2 and 3 represent the main part of this work as cost, benefit and risk factors are derived in these sections. Equally, the conjunction of analysis components is a central issue of this chapter, as it aggregates all aspects of the cost-benefit analysis model and builds the theoretical foundation for an implementation as a web application. C*hapter 4* comprises a brief presentation of the technical environment and application architecture. The following section draws an application example to demonstrate the functional principle of the web ap-

[10] Cf. Brugger (2005), p. 84 and Simmons (1998), p. 116.

plication. Finally, *chapter 5* summarizes central findings from a critical perspective. This work closes with a prospect on further research issues and potential future requirements of VTS analysis (Figure 1).

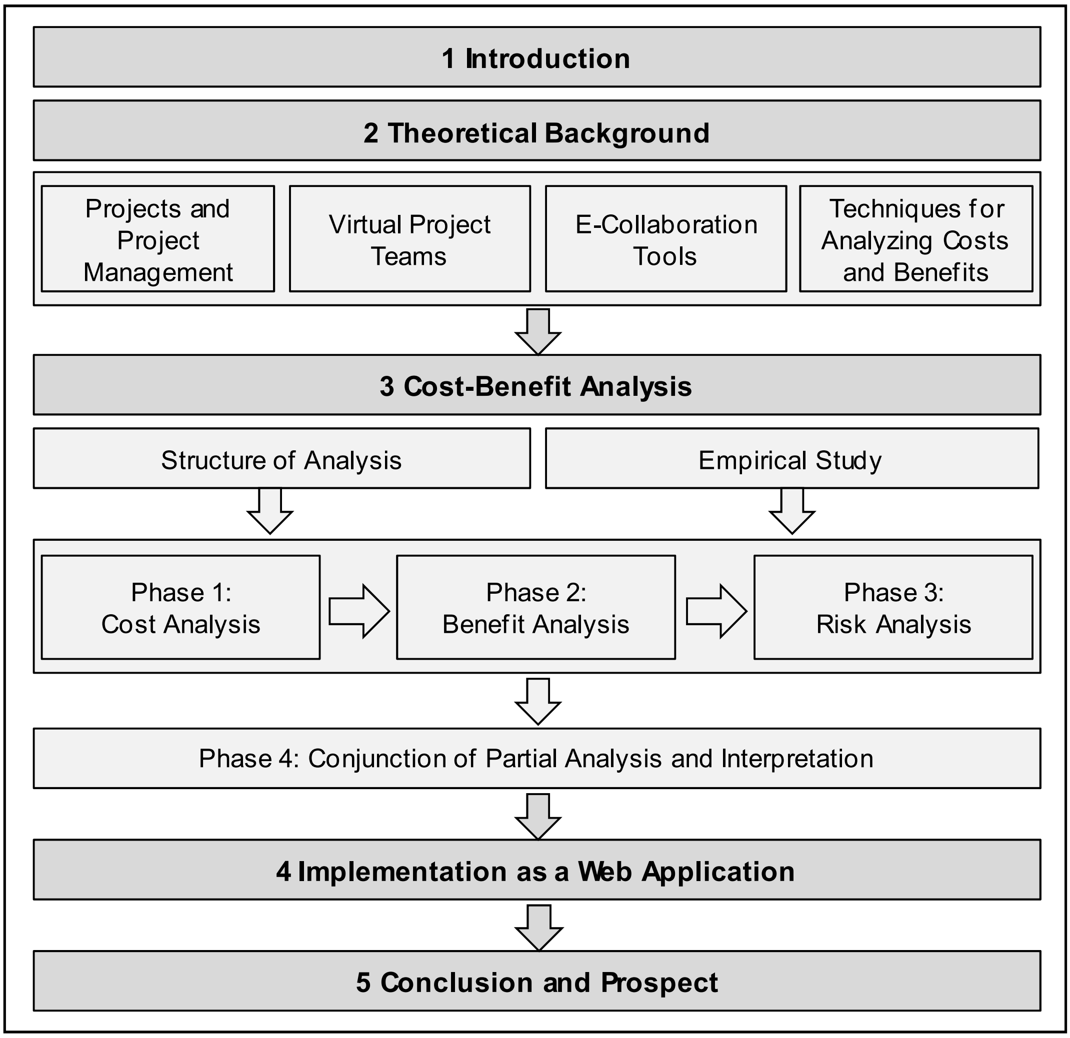

Figure 1: Structure of this paper

5 Conclusion and Prospect

5.1 Summary and conclusion

The goal of this work was to develop a holistic analysis model accounting for costs and benefits linked to the implementation and utilization of VTS in virtual project environments. Furthermore, the final result of this work was an implementation of the analysis model as a web application. The motivation for the research subject resulted from an increasing demand for videoconferencing technology and its potential contribution to virtual project environments. This work can be considered in line with former research papers on videoconferencing technology but moves the focus to VPTs and regards recent technology advancement.

Cost and benefit factors were derived from literature-based research and an empirical study conducted in the scope of this paper. Qualitative analysis of practical knowledge allowed for substantiation and selection of respective factors. Empirical data was mostly in accord with the theoretical perspective but also revealed new aspects and the complexity of dependencies between analysis factors. The results of literature research and empirical analysis indicated that VTS-related costs and benefits might be of a similar type but have varying relevance in different enterprises and for different virtual projects. This central finding is implemented into the model as identified benefits can be weighted and adjusted to a specific organizational environment. At the same time, materialization of each benefit is affected by the weighting and valuation of VTS characteristics, i.e. qualitative system evaluation. While investment and recurring costs are easily quantifiable in most cases, benefits must be considered in two separate categories: tangible and intangible. Potential benefits that are measurable directly or indirectly contribute to the monetary valuation of a VTS. Intangible benefits serve as an additional criterion for system comparison. These aspects are incorporated as an aggregation of tangible benefits to cost and productivity changes and an aggregation of intangible benefits to a qualitative cluster.

The model developed in the progress of this paper intends a merging consideration of costs and benefits. It is assembled of four phases regarding costs, benefits, risks and a conjunction of these phases. Parameters, base data and a system of objectives build the basis for the final VTS ranking. The analysis result is split into cash flow calculation, qualitative comparison and risk adjustment allowing for a reasonable selection of system alternatives. Cash outflows (costs) are added directly to the cash flow calculation as these values have a monetary origin. Cash inflows arising from VTS utilization must be converted from percentual estimations on cost and productivity changes. Anon, percentual estimations are derived from the qualitative evaluation of system alternatives. Due to uncertainty of future cash flows, a risk adjustment is implemented into three risk scenarios.

The development of the CoBeAn web application allows for practical usage of the analysis model. CoBeAn standardizes analysis, enables replication of decisions and ensures consistency of results while enabling decision-makers to compare VTS alternatives with less effort.

The problem of estimating the actual impact of benefits on cost savings and productivity increases remains. Even though the model suggests a qualitative evaluation of VTS system alternatives, decision-makers need to assess percentual changes subjectively. In consequence, the model offers assistance on system selection but delivers no definite answer on the NPV of a VTS investment. The quality of an analysis result is bound to the data provided and a reasonable weighting of benefits and evaluation criteria matching the organizational and project environment.

Another critical point on the analysis model is the technological advancement in general. The presented model is meant to evaluate single systems used for a specific purpose. Videoconferencing technology expands to unified communication and collaboration, though. Instead of single systems, the overall videoconferencing infrastructure may be in the focus of analysis, i.e. room-based systems, desktop-based systems and mobile devices. This fact is not explicitly regarded in the analysis and may only be supported to some extent.

5.2 Prospect

Recent publications in specialist magazines and announcements of major vendors indicate an increasing interest in videoconferencing technology in general – although GARTNER'S '2009 Life Cycle' predicts video telepresence to reach the productivity phase not until two to five years. Enterprises start to reconsider VTS after many drawbacks in the past, while expectations towards recent systems are high: Not only cutting travel costs but also increasing business performance are major goals for VTS introduction. The implementation of videoconferencing technology to virtual project environments can be one part of a strategy to adapt to increasing competitive pressure. Ecological aspects may gain importance in the future. In case of compulsory carbon offset payments per ton of CO_2 emission, an additional burden emerges. With regard to business travel, videoconferencing can help to improve the carbon footprint. Also challenges raised by the labor market and the society in general may be faced by changing hierarchical to project-oriented structures. VTS offer employees the opportunity to take part in working processes regardless of their physical location. Future technological aspects such as augmented reality might open videoconferencing to new fields of application. Virtual projects may be expanded to complex engineering or design tasks that require the manipulation of virtual objects.

It remains to be seen if recent VTS assert themselves on the market or if the present 'hype' is only the fifth short-term wave of interest. However, it seems that the technological environment of VTS – most notably network bandwidth, compression techniques and HD displays – have finally reached a sufficient level to push videoconferencing technology to mainstream adoption.

This work makes a contribution to an impartial consideration of actual costs and benefits related to recent VTS. As the advancement of these systems is rapid, the analysis model must be updated regularly to ensure qualified results in the future. With respect to project goals, the focus of the model is on the dimensions 'time' and 'costs'. A modification may take project quality aspects into account. Conceivable are further market-side effects apart from time-to-market advantages. An extension of the model to analyze the impact of VTS utilization on the whole organization, is also considered as a potential modification. Virtual project environments represent only an excerpt of an enterprise's structure and do not cover all processes and resources.

The crucial point of the analysis model – the conversion of qualitative system evaluation to monetary figures – requires further research in terms of empirical data. It should be the goal of further research to collect data on productivity increases and cost savings. This data could prove the model for validity. Moreover, the CoBeAn tool could be enhanced by a function suggesting percentual changes of productivity and cost savings corresponding to qualitative evaluations of system alternatives. Likewise, the interdependency of potential benefits may be subject to further research on videoconferencing technology in enterprises.