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Analysis of E-Learning Implementation Cost Pools

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Abstract

Public German universities face risen expectations of students. Changes in the environment force them to increase service degrees while additional resources are not disposable. The usage of e-learning technologies is one possible lever to enhance service degrees while leaving the total budget nearly unchanged on the long run. To enable the organizational implementation of the new media, nevertheless, substantial investments are necessary up-front. In this work cost pools relevant for implementing e-learning technologies in an organization are identified based on a set of e-learning initiatives at the Johann Wolfgang Goethe-University in Frankfurt am Main. Using theoretical findings of language critique a considerable fraction of the total cost can be explained as set-up costs lowering variable costs in later project phases significantly.

Keywords

e-learning, organizational implementation, cost pool, sustainability, language critique, language community

Introduction

The strategic situation of German public universities is defeated nowadays by a radical change for which they must prepare themselves. For the department of economics and business administration at Johann Wolfgang Goethe-University these changes manifest as follows: since winter term in 2005/06 the university places are no longer assigned by the central office for assignment (Zentralstelle für die Vergabe von Studienplätzen, ZVS), and the students now have to apply at a university directly. Universities are now in a far more competitive situation requiring active marketing to address as many applicants as possible. Furthermore, nationwide university rankings as well as accreditation initiatives provide for an additional pressure to work actively on the outside representation of the universities. The introduction of modular bachelor and master studies displacing the traditional German diploma structure facilitates the change between universities for students and leads to further competition. Finally, the introduction of tuition fees will further enhance the students' expectations of adequate high qualitative education for their fees. This means for the universities that they must offer a higher service level, while still facing the problem of stagnating budgets. According to Chopra, a rise of service level is only possible in two ways (Chopra & Meindl 2001, pp. 30). Beside a rise of the resources spent an improved technology can lead to higher output, in this case higher service level. At German universities both trends actually apply. There are increasing endowment professorships (Kulicke 2005) as well as public private partnerships - both trends lead to additional resources for universities. A more intensive support for the students regarding the available communication channels to the lecturers is the result. By the reinforced application of modern information and communication technologies (e-learning) the universities at the same moment hope for a better support of students leaving total costs relatively constant.

In this paper it will be shown that e-learning can lead to a higher service degree while leaving the total budget nearly unchanged. We understand e-learning as all teaching and learning relying - at least in parts - on modern computer and network technologies.

However, experience from the past shows that the introduction of e-learning in the higher education requires initial investments. Disregarding the collection of additional resources, we examine the cost of introducing e-learning in a German university setting. We show that a considerable fraction of these costs are set-up costs to change the organization's - and people's - behavior. This means beside the costs for the necessary technical infrastructure organizational change costs must be taken into consideration when planning the introduction of e-learning. We focus our analysis on the situation in Germany due to the special German university scenery, which differs significantly from the situation in North America.

In this paper we analyze these costs in different projects. Our research question is how these costs can be explained theoretically and which factors determine the overall costs. This work is structured as follows: after an overview over related work and the analyzed case, the following section devotes itself in detail to the examined case in which the described development of the German university scenery becomes visible. Next an analysis identifies the relevant cost pools and proposes a classification. Then, based on language critique one significant

cost pool is analyzed. Finally a summary of the relevant findings as well as an outlook of future works concludes this paper.

Literature Review

A sustainable implementation of e-learning offerings within the higher education depends on several factors. Recently, these factors were intensively discussed in the literature (Euler et al. 2006; Owston 2006; Werner 2006). E-learning systems are one form of information systems (IS). The success factors for a sustainable e-learning implementation are similar to these for an IS implementation (Knolmayer 2004). One key factor determined in current IS literature is the top management support which enables an implementation in general (Jarvenpaa & Ives 1991; Kwon & Zmud 1987; Leonard-Barton & Deschamps 1988; Purvis, Sambamurthy & Zmud 2001; Sharma & Yetton 2003). For the implementation of e-learning offerings in the higher education this means that the university management must promote the offerings and must support the implementation actively (Owston 2006). A university wide development plan as well as mandatory objectives serve to speed up the application of new media in the education (Werner 2006).

Especially during the initial implementation, new media require a substantial financial and personnel expenditure. Beside the investments in the necessary infrastructure, above all, the expenditure for the production of multimedia offerings shows a substantial cost pool (Encarnacao, Guddat & Schnainer 2002). In addition, the support of the offered courses also during their operating time continuously causes additional personnel expenditure. Therefore financial means and personnel resources can be identified as another success factor.

A reliable technical infrastructure counts as an enabler of e-learning (Seufert, Sabine 2004). Furthermore, the used technologies require a stronger motivation of the students than necessary with conventional media (Deimann 2002). Successful learning requires a high motivation (Blumstengel 1998). The current literature offers several models which should help to activate motivation to support learning efficiency (e.g. ARCS-Model (Keller 1983), Time-Continuum-Approach (Wlodkowski 1978), Supermotivation-Approach (Spitzer, Dean. R. 1995; Spitzer, Dean R. 1996)). Each approach requires different actions to guarantee a high motivation and therewith successful learning.

Another important factor which determines the sustainable application of new media in the higher education is the motivation of the teachers (Hagner 2000; Owston 2006; Seufert, S., Back & Häusler 2001; Werner 2006). Based on Rogers (1995), Hagner and also Euler distinguish four types of teachers who differ concerning their willingness to innovate: entrepreneurs, risk averse, careerists and reluctant (Euler et al. 2006; Hagner 2001, 2003). Thus the lecturers must be motivated differently for the application of the new media. While the entrepreneurs are motivated primarily intrinsically and use the offerings on their own initiative, the representatives of the other types need external motivation. They also must be supported in technical and organizational aspects due to their lack of abilities. Although individual support means additional workload for the employees, it applies as the most effective way to animate lecturers to implement e-learning applications (Hasanbegovic & Kerres 2006).

A central e-learning-coordination center likewise counts as an important success factor (Seufert, S., Back & Häusler 2001; Werner 2006). The bigger the university respectively the faculty the more importance accords such a center (Kolbe & Nikolopoulos 2007; Werner 2006).

The tasks assumed by the coordination center can be of different nature: they reach from the mediation of already existing offerings up to complete consulting services for the whole period of the e-learning application. The support of the teachers is as well as called task of the coordination center (Schönwald, Euler & Seufert 2004).

The Faculty of Economics and Business Administration at the Johann Wolfgang Goethe University

The analyzed university founded in 1914 is one of the biggest universities in Germany (approx. 35,000 students). About 500 professors in 16 faculties teach at four city wide spread locations. Beside the size of the university, the high proportion of international students (approx. 10%) is another specific feature. Numerous problems arise from the big number of the students, as well as the spatial distribution of the locations. Students complained about low support by the lecturers, congested auditoriums, inadequate infrastructural equipment of the university, as well as the partial long and time consuming traveling.

The faculty of economics and business administration is one of the biggest faculties of the university and consists of more than 42 professorships for business administration and economics. The professorships are organized in 12 departments and teach all together approx. 4,200 students. Every term approx. 350 new students enter the faculty for bachelor study courses (Bachelor of Science in economics and business administration). The bachelor study course was initiated in 2005. The new courses are organized in self-contained modules. Because

of the involved modularization of the studies all examinations will be accepted at other universities. The modularization therefore facilitates the change of different universities during the studies.

One unique qualification of the faculty was the AACSB (Association to Advance Collegiate Schools of Business) accreditation in 2005. The AACSB is a non profit corporation of educational institutions and other organizations devoted to the promotion and improvement of higher education in business administration and management. Founded in 1916, the AACSB is a leading accrediting agency for bachelors, masters and doctoral degree programs in business administration and accounting. One goal of the voluntary accreditation process is to signal an outstanding engagement for excellence in teaching and a continuous improvement of the educational process. Only three universities in Germany are accredited at present. The accreditation commits the faculty to evaluate the education on a regular basis and to optimize the whole process of education.

The long term strategy of the university as well as the faculty's strategy envisages more e-learning-applications for the support of the students. Diverse projects aim to reach that goal. They are based on the assumption that e-learning applications allow a more intensive support of the students with relatively the same cost. Especially blended learning scenarios are considered to be the most effective form of teaching. For example exercise sessions in small groups are held in the pc-pool. About 30 students and one tutor together solve given exercises.

In this study we analyzed five e-learning projects. The projects are part of the long term strategy to apply more e-learning in higher education. The projects showed that a considerable funding is needed to start these initiatives. In this paper we focus on these costs. We address the following questions: Which cost pools for the implementation of e-learning can be identified and how can these cost pools be theoretically explained? To answer these questions we used the following research approach.

Research Approach "Multiple Insider Action Case"

Our research approach is based on classic action research. Action research is a well accepted approach in current IS research. Through solving current problems in real organizations action research aims to generate new insights and theories. The action research process follows a cyclical process. After identifying the relevant problem the researcher plans new actions and implements them in the real organization. The actions are usually based on his theoretical background and his interpretive understanding of the problem. By evaluating the consequences of the actions general new findings can be reached and a new cycle starts. The process continues until the effort for an additional cycle exceeds the anticipated value (Baskerville & Wood-Harper 1996; Susman & Evered 1978).

We use an approach which differs from classic action research. First, we analyzed more than one project so that it contains also parts of a multiple case study (Yin 2003). Eisenhard considers multiple case studies as an advanced research approach to test and to develop new theories based on real organizations (Eisenhardt 1989). Multiple case studies offer the possibility to test the newly developed theories on several cases. Another special feature of our approach is the strong involvement of the researcher. As faculty members at the analyzed university we are part of the observed organization. Potential bias results from this situation. Nevertheless, this is an established form of action research called insider action research (Meehan & Coghlan 2004).

The insider action research can be problematic: a critical distance to the observed organization can not always be kept (Lalle 2003). The researcher must keep that in mind during the research process. On the other side the strong involvement of the researcher helps to understand the problems and the whole environment of the organization. Especially the more straightforward interpretive understanding (Lee 1991) helps to accelerate the whole research process (Coughlan & Coghlan 2002). The approach used in this paper can therefore be called „multiple insider action case". The findings can be considered as highly case sensitive so that it is only possible to generalize the findings to a limited extend. But in our opinion valuable results can be generated by using this approach.

We chose a set of projects to analyse the accrued costs due to several reasons. On the one hand, they were conducted successively over a three years period. The findings of the first projects could therefore be validated in later projects. In this manner, every single project can be understood as one action cycle. On the other hand, the project goals and amounts differed significantly. Following (Eisenhardt 1989) this enabled us to identify factors, which determine the accruing costs. For example, the number of involved actors differed between 2 and 17. We are therefore able to show, which impact the number of involved actors had on the costs for training and support. The shown work amount is only a fraction of the total afforded efforts. Especially in project 1, 2 and 5 we accomplished additional services, which are not analyzed in this study. Therefore we depict only man days as a measure for the accrued costs.

Analyzed e-Learning Projects

To analyze the costs for the implementation of e-learning in higher education we describe five e-learning projects which were conducted at the faculty in the past three years. These projects allow us to identify the main cost pools which have to be considered for a sustainable implementation. While the German Federal Ministry of Education and Research (BMBF) funded the *project 5* and the Hessian Government *project 1* the other three projects were funded by university-intern grants.

Project 1 – Enhancing the Support Level

First steps to ease the situation at the mass faculty were taken during *project 1*. The project started in the winter term 2004/05 for the duration of 12 months. The main goal of the project was to raise the support level for the students by using new technologies like the learning platform WebCT in mass lectures. Additional communication channels enabled this aim. Only two lecturers participated in this relative small project, the total work effort for this project amounted to approx. 35 man days.

The students' feedback was very positive. We evaluated two lectures: one basic course in business informatics and one advanced in database systems. The students of both courses appreciated our initiatives (63% in the basic course and 87% in the advanced one).

The main cost pool accrued during the implementation of the offerings was conventional set-up costs, especially the course design. The used platform WebCT offered all required functions and communication channels. The local computer center offered the platform to all faculties at no charge. The two lecturers already had profound knowledge about e-learning tools so that expenditures for training or support of other lecturers were negligible.

Project 2 – Implementation of SAP in Higher Education

Project 2 aimed amongst others the implementation of SAP R/3 at the faculty. Lecturers should use the ERP (Enterprise Resource Planning) system to show and practice real-world business processes. The project enabled access to the SAP R/3 system from the university's pc-pool and student's private PCs as well. The lack of this possibility was a major handicap for the faculty in the past. The project started in the winter term 2005/06 for the duration of 12 month. Initially five lecturers were involved in the project.

We used the system during the project in a basic course on business informatics and in another advanced course on supply chain management. The students evaluated the initiative differently: while the feedback in the basic course was more or less neutral, the students of the advanced course appreciated the initiative and used the system more intensively. This result indicated that the ERP system is far too complex to be used in basic courses.

The costs for the installation of the system accrued mainly contract negotiation within the faculty and with the service provider who hosted the system for the university. These costs were relatively low, the main cost pool accrued during the training of the lecturers. The basic training, which is offered for free for participating universities, took about 25 man days overall.

Project 3 – SQL and Python Playground

A project called "playground" was initiated to provide the possibility of individual web-based trainings for students. The project was initiated in the winter term 2005/06 for one term in a basic course on business informatics. Later it was continued until now and is used by six lecturers for their courses.

The students can use the system to practice SQL statements on a MS-SQL database via a web front end. Another web front end for the programming language Python was also developed, so that the students did not need to set up their own programming environment. The system lead to a great benefit for the students, because they can now practice SQL statements and Python exercises from their home work station without installing additional tools. The students appreciated the system and evaluated it in a positive manner in a basic course as well as in an advanced course.

The implementation of the system took about 20 man days. This was the main cost pool accruing during this project. Another cost pool amounted for about 10 man days resulting from the support of additional lecturers who used the system in their own courses.

Project 4 – Registration Script

In the winter term 2006/07 we implemented a system to ease the registration process for small sized tutorials supporting several mass lectures. At first, the project was laid out for the duration of one term, but it was continued in the current semester due to the success and the positive feedback of the students. In the 2007 summer term 10 lecturers used the system to allocate the students to exercise sessions. The aim of the project was to ease this process.

In the past we used paper based lists for the sign-on process, which lead to difficulties in the process. Now the students can sign on that exercise session they want to apply via a web front end. The first feedback of the students was positive. Before the installation of our system the students criticized the sign-on process but now they appreciate the system.

The allover costs for the system were relative low. The implementation took about five man days, future support of additional lecturers also amounted to five man days.

Project 5 – Diffusion of e-Learning at the Faculty

The *project 5* started in the winter term 2006/07 for a duration of 15 months. The purpose of the project was primarily to build up a central coordination centre for the faculty of economics and business administration which coordinates all e-learning activities. This should help to persuade more lecturers to use new media in the higher education. Especially the e-learning platform WebCT should be spread around the faculty

Until now 17 lecturers were consulted and supported during the project. We executed three workshops and several individual consulting sessions. Especially these individual sessions were very effective in accordance with Hagner (2003). Additionally, we developed quick start manuals, which were shared to all interested lecturers. Evaluations showed that the students do not honor these new media as an innovation any more, rather they are felt now as matter of course and must be offered.

The support and the workshops took about 40 man days, the initial installation of the coordination center took only five man days.

The following Ttable 1 summarizes the key facts of the described projects.

Table 1: Summarization of key facts

	Project 1	Project 2	Project 3	Project 4	***Project 5***
Project Start	2004/05	2005/06	2005/06	2006/07	2006/07
Project Duration	12 months	12 months	6 months	6 months	15 months
Goals	Rising of support level	Application of SAP R/3	Individual Exercises	Easing the registration process	Spreading of new media at the faculty
Involved Actors	2	5	7	5	17
Estimated Work Amount	35 man days	30 man days	30 man days	10 man days	45 man days

Analysis of Identified Costs

According to project purpose and project duration, different costs resulted in the projects mentioned above. All projects had in common that at first a substantial initial financing had to occur to speed up the projects. The whole expenditures can be categorized in two big cost pools: technical infrastructure, software and development (1) as well as consultation services and trainings for other incorporated lecturers (2).

The following Table 2 assigns the identified costs of the single projects to the two cost pools and gives an overview on their proportion.

Table 2: Allocation of costs

Cost pool	Project 1	Project 2	Project 3	Project 4	***Project 5***
(1) software and development	Development of WebCT courses Installation of additional tools	Contract negotiation	Software development Initial Installation	Software development Initial Installation	Installation coordination center
	30 man days	5 man days	20 man days	5 man days	5 man days
(2) consultation services and trainings	Coordination meetings with other e-learning actors	Instruction of lecturers	Consulting of additional lecturers	Consulting of additional lecturers	Consulting and instruction of lecturers Execution of workshops
	5 man days	25 man days	10 man days	5 man days	40 man days

Theoretical Analysis of Identified Cost Pools

Obviously, the ratio of the cost pools depends on two factors: the number of the involved actors and the complexity of the problem domain. The more actors are involved, the higher the proportion of the costs for support and training is. As the other factor, the complexity of the implemented software, determines the comprehensiveness of the trainings and support sessions. This factor explains the high proportion of costs for training and support in the *project 2* although only five actors were involved.

Both factors can be explained using a language critical approach (Kamlah & Lorenzen 1984). This approach can serve as a theoretical fundament for the benefit of a common terminology. A terminology is a basic component of a so called language community (Kamlah & Lorenzen 1984). The use of such a terminology leads to a more effective communication. While colloquial communication often lacks of clarity, the use of a common terminology provides for a more effective information exchange. In particular with rising complexity of the problem domain this effect becomes apparent. Complexity in our case can be measured as the number of involved actors and the size of the terminology for considered the problem domain. The following figure 1 depicts this issue in sketch form:

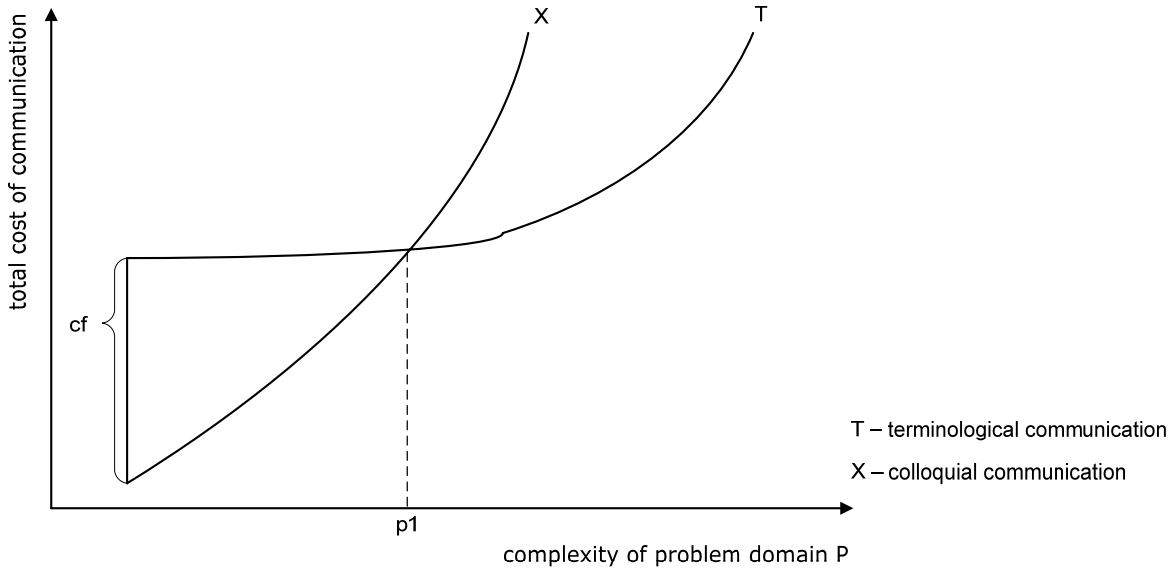

Figure 1: Linguistic vs. terminological communication

It appears that the communication costs based on colloquial or standard languages (X) increase quite fast with increased problem domain, while communication costs remain relatively constant on a higher level when common terminology (T) is used. The rationale for these cost functions is that by use of a common terminology the contained concepts and assumptions can be used without additional explanation. Nevertheless, the development of a terminology can be very costly: The set-up costs for the initial development of a terminology are marked with *cf.* So, the theoretical break-even point (*p1*) when comparing colloquial and terminological

communication will be reached not until a certain complexity of the problem domain is given. To put it simple, the development of a terminology does not pay in clear problem domains.

The more potent the agreed upon terminology is, the higher the number of contained concepts and the more costly the development process. Development costs of terminologies rise quadratically with the number of terms introduced. As a result every new term *t* must be checked whether it is consistent to the already contained terms. At the same time a more potent terminology stronger reduces the variable communication costs. Hence, the potency of the terminology to be used depends on the complexity of the problem domain. This potency of the terminology becomes marked in following with |T| = n where n is the number of terms contained.

In the analyzed cases at the faculty of economics and business administration at the Johann Wolfgang Goethe-University the costs for training and consultation services can be identified as costs for the development of a terminology. In *project 1* merely employees of the professorship were involved and therefore the main part of the communication occurred only between two actors. In contrast, the focus of the *project 5* lies explicitly on the consultation and on the inclusion of a big number of new lecturers. Hence, the communication costs would have been exorbitant high without a central coordination center. A common knowledge basis could be formed by intensive individual support and trainings. The need for support services during the project could be reduced therefore to a minimum. Because the lecturers at the faculty of economics and business administration have already a certain basic understanding for modern information technologies and communication technologies, it was not necessary to offer very extensive trainings. In this case easy introductions were adequate. On the other hand, in the *project 3* only a few actors were involved and trained. Anyway, the costs for training and support were also exorbitant high. The more complex software SAP R/3 determines these higher costs. To use the software intensive trainings must be conducted. Even the initial trainings took 4 to 5 days per lecturer. In contrary to the learning platform WebCT, which could be used after short instructions, much more knowledge must be transferred. The number of terms n_2 in the terminology T_2 in *project 2* was much higher than in *project 1* ($n_2>n_1$, resp. $|T_2|>|T_1|$).

To estimate the total costs for developing a terminology both factors have to be considered. The following figure 2 outlines this correlation. The x-axis marks the number of involved actors, while the y-axis shows the potency of the terminology |T|. The resulting costs are marked by the z-axis. The five analyzed projects fit into this function. They are market with P1 to P5.

In *project 1* only a few lecturers (2) used a relative simple system. The terminology was therefore not very comprehensive. Costs for training and support stayed on a lower level. In *project 2* also only a few lecturers were involved (5) but the used system was much more complex. With a more comprehensive terminology the costs rose. The used system and also the terminology in project 5 were as simple as in *project 1* but the number of lecturers was much higher. The result was also an increase of the cost pool.

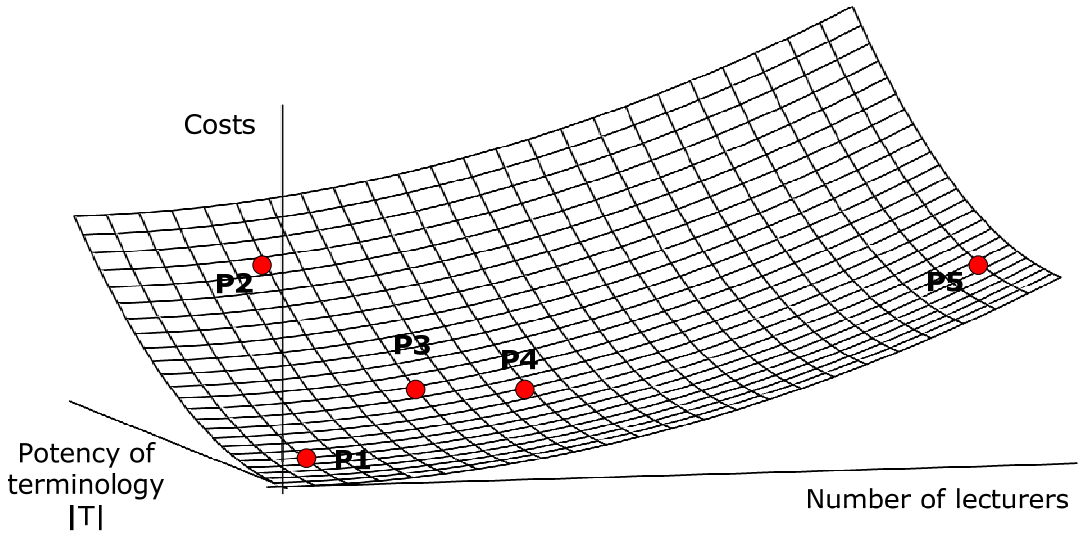

Figure 2: Costs for developing a terminology against the two identified factors

Until now the depicted function is only an approximation of the correlation. Detailed forecasts are not possible yet due to several reasons. While the number of actors can be counted, only a qualitative determination of the potency of the terminology is possible so far. The number of contained terms can only be estimated. The functional correlation between the two factors and the resulting costs can also be only approximated.

Nevertheless, the analyzed cases suggest that this functional correlation exists and can be understood as one explanation for the costs for training and support.

Conclusion and Further Research

The analysis of the different projects at the faculty of economics and business administration at the Johann Wolfgang Goethe-University has shown that the costs for training and consultation create a substantial cost pool. These costs must be taken into consideration while planning new offerings explicitly, otherwise no sustainability will appear. The projects showed that the proportion of this cost pool depends on two factors: the number of involved actors and the complexity of the implemented software.

In the examined cases of the implementation of e-learning offerings in the higher education, the total costs for training and education were determined by the number of the involved actors. The more actors are involved in the project, the bigger the proportion of the cost pool becomes for the initial trainings and consultations, i.e. the development of the terminology.

At the same time it could be shown that a more potent terminology can lead to lower costs during the project duration, because later consulting and support services are less needed and, in addition, can be more effective. The development of a terminology itself causes costs so that the terminology becomes profitable from a certain point.

Both these factors determine the overall costs for training and support. Our approach can explain the accrued costs in all five analyzed projects.

In future works, the results should be checked in other cases to be able to deliver more general statements. Especially members of other faculties have to be interviewed to analyze their projects. Additional, cases from other problem domains like the implementation of innovations in general will be analyzed.

As a main challenge for future research we strive for a measurement of the still only qualitative measurable factors and also to identify a better function which describes the correlation between the single factors and the resulting costs.

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