CORVINUS UNIVERSITY of BUDAPEST

Doctoral School of Economics, Business and Informatics

THESIS SUMMARY

for the Ph.D. dissertation of

Zsolt Orbán

on

The success factors of e-learning projects

Actor-network theory analysis of e-learning solutions

Supervisor:

András Nemeslaki, CSc
professor

Budapest, 2021

Department of Infocommunication

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1 RESEARCH BACKGROUND AND JUSTIFICATION OF THE TOPIC

In recent years, I have been able to participate in about 80 e-learning projects. These, of course, include really short projects, such as updating or validating an existing curriculum, or teaching how to use an existing e-learning system. These also include ordinary improvements over a few months, such as the introduction of simple new e-learning systems or the migration of a new training to digital education format. There were also extremely complex projects in terms of length, number of participants, and complexity of tasks, which sometimes resulted in tens of thousands of users learning from the resulting training systems.

These projects vary according to the area (market, state, higher education), field of specialization (IT, pharmaceuticals, finance, ministry, chamber, etc.) and size (from a few tens to tens of thousands) of the contracting organizations, and the differences are even greater when examining their initial goals (online examinations, reportable employee progress, alternative to classroom training, etc.).

Nevertheless, the biggest motivation for me is always when during an e-learning implementation project we not only solve a well-defined problem, but also bring about a change in organizational culture, i.e. we gradually make e-learning a part of everyday life: technology "comes to life", so newer and newer participants and disciplines discover it, start to use it and adapt it for their own purposes. A good example for this is my alma mater, the Corvinus University of Budapest: at first, we only developed a simple LMS for ourselves, a small circle of lecturers within our department, which we only wanted to use for managing incoming homework at the time, and it was just one of the 5-10 different, competing e-learning solutions available at the University. This e-learning system is now used daily by University students from freshman camp to graduation, and provides hundreds of faculty members a technological tool for a wide variety of educational styles.

However, in many cases, even the successful completion of the project, which is acceptable to all participants, i.e. the launch of the e-learning solution, is a challenge, not to mention embedding it in the organizational culture. The reason for this is the heterogeneity of e-learning: with e-learning solutions, a diverse system of technological and methodological, content and IT, management and user aspects appear, and the participants of the implementation projects from different sides voluntarily or unintentionally represent their own aspects. E-learning solutions differ from "average" information systems in that everyone has experience with education - as they have surely already sought to acquire and transfer knowledge - and therefore has an opinion too, which they will represent and clash with other participants.

During my years in the field of e-learning implementation, I have often been confronted with the fact that the end result of an e-learning project is determined alone by the type of actor that started it. Very similar business needs or project descriptions can lead to a completely different

e-learning solution depending on who we "give" the project to. Just to mention two extreme, but real examples: with the goal of introducing an e-learning solution, IT installed a free downloadable open source e-learning system and then allocated access to the empty system to users. Meanwhile, in another project, training specialists, methodological experts and educators worked actively in a team to develop an e-learning solution, which became a presentation compiled with several months of work, eventually being circulated to colleagues via email. But similarly, completely different e-learning materials can be created from the same textual content if we create them with two different e-learning curriculum development software.

Of course, my words above do not contain any value judgments about the e-learning solutions implemented. They cannot contain, because in order to determine the quality of the chosen solution, we also need to know the goals and possibilities. Through this example, I just want to shed light on the importance of being aware of the whole e-learning ecosystem, the limitations of our own perspective, and the role of other sides in e-learning solutions at the frontiers of technology and society.

Recognition of this and the guidelines of my supervisor led to my studies of the interaction between technology and society (Science, Technology and Society studies, STS). The aim of the STS is to open the "black box" of science and technology: to place the relationship between the actual content of science and technology and society at the center of research, beyond the level of logical analysis and the description of institutional norms and values. (Nemeslaki, 2011a)

E-learning in my interpretation is an area halfway between technology and methodology, informatics and pedagogy, engineers and humanities, IT and HR, where one or the other, or maybe even an external actor prevails in the "power struggle", i.e. asserts its aspects in the developmental e-learning project. In my dissertation, I chose the actor-network theory (ANT) of STS studies to explore these heterogeneous actors of e-learning implementation projects, their perspectives, and the complex relationships between them, which also determine the course and outcome of the project.

In my dissertation, I use the ANT to explore how an e-learning implementation project can be successful along these complex relationships, i.e., what are the success factors of e-learning implementation.

2 METHODS USED

In my research, I explore the success factors of e-learning implementation projects by analyzing specific projects, therefore, as one of the methodological pillars of my dissertation, I will use Case Study Research Methodology (CSR) based on Yin (2017). The cases analyzed in detail are e-learning projects of high complexity, which are among the largest in terms of time, cost, and number of participants at a national level. What they also have in common is that they were initiated without precedent, they were built almost from scratch, i.e. there was no widespread e-learning solution used in the implementing organization prior to it. Also, tens of thousands of students can learn thanks to the results of these projects in each of the cases presented, making them among the most significant in this respect as well.

In processing the projects, I rely heavily on the constructivist version of Charmaz's (2000) method of the Grounded Theory (GT) method developed by Glaser and Strauss (1967). On the one hand, the GT method brings documented scientific rigor and transparency to qualitative research (Strauss - Corbin, 1990). On the other hand, it argues for limiting preliminary theories to the strongest possible limits and for developing the theories during fieldwork. (Charmaz, 2009) As I have been involved in different roles in a significant part of the e-learning projects examined, I am familiar with some of the actors (and my interviewees). I also chose GT as a methodological basis to increase my self-reflection ability and skepticism towards my prior theories developed as a participant in the research. On the other hand, the best-known author of CSR, Yin (2017), also uses a significant part of the GT's principles in his method, called "explanation building," which covers an iterative process similar to GT to explain experienced phenomena. Third, the basic idea of the constructivist tendency of the GT method I use, according to which knowledge is constructed by the cognitive and the known together, bears many similarities to the notion of social construction of STS technology, thus providing additional opportunities for research.

After examining different innovation and STS theories, I chose the actor-network theory (ANT) as the subject of my research. ANT describes the world as a disordered connection between local and global networks that are made up of actors but also act as actors themselves in other networks. (Latour, 2005) The most important argument in favor of choosing the ANT is that one of its main objectives is to explore the processes and interactions leading to the consolidation of objects, technologies and phenomena (Latour 1999), which coincides with my aim to explore how to succeed and consolidate e-learning in an organization. In the interpretation of the ANT, actors make a continuous effort to create something stable on the network, so the success of technical products is the construction of the actor-network. (Law – Callon, 1992) The translation is used to describe the large number of transitions that appear until the final configuration, the stable version is reached. During the momentums of translation, the actors frame the solutions of the problems according to their own point of view, thus creating

frames and dependencies for the other actors as well. (Callon, 1986) This kind of dynamically changing relationship system is similar to the competition I experienced between different e-learning interpretations, pedagogy and informatics. A major innovation of the ANT is that it not only seeks out actors among people, but also expands it with inanimate actors, objects and technological solutions (Callon, 1987). This freedom of thought provides an opportunity to examine how e-learning solutions "come to life" and in what direction the available technologies and methodologies influence the participants of the implementation projects. In addition, the ANT's "follow the actor" principle (Latour, 2005) argues that we can only familiarize with the phenomena that shape the world following its participants in the field - which harmonizes with the basic essence of the GT method.

Importantly, the skepticism represented by the constructivist GT may conflict with some of the prior theories here, the avoidance of which requires the researcher's attention. By accepting the ANT as a starting theoretical point of view, we are apparently doing exactly what the GT is agitating against: we arrive in the field with preliminary theories and convictions. On the other hand, the ANT in this case is more of a kind of "meta-theory", which is not a specific research question related to the study of the success factors of e-learning projects, but rather a possible framework of world interpretation. Also, compared to the stricter conception typical of the 20th century, Charmaz (2008) herself argues that it is no longer a realistic expectation for today's researchers to arrive at their research completely excluded from all influences.

The structure of the dissertation, the main research question, the sub-questions and the methods used are summarized in the table below.

MAIN RESEARCH QUESTION: ***What will make an e-learning project successful, what are the success factors of an e-learning implementation?***		
Research sub-questions	**Method**	**Dissertation chapter**
1. Preparation: methodological foundations		
Description of the research strategy, and the Case Study Research and Grounded Theory methodologies		Chapter 2
2. Exploring e-learning implementation projects		
2/1. research sub-question: What are the literature approaches and current research topics of e-learning?	literature review	Chapter 3.1
2/2. research sub-question: What organizations are launching e-learning implementation projects to achieve what goals, and how can these be typified?	Collection and statistical processing of descriptive data of ~ 50 projects Grounded Theory (GT)	Chapters 3.2 and 3.3
3. Exploring the actor-network theory		

3/1. research sub-question: In which fields of science, and in connection with which topics and research questions does the ANT have scientific relevance? What problems can it help solve?	statistical and text mining analysis of publications (density map, keyword network, tokenization, collocation)	Chapter 4
3/2. research sub-question: Is the conceptual system and way of thinking of the Actor-Network Theory suitable for answering the research question and exploring the success factors of e-learning projects?		
4. Exploring the e-learning ecosystem with the ANT		
4/1. research sub-question: Which central concepts and thoughts of the ANT play a role in understanding the functioning of the e-learning ecosystem?	literature review	Chapter 5.1
4/2. research sub-question: In general, how is an organization's e-learning service structured? What actors make up the e-learning ecosystem? How are actors organized into networks and what effects do they have?	Grounded Theory (GT) Actor-Network Theory (ANT)	Chapters 5.2 and 5.3
5. Identifying success factors for e-learning projects		
5/1. research sub-question: What factors can support and what factors can hinder the successful completion of an e-learning project, the start of trainings?	Case Study Research (CSR) Grounded Theory (GT) Actor-Network Theory (ANT)	Chapter 6
5/2. research sub-question: What actors are involved in the process, with what goals and with what force, how and why can the range of dominant actors change during the implementation?		
5/3. research sub-question: What objects, technologies, software and solutions act as actors and active actors in the implementation of e-learning projects? What intentions do they convey?		
5/4. research sub-question: What factors can support and what factors can hinder the stabilization of the results of an e-learning project in an organization?		

Table 1:
Research questions of the dissertation and the methods used to answer them (Own creation)

The dissertation contributes to the development of science in the following areas:

1. **Contribution to the actor-network theory:** the dissertation explores the role and applications of the actor-network theory in the sciences, it summarizes and synthesizes the most important concepts of the theory, and shows the practical applicability of the theory through the analysis of e-learning implementation projects.
2. **Contribution to business informatics**: the dissertation expands the toolkit of Hungarian business informatics research by presenting the opportunities of using a

theoretical framework in ICT research, which is not yet widely used in doctoral school, but is already popular in international business informatics literature.

3. **Contribution to the world of e-learning**: the dissertation provides a well-founded theory and practical advice on the successful implementation and operation of e-learning projects, and the integration of e-learning into organizational culture. That is, it shows the success factors of e-learning projects.

In summary, it can be said about the topicality of the research, that the dissertation undertakes to present new results in the field of e-learning, which has been researched for a long time, but which is constantly of great relevance. The topic and its approach are novel in several ways. On the one hand, the questioning of the topic, the examination of the success factors of e-learning implementation projects according to the actor-network theory is new in itself. On the other hand, it analyzes large case studies, which present the structure of in-service training systems which are significant individually too, and due to their size and complexity, are considered to be exceptionally large at a domestic level. Also, the research does not limit the examination of e-learning to the issue of curriculum, framework, or methodology, but focuses on the success factors of the introduction of comprehensive e-learning services as a unified whole.

The COVID-19 pandemic also gives the dissertation an unfortunate topicality. The analyzed case studies present the introduction of e-learning solutions for organizations that did not previously have significant digital education solutions. As a result of the constraints caused by the pandemic, social distancing and home office culture, that will presumably remain with us even after it has subsided, more and more organizations are switching to e-learning solutions in part or in full. The case studies show how to make an e-learning implementation project a success and how to make e-learning a lasting part of the organization, contributing to its success. Thus, the dissertation will hopefully provide useful lessons for organizations starting e-learning implementation projects in the near future.

3 RESULTS OF THE DISSERTATION

During the research I relied on the data of Hungarian e-learning implementation projects. For the analysis, I used a case study-based research methodology and the constructivist grounded theory method, the background of which I described in detail in Chapter 2 of the dissertation during the methodological foundation.

3.1 E-learning projects: goals and solutions

To begin with, in Chapter 3.1 of the dissertation I described the international literature on e-learning, summarized current research trends and models, and defined my own – simplified and general - definition of e-learning (based on Aparicio et al., 2016):

> *E-learning combines learning and technology: learning is a cognitive process to acquire knowledge, and the role of technology is to support the learning process, just like any other tool in educational practice, such as a pencil or a notebook.*

With this subchapter, my goal was, on the one hand, to familiarize the reader with the details of the world of e-learning that are essential for the interpretation of the dissertation. My goal was also to demystify e-learning and draw attention to the fact that professional discourse is not driven by the collision, the definition and the explanation of different e-learning concepts, interpretations and terminus technicuses, but by looking behind for the solutions.

Therefore, after a general description of e-learning, as a continuation of Chapter 3, my researched was focused on what goals organizations want to achieve by launching e-learning implementation projects. To explore this, I systematically collected data from 51 e-learning projects and analyzed the database built from it. Criteria for analysis included whether the organization operates on a state or market basis, whether it had previous e-learning aspirations, whether the project was focused on system or curriculum implementation, which organizational unit started it, what was the scope of its target group, and whether it was continued, that is, whether the solution had been embedded. By processing the database, the project documentation and additional interviews using the GT method, I identified 15 objectives, which are included in the following table.

#	E-learning implementation objectives	Number of occurrences
1.	**Knowledge transfer**	46
2.	**Simplification of trainings**	26

3.	**Administrative simplification**	25
4.	**Simplification of mass examinations**	21
5.	**Have time for the target group to learn, even with a heavy workload**	13
6.	**Selling as many trainings as possible (for social benefit)**	12
7.	**Promoting one's own organization**	12
8.	**Strengthening the culture and motivation for self-education**	10
9.	**Further development of organizational e-learning methods and solutions**	8
10.	**Marketing, service or product promotion**	6
11.	**More effective IT system education**	5
12.	**Reducing helpdesk calls**	5
13.	**System integration**	3
14.	**Sell as much trainings as possible (for business benefits)**	2
15.	**Replacing an existing licensed solution with open source**	2
	No objective	1

Table 2:
Objectives of the examined e-learning projects (Own creation)

In addition to the number of appearances in absolute terms, I also examined the shared appearances of the objectives and the typical patterns. Then, I included the revealed objectives in a system of 5 objectives, which identify the endeavors of the organizations launching e-learning implementation projects:

» **efficiency focused objectives**: for typically larger target groups, often in the case of compulsory trainings due to the legal environment with simplification objectives for training, curriculum sharing, examinations and administration, which are ultimately expected to reduce time and expense input and to maintain results, i.e. increase efficiency.

» **life-long learning focused objectives:** enabling and promoting the self-education and self-development of the target group as widely as possible, which may include both technical objectives (e.g. integration of previously sporadic e-learning solutions into a unified organizational system) and methodological objectives (e.g. motivating the target group).

» **socially focused objectives:** they typically appear in organizations within the public sector, often through public trainings open to all interested parties, and are connected to the implementation of tasks to be performed by the – in a broad sense - state. In this case, the basic goal is for as many members of the target group as possible to complete their training, and the secondary goal may be to introduce "self-marketing", to acquaint the widest possible target audience and to strengthen the need for the organization's activities.

» **marketing focused objectives:** partly in overlap with the previous one, but also with addition of organizations from the market sector, these objectives are not focused primarily on the transfer of knowledge, but on the organizations to promote themselves and the marketing of their specific products and services by introducing them to customers through education.

» **IT solution focused objectives:** finally, with a smaller number of cases than the previous ones, but clearly appearing as a separate category, when an organization, be it market-based or public, introduces a new in-house software that is taught to its employees through e-learning to make the training as resource-effective as possible in order to train all employees on how to use the app, thus relieving the helpdesk.

3.2 The role of the actor-network theory in the sciences

In the rest of the dissertation, I examined how the above objectives can be achieved, i.e. what components make up an e-learning solution, and what factors can help to successfully close a project for implementation. In addition to IT solutions, the content, the methodology and many other human factors necessarily play an important role in the e-learning ecosystem. To explore the components and success factors, I therefore chose one of the theories of the STS sciences that studies the interaction between technology and society, the actor-network theory.

In order to confirm this choice based on empirical data, in Chapter 4 of the dissertation I examined the scientific publications that chose the ANT as the analytical framework, using statistical and text mining methods. I built a database of 1713 publications, which includes the titles of the publications, the author, the full text of the abstract, the citation of the study, the name of the publishing journal, the SJR quartile, and the H-index.

With a comprehensive analysis of these data, I found that we can find relevant publications in almost every field of science that uses the actor-network theory, but nearly three-quarters of the publications have been in the social sciences, management, and computer science. The analysis showed that despite the fact that the ANT is a theory with a history of several decades, its relevance only increased from the 2010s, with the increase of technological embedding. This was also supported by keywords that emerged during the text mining analysis, such as implementation, adaptation, new technologies, efficiency, success, failure, stability, or alignment.

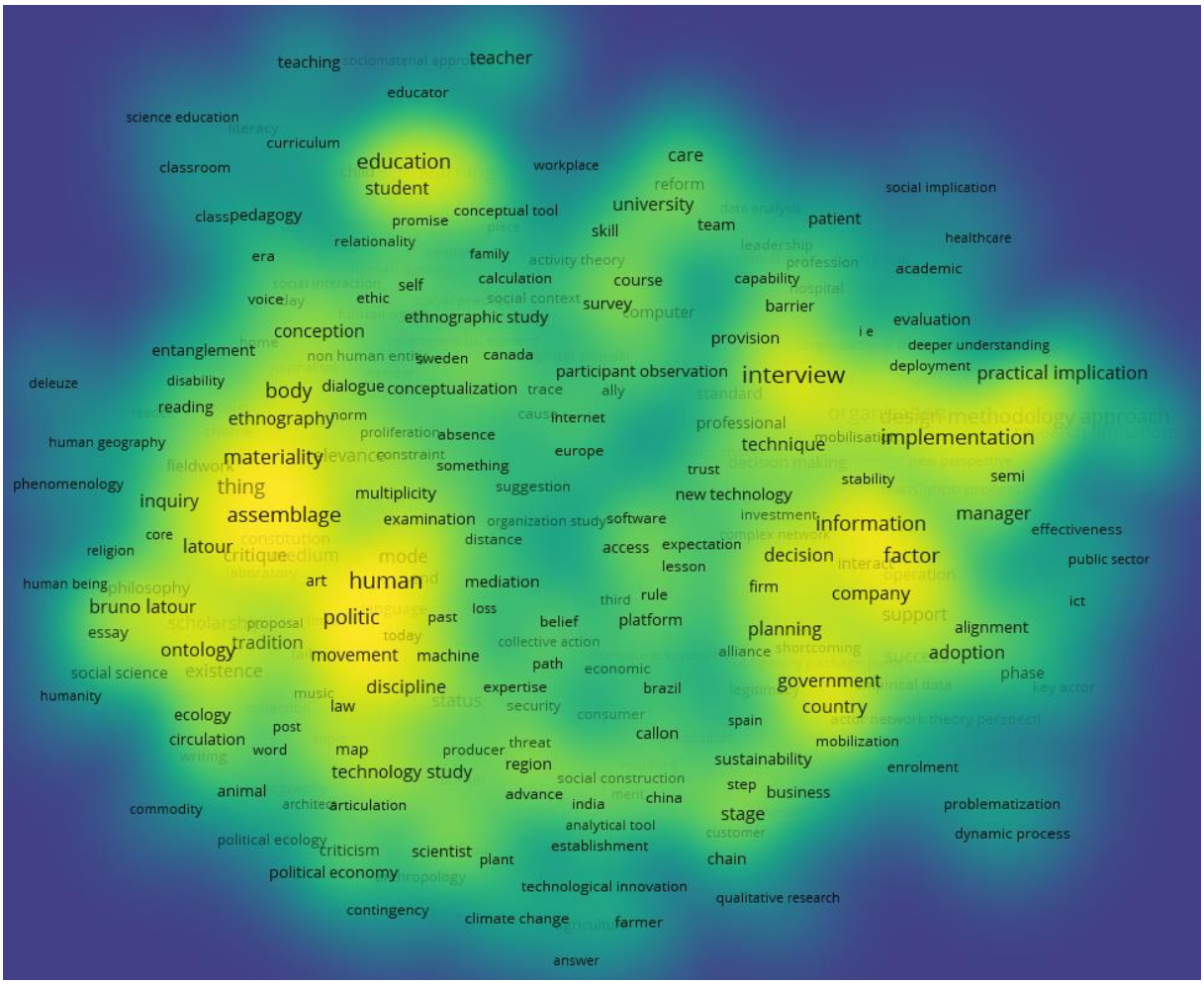

Figure 1:
Keyword density map for publications using the ANT (Own creation)

I have also shown that the ANT is a useful tool for both case study-based research and education, however, analyzing e-learning projects in this way is still novel. I found that while the number of publications using the ANT has been growing dynamically since 2010, their scientific relevance is markedly high, with 90% appearing in Q1 and Q2 journals.

3.3 Analysis of the e-learning ecosystem according to the actor-network theory

Based on the above, I clearly identified the ANT as a powerful tool for breaking down e-learning solutions into components and exploring success factors. In the next chapter of the dissertation, I therefore described the theoretical system of the ANT, with the most important concepts and ideas that emerged during the processing of the literature and in the text mining study, from the actor-network, through the translation, to the black box. Organized around the concepts, I have shown how the solution and the user construct in interaction with each other, and how our world is made up of actors and the actor-networks organized from them, which at the same time modify the behavior of the actors and thus act as actors themselves. I have also shown that the ANT is not a classical methodology - in my dissertation the CSR and the GT play this role - but a way of thinking, a worldview that helps to look at events from a new perspective, thereby better understanding society and the complex relationship of the technology that weaves it through with a thousand strands.

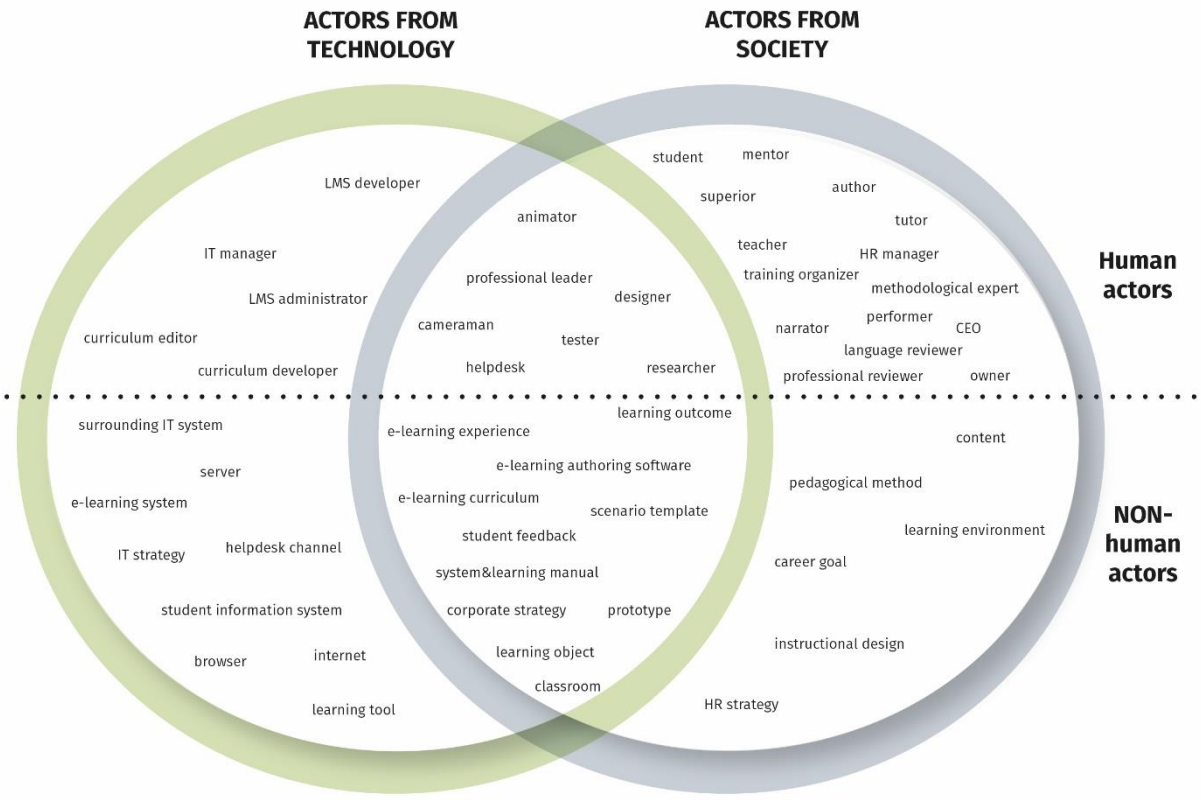

Figure 2:
Technological and social actors in e-learning (Own creation)

Based on the conceptual system of the ANT, I then broken down the e-learning solutions into its components: I explored the actors of the e-learning ecosystem, i.e. the organizational e-learning service, using the follow the actor method. I identified a total of 53 actors, including a

similar proportion of social-focused, technology-focused, and actors focusing on both areas. In accordance with the third symmetry principle of the ANT, I also identified inanimate actors who have an impact on the actor-network: only about half of the actors are living actors, the rest are non-human actors influencing the operation of the e-learning solution.

To conclude the chapter, I finally presented the operation of the ANT's approach to actor-networks in practice: I described seven different actor-networks that construct e-learning solutions. In connection with the explored actors, I described the important aspects, categorizations and decision possibilities that must be taken into account during the maintenance of an e-learning implementation project or e-learning service. An important result of this chapter is that with knowledge of the actors and aspects, organizational e-learning services can be easily evaluated during either implementation or operation, and the proper involvement of important actors can contribute to the success of an e-learning solution in general.

3.4 Exploring e-learning success factors: case studies

The evaluation of the actor-networks also showed that the e-learning ecosystem is too complex to represent the functioning of these networks with universal validity. Therefore, in addition to the general presentation, I examined two specific projects in the last chapter of the dissertation. Both projects focused on the introduction of e-learning in an organization where e-learning did not have a substantive tradition. Both involved hundreds of people in the implementation process, and tens of thousands of students are continuously learning from the solutions implemented. In addition to the number of participants, they are outstanding projects in Hungary in terms of their complexity, duration and budget. Due to all these, a wide range of actors explored in the previous chapter could be identified in these cases, so they are suitable for analysis and formulation of success factors.

I examined the two projects according to the CSR by analyzing the available documentation, based on previous extensive in-depth interviews and questionnaires, and through new interviews conducted according to the GT's theory-driven sampling. In processing the cases, I used the previously presented theoretical frameworks of the actor-network theory. In both cases, the focus of the study was on the key momentums of the translation and the role of the actors in them. After depicting the initial system of actors, examining the momentums of problematization, interessement, enrolment and mobilization, we were able to explore how e-learning solutions are constructed and reconstructed in a heterogeneous system of actors according to different social- and technological-focused aspects.

One of the important lessons of this chapter is that due to the limitations of organizational and advocacy capacity in the implementation process, the learner is not given sufficient weight as

an actor while becoming a dominant actor after implementation, which can lead to many technological and methodological coordination problems. Meanwhile, during the implementation process, the interpretations of the dominant actors create black boxes, which the other actors accept as facts, while in many cases they only reflect the dominant actor's subjective interpretation of reality or their own interests.

I identified such a black box in the second case study in relation to the category of e-book-type and gamified learning materials, and then opened it with a quantitative analysis of the data of more than 21,000 students. For the analysis, I compiled an input and output knowledge measurement test and examined how the two curriculum formats, from which students could optionally choose, affect students' knowledge level growth and attitude. To do this, I analyzed the scores and time requirements of the input and output tests, as well as the correlations between the learning time spent with the e-book and the gamified curriculum, supplemented by an attitude measurement questionnaire completed by the students.

The results clearly showed that the accepted opinion of the dominant actors in the actor-network, that the e-book represents a lower level of e-learning and the gamified curriculum represents a higher level of e-learning, is generally not valid. There is no such thing as a universally "good" e-learning curriculum, it cannot be said that one curriculum is "better" than the other, this can only be stated in accordance with the aspects and goals of the actors. The e-book has been measured in itself to be more suitable for the rapid transfer of knowledge in mandatory trainings than a gamified solution that can only be developed from significantly larger resources. In contrast, the gamified curriculum may be more suitable for purposes beyond the transfer of lexical knowledge, such as increasing student loyalty. The key factor, therefore, is to assess organizational goals, ownership needs, and student opportunities in each case and look for the best suited e-learning curriculum for them.

To conclude the chapter and the dissertation based on the two analysis methods, an ANT-centric qualitative analysis focusing on the process of implementing e-learning solutions, and a quantitative analysis based on learning and questionnaire data from 21,000 students focusing on comparing the two e-learning solutions, I have summarized the success factors of e-learning projects that can provide theoretical and practical help to organizations facing implementation projects and thinking about reviewing their e-learning services.

In this chapter, I have presented the operation of e-learning ecosystem actors and actor-networks in practice by processing two case studies. Based on the cases, generalized conclusions about the e-learning implementation process can be drawn, which can help the successful realization of implementation projects and the consolidation of the e-learning ecosystem, which I describe below.

» The introduction of e-learning solutions is never self-serving: they also provide answers to operational-level problems, but ideally serve a higher-level organizational goal.

Defining this goal and representing it transparently in the developmental process is an important task for the owner and the delegated managers. *[organizational goal] [management policy]*

» After defining the goal, the initial step in the development process is the needs assessment. To select the right e-learning solution, we need to have data on both the direct (learners) and indirect (e.g. clients) beneficiaries of the training. *[involving student] [project management tool] [management policy]*

» Students are typically not an organized unit, so they are not represented on the network. Nevertheless, it is worth involving them in every part of the development process. Among their various characteristics, both technological (e.g. device availability, internet connection) and social (e.g. learning environment, career goal) factors can have a decisive influence. These will definitely become the dominant actors at the latest when the trainings start, so it is better to assess in advance and choose an e-learning solution adapted to them. *[involving student] [content and technologies] [project management tool]*

» When defining the problem, it is worthwhile to create as flexible a framework as possible and to involve as wide a range of lower-level professional actors as possible in the tasks of the managers at the management level. In addition to problematization, at least the HR and IT managers should monitor the entire development process, but it is advisable for other managers to do the same. *[management policy] [organizational goal] [project management tool]*

» When planning, you have to constantly think in a complex system. We can "trap" all the actors with a single decision by creating an artefact. To avoid this, it is worthwhile to define the planned parameters of the whole ecosystem and make all instructional design decisions at latest until the development of the scenario template. Only with careful planning can we avoid technology blocking the activity of actors by becoming a mandatory transit point in the later moments of development. *[content and technologies] [project management tool]*

» The most important considerations when choosing an e-learning solution are practical, fast-to-apply content and ease of use. Even though an e-learning solution follows the current trends, it will not necessarily be "good", only after the exact exploration of our goals can we choose what is a "good" solution. *[organizational goal] [content and technologies]*

» It is worthwhile to start developing and using complex e-learning solutions as a pilot, developing a smaller amount of curriculum and testing it with a smaller group of students, and then evaluating, constructing and reconstructing the chosen solutions

instead of committing to a technology and methodology and starting series production right away. *[involving student] [project management tool] [content and technologies]*

» In the e-learning ecosystem, social and technological actors are similarly represented in terms of their number and strength. It is the responsibility of the professional leader to reconcile the technological and social aspects, to mediate between the two sides, and to find a balance, and he/she must represent both sides equally in order to do so. *[content and technologies] [project management tool]*

» The conflict and discussion of the technological and social aspects will advance the project, but we must strive for a stable position. This should be supported from the communication side (building relationships between actors), from the power side (creating interests) and from the administrative side (contractual constructions), which is also the task of the professional leader. *[project management tool]*

» The prototype is an important element of e-learning curriculum development, with the help of which the methodological and technological elements of e-learning curricula can be recorded and the relationship between the e-learning curriculum and the e-learning system can be tested. It makes the operation of later materials tangible and understandable for development actors, especially authors and managers with less e-learning experience. *[content and technologies] [project management tool]*

» However, if the prototype development becomes the dominant driver, it can cause gaps in the development of content and thus the final curriculum, so efforts should be made to address the two processes running simultaneously with similar emphasis. *[content and technologies] [project management tool]*

» Equal quality of content should also be sought. Bridging the differences between individual authors is a methodological task that can be very resource intensive. Motivating the authors can help in this: in addition to financial incentives, the creation of personal commitment, and the inclusion of the author with his/her name and face in the curriculum. *[project management tool]*

» The actor-network around the e-learning system and the e-learning curriculum can be a conflicting zone with similar strength to the technological and social aspects. However, this does not necessarily mean two opposing sides, it is best to coordinate them when defining the problem, but if this is not the case, it is up to the IT and HR manager to make the connection. *[content and technologies] [management policy]*

» Although they rarely play a direct role in the development process, it is worth involving helpdesk and training actors from the first steps. After development is completed, from the students' point of view, they will be the frontends of the e-learning solution, thus they can have the same impact on the assessment of the solution as the curriculum itself.

They need to feel at home with the solution and be prepared when waiting for incoming questions. The ideal e-learning helpdesk represents not only technological aspects but social aspects too, with equal weight. *[content and technologies] [project management tool]*

» System usage aids are almost unnoticeable to actors when they are present, but quickly become critical when they are not. Simultaneously with the development of the new solution, it is always necessary to create these as well. It is worth devoting enough energy to their development, which will pay off later in the helpdesk workload. System usage aids should support both technological aspects (e.g. where to click) and social aspects (e.g. how to learn on your own, from home). *[content and technologies] [project management tool]*

» Most development activities can be outsourced, but efforts must be made to avoid fixation, to maintain a competitive position and to make contract terms as flexible as possible. The advantage of buying ready-made solutions is that we see exactly what we are getting, but at the same time they can make us vulnerable to the suppliers' interpretive frameworks. *[management policy] [project management tool]*

» In addition to formal relationships, informal ones should also be kept in mind. Authors are typically recognized representatives of the field, and they also come into contact with managers and owners in addition to the development, and can have a decisive influence on the management's judgment of the solution. Equally, it is worth paying close attention to discovering and attracting key users: vocal learners can have a big impact on their peers and in judging the solution. The role of the training provider and the helpdesk is important in the management of formal relationships, and the role of leadership commitment is important in the management of informal relationships. *[involving student] [project management tool]*

» Previous e-learning experience of any actor can be distorting: there can be huge differences between two different e-learning projects, so for each actor involved in the development, the scope of the e-learning solution must be transparently defined from the beginning. *[management policy]*

» It is easier to gain the satisfaction of a learner and a leader with no previous e-learning experience with a new solution than to replace an existing one. Time should also be taken to persuade key actors with previous e-learning experience, just as for the development itself. *[project management tool] [management policy]*

» It's hard to get students to be a fan of a mandatory training, but it's easy to get them to not hate it. The more characteristic an e-learning curriculum we develop is, the more divisive it will be. When trying new methodological and technological solutions, we

should always provide students with the usual, simpler learning opportunity. *[involving student] [content and technologies] [project management tool]*

» In an organization's e-learning service, it is neither worthwhile nor possible to make a significant distinction between technology and methodology, IT and content, e-learning framework and curriculum. The unity of these is the "e-learning solution", which, however, can only be understood and managed well when broken down into its components. *[project management tool] [content and technologies] [management policy]*

» Of course, the balance between technology and society does not mean that there can be no situation where one side of an organization's e-learning ecosystem dominates the other, or just needs to be developed and therefore needs special attention. Our goal may just be to use the ANT to observe these phenomena, understand their causes and consequences, and - being no longer an ANT issue but a project management issue - be able to intervene if necessary to support stabilization. *[management policy] [project management tool]*

» With the stabilization of the solution, the development process does not end. As it is a complex system from the point of view of the organization focused on technology and society, and from the learner's point of view it is a cognitive process for organizational goals, the role of researchers is significant in all projects. Ecosystem functioning needs to be constantly monitored and fed back. Measurement- and data-based analyzes can be used to open black boxes and confirm or refute the beliefs represented by dominant actors. *[management policy] [organizational goal] [involving student]*

3.5 Summary of conclusions

The theses of the dissertation discussed above is summarized below.

T1: By processing 51 projects of 10 years using the grounded theory method, I identified 15 different objectives for which organizations launch e-learning projects. Based on their typical shared occurrences, I defined 5 objective systems, which identify the typical aspirations of the organizations launching e-learning projects.

T2: By statistical and text mining analysis of 1713 publications, I found that the actor-network theory's relevance, although a theory dating back several decades, has grown significantly since 2010, and is still growing together with the embeddedness of technology: theory-based research revolves around the issues of the relationship between society and technology - such as e-learning implementation projects - in prestigious scientific journals, mainly in the fields of social sciences, management and informatics, examining the possibilities of harmonization.

T3: I presented and analyzed the conceptual framework of the actor-network theory, and then used it to identify 53 actors who play a key role in the implementation, operation and success of an organizational e-learning solution. 14 of the actors focus their efforts on e-learning ecosystem actor-networks with a technological, 21 with a social and 18 with a mixed focus, of which I identified 7 as top priorities.

T4: I summarized the success factors of e-learning implementation projects by ANT-centric case study-based processing of two complex e-learning implementation projects involving hundreds of developers and tens of thousands of students, as well as the quantitative analysis of survey data among 21,000 students, which support the efficient and effective development and use of e-learning solutions implemented in organizations.

T5: The case study-based analysis showed how living and inanimate actors involved in the introduction of an organizational e-learning service are organized into dynamically changing networks, which forces they interact along with each other within the networks, and how they eventually achieve a steady state, thus the actor-network theory giving a deeper understanding of e-learning success factors.

My relationship with e-learning projects started in 2007, when I first participated in the introduction of an e-learning system as a demonstrator and research assistant at the E-business Research Center of the Corvinus University of Budapest. My dissertation is another important milestone in the long journey since then. My research aimed at gaining a better understanding of the characteristics of e-learning implementation projects and the factors that can help the successful completion of these projects and the organizational stabilization of e-learning services, with the help of the sciences dealing with the interaction of society and technology.

I hope that with my results and the additional research questions based on them, I will inspire myself and other researchers in the field for future research on e-learning projects.

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