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Enterprise collaboration systems: addressing adoption challenges and the shaping of sociotechnical systems

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Abstract:
This article examines the adoption challenges organizations encounter when they introduce enterprise collaboration systems (ECS) and the measures that can be used, i.e. actions that can be taken, to address these challenges. The aim of the article is to provide an overview of the multitude of different ECS adoption challenges and measures, and based on these, to lay the theoretical and analytical basis for studying the shaping of such complex sociotechnical systems. For this purpose, a qualitative meta-analysis of the academic literature and interviews with companies were conducted, which resulted in a collection of ECS challenges and measures classified and analyzed with regard to their specific spatiotemporal aspects. Drawing on the results of this study, research imperatives, which include the call for studying ECS over multiple time frames and settings, are presented. These will be examined in greater depth as part of our wider, multidisciplinary research program that focuses on enterprise collaboration systems use in the emerging digital workplace.

Keywords:
Enterprise Collaboration System (ECS); Enterprise Social Software (ESS); sociotechnical systems; CSCW; adoption.

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1. Introduction

This article links to the findings presented in our previous publication on identifying the adoption challenges of enterprise collaboration systems [1]. In this article, we extend that work to show not only the challenges that organizations encounter during the introduction of an enterprise collaboration system (ECS) but also the measures that can be used, i.e. actions that can be taken, to address these challenges. ECS are software systems that combine enterprise social software (ESS) components (e.g. social profiles, tags, wikis, blogs) with traditional groupware components (e.g., e-mail, group calendars, document libraries) [2], [3] to support organizations specifically in internal business communication, collaboration, and content and knowledge sharing activities. Today, ECS are seen as an important enabler of the modern digital workplace [4]. Such "socially-enabled" collaboration systems have gained attention from both the scientific research community and practitioners, however there are still uncertainties regarding their successful adoption and appropriation [5]–[7]. One reason is that organizations often introduce an ECS to utilize its potential for organizational innovation [8], but due to its novelty have little experience from which they can draw. The ESS and ECS literatures have started to document both challenges organizations face when introducing ECS and measures to address these diverse ECS adoption challenges. However, the body of research literature examining the adoption of ECS and ESS is currently fragmented and provides few in-depth empirical cases. In addition, the nature of the challenges that occur as part of an ECS initiative are multifaceted in terms of space and time and thus often require different ways of addressing them.

The study presented in this article constitutes only one part of a wider and multidisciplinary research program which focuses on enterprise collaboration systems and the emerging digital workplace [9], [10]. This article aims, firstly, to provide an overview of the multitude of different ECS adoption challenges and measures to address them, and secondly, to lay the theoretical and analytical basis for studying such complex sociotechnical systems. While transactional business software, such as Enterprise Resource Planning (ERP) systems, are typically used on a mandatory basis and introduced with clearly defined usage scenarios within specific business contexts, ECS are usually used voluntarily and use may change as well as be shaped over time. As opposed to traditional business software ECS stands out due to the possibility to use ECS in a variety of different ways depending on the context in which it is used and the actors involved as well as the experiences collected over time [4]. As a consequence, space and time specific challenges might arise when organizations introduce ECS and the measures proposed in the body of ECS literature for successfully using ECS might not be universally valid. However, for organizations to be prepared for the challenges that might arise and to assess the possibilities for dealing with them, a preliminary overview of ECS adoption challenges and measures is needed.

Through an in-depth analysis and synthesis of the extant literature and triangulating company interviews, the research objectives to accomplish the aims outlined above, are to i) identify and classify the challenges that organizations experience during the process of ECS introduction and the measures that can be used by organizations to address these challenges, ii) illuminate the identified ECS adoption challenges and measures to provide examples that illustrate their spatiotemporal characteristics and impact on the ECS adoption process and iii) discuss issues of sociotechnical change that guide the further analysis of ECS adoption, appropriation, and use as part of this broader research program.

This article is organized as follows. In the next section, the emergence of socially-enabled ECS and associated adoption literature is outlined to provide a common understanding for this research endeavor. Section 3 shows the underlying research design of this study. The results are presented in section 4. In section 5, the results of this study are interpreted to derive research imperatives, and section 6 concludes the study with a short summary of the findings and future research.

2. The adoption of Enterprise of Collaboration Systems in the Literature

Globally, there are high levels of financial investment in information systems and technology (IS/IT) to adapt and support business (e.g., [11], [12]). Research on the value companies gain from IS/IT investments is extensive and has

been reported as an issue for over 25 years (e.g., [12]–[17]). The use of traditional enterprise software has now been complemented by ESS, confronting both researchers and practitioners with new adoption challenges that might impact the realization of benefits that contribute to IS/IT value. The successful use of ESS is seen as a crucial factor for the competitiveness of organizations.

Based on the immense success of social media, open platforms on the internet, as evidenced by the increasing number of users [18], the development of and demand for socially-enabled collaboration software in the workplace has gained momentum. Organizations have started to embrace the opportunities and challenges that come along with these enterprise collaboration systems that enhance traditional groupware with ESS. Attracted by new possibilities for content syndication, sharing user-generated content, socializing and networking, organizations expect to improve and extend their information sharing, communication, coordination and interaction capabilities [9]. The Computer Supported Cooperative Work (CSCW) research field has for some decades investigated how collaboration in work groups can be supported by means of traditional groupware [4], but the emergence of social software features, such as social profiles, wikis, blogs, microblogs, forums, or activity streams, as a supplement to traditional groupware has led to a shift from purpose-specific software to malleable software that is dependent on time and space, and therefore also on the employees working with it and their skills and experience [4], [8].

Meanwhile financial spending on ECS is significant and the ESS market is rapidly growing, forecasts predict up to $US6.18 billion expenditure in 2018 [9], with large software vendors like IBM, Microsoft or Atlassian dominating the market. Despite the significant interest in the use of social software behind company firewalls and the fact that ECS are increasingly being integrated into daily work, there is still considerable uncertainty regarding the best ways to gain business value from them [9]. This uncertainty is linked to a plethora of ECS adoption challenges and the fact that organizations often find themselves in a cultural change situation with regard to their ECS implementation.

A growing body of literature in the ESS and ECS research field draws attention to the potential of ECS for collaborative work and to the different ECS adoption challenges (e.g., [19]–[23]). This work is complemented by research on how to successfully introduce behind-the-firewall social software by means of appropriate adoption measures (e.g., [24]–[27]). Although a significant contribution has been made towards raising corporate awareness for a new form of business software, which is characterized by gradual diffusion and evolutionary business change, an overview of the challenges organizations can be confronted with when introducing ECS and the measures that can be used to address these challenges is missing. The sub-sets of ECS adoption challenges and measures raised and/or discussed in literature are often based on cross-sectional case studies conducted at a single point in time (e.g., [23], [25], [28]) which therefore downplay the characteristic that ECS evolve over multiple time frames and settings. Therefore, the implementation of proposed ECS introduction strategies typically incorporating a set of measures by a company may not necessarily lead to success. The study presented by Heinemann et al. [24] further shows that ECS adoption challenges, which can be linked to different stakeholder groups, can be addressed by appropriate actions and interventions at different stages in the adoption process. This can be explained by challenges occurring or being noticeable at different times. This is not surprising, since ECS are, due to their voluntary use, not adopted by all stakeholders all at once and ECS use purposes and patterns typically emerge through experimentation [8]. Different stakeholders have different capabilities in terms of skills, experiences and traits leading to individual adoption challenges. Likewise, ECS adoption measures might be applied by different stakeholders depending on their background. So-called champions are often named as a group of actors who are familiar with the use of social software to support daily work practices and who are supposed to promote this new type of working among the other employees [19]. By contrast, employees who stick to traditions and old work practices are more likely to be resistant to ECS-triggered change [29]. In order to gain value from ECS organizations need to flexibly react to ECS adoption challenges that emerge over time and space. This article does not aim to propose a generally valid solution to successful ECS adoption but to illustrate the diverse nature of ECS adoption challenges and measures and, building on this, to lay the foundation for studying the evolution of ECS considered as complex sociotechnical systems.

3. Research Design

This study examines the ECS adoption *challenges* that organizations face when introducing enterprise collaboration systems (ECS) and the *measures* that can be used, i.e. actions that can be taken, to address these challenges. For this purpose, an iterative, interpretive and qualitative research approach with a qualitative meta-analysis method is applied by which key challenges and measures are identified, aggregated, and categorized. The goal is to consolidate prior research to provide a more complete and comprehensive overview than any of the original, individual studies dealing with the successful adoption of ECS. At the same time, the research seeks to reveal the multifacetedness of ECS adoption challenges and measures in terms of space and time. Based on this and the specific nature of ECS as complex and evolving sociotechnical systems that incorporate human and non-human actors, suggestions for analyzing ECS initiatives are derived. As input data two main sources are used: i) the academic literature on ESS/ECS and ii) company interviews as a means to triangulate and, if necessary, to extend the findings drawn from the literature. This study is structured into three research phases as shown in Fig. 1.

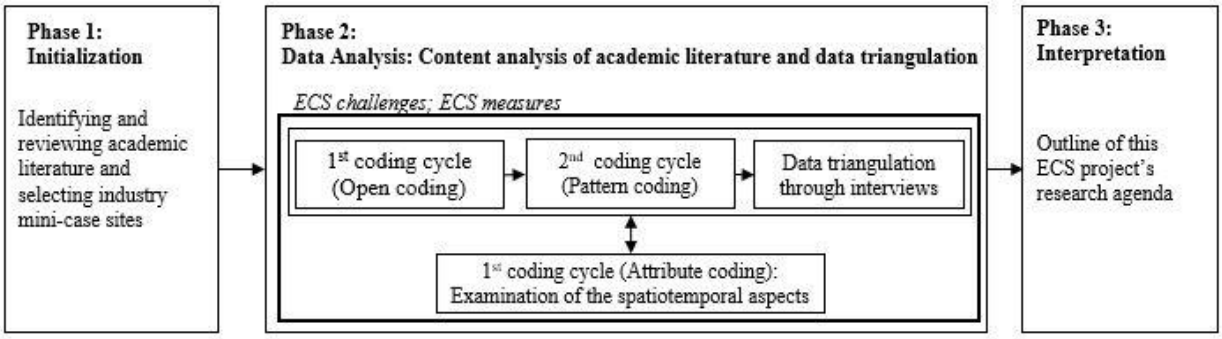

Figure 1. Research steps

Phase 1: Initialization includes an extensive search and analysis of the academic literature on enterprise collaboration systems. By adopting the approach of Huff [30], a broad search of the topic of ECS was carried out first, since it was expected that ECS challenges and measures could be identified from all fields of study. As social software has been subject to both technological development and changing conceptions with regard to its potential, different terms used in the academic literature were taken into account, in order to avoid excluding findings that equally apply to socially-enabled ECS. Literature databases including ACM Digital Library, Emerald Insight, SpringerLink, IEEE Xplore Digital Library, ScienceDirect, and Google Scholar were searched using the search terms "social software", "e-collaboration", "web 2.0", "enterprise 2.0", "social business", "collaborative software", "enterprise social software", "enterprise collaboration system", "adoption", etc. and combinations of them to start with a corpus of primary articles. To identify additional relevant articles from the reference lists of the primary articles, snowballing as a search method was then applied. The literature search was supplemented with a search for suitable companies for the elaborating company mini-cases and interviews were arranged in order to collect data for triangulation. A prerequisite for conducting the interviews was that the selected companies had not only introduced an ECS but were also willing to speak openly about the adoption challenges they had experienced and the measures applied to address them. Two hi-tech companies who had adopted ECS were selected for the study. Technology savvy companies are more likely to have implemented social software. Since the focus of this research is on the exploration of ECS challenges and measures, the restriction to technology companies is regarded as appropriate. In order to structure the planned interviews, an interview guideline was developed which introduced the interviewees to the topic, and used open and closed questions to investigate their ECS adoption challenges and measures.

Phase 2: Data Analysis comprises a qualitative in-depth content analysis of the academic literature to identify and categorize both ECS adoption challenges and measures. For this, two cycles of literature analysis and coding to classify the ECS adoption challenges are conducted and then triangulated with the data collected from the interviews in the two selected German case study companies. While the empirical cases in literature often cover large enterprises and SMEs (e.g., [21], [24]), the selected companies comprise less than 15 employees each and have a flat hierarchy to allow fast decision making. Upon approval by the companies the interviews were recorded and transcribed before using the data to refine the classification and capture any additional challenge and/or measure. The identified ECS adoption challenges and measures are then examined by using another coding cycle to understand their spatiotemporal nature in terms of timing and actors involved as well as the impact of the challenges on the ECS adoption process. For illustration purposes, the specific characteristics of selected ECS adoption challenges and measures are captured exemplarily.

Phase 3: Interpretation is used to reflect on the identified challenges and measures and, based on that, to propose a research agenda for this wider and multidisciplinary research program. The focus is on the theoretical and analytical implications of the spatiotemporal facets of ECS projects for the future analysis of such projects.

4. Data Analysis and Findings

Based on the research design selected it was possible to identify and categorize both ECS adoption challenges and measures through an in-depth content analysis and triangulating interview data. Furthermore, the spatiotemporal characteristics of challenges and measures could be examined and examples provided accordingly.

4.1 Identified and categorized ECS adoption challenges and measures

The aim of the first coding cycle is to generate two preliminary code tables, one containing the adoption challenges and the other containing the adoption measures identified from the literature. Following the open coding approach proposed by Miles and Huberman [31] and Saldaña [32], each selected article was carefully read, analyzed and coded. The first coding cycle with several coding iterations resulted in one code catalogue with 29 distinctive codes of ECS adoption challenges and another code catalogue with 39 distinctive codes of ECS adoption measures. Based on these open codes a second coding cycle applying pattern coding [31], [32] was initiated to iteratively develop meaningful categories and sub-categories of the identified challenges and measures. For this purpose, similar codes were grouped together and thematic codes developed. Five adoption challenge areas were identified, namely *culture*, *business/operation*, *technology in use*, *benefits*, and *attitude/behavior* each to which a group of challenge types and sub-types were assigned. Likewise, five adoption measure areas were identified, that is to say *preparation*, *guidance*, *optimization*, *influence*, and *prerequisite* each of which comprises also a group of measure types and sub-types.

Two technology startup companies that had introduced an ECS, MS SharePoint (Company A) and Atlassian Confluence (Company B), respectively, were willing to speak openly about their experience with the ECS adoption in semi-structured face-to-face interviews with a length of about 60 minutes each. One key user of Company A and one key user as well as the CEO of Company B were available for an interview. The data collected in these interviews in 2015 were recorded, transcribed and used to confirm and cross-reference the codes identified from the literature analysis as shown in Fig. 2. All codes were hierarchically structured to represent groups of challenges and measures and their order from general to particular.

The descriptions of all challenge codes can be found in our previous publication [1] in which we limited our analysis and discussion to understanding ECS adoption challenges. Building on our previous work and the new insights gained the challenge areas and the adoption measure areas (metacategories) can be described as follows (Table 2).

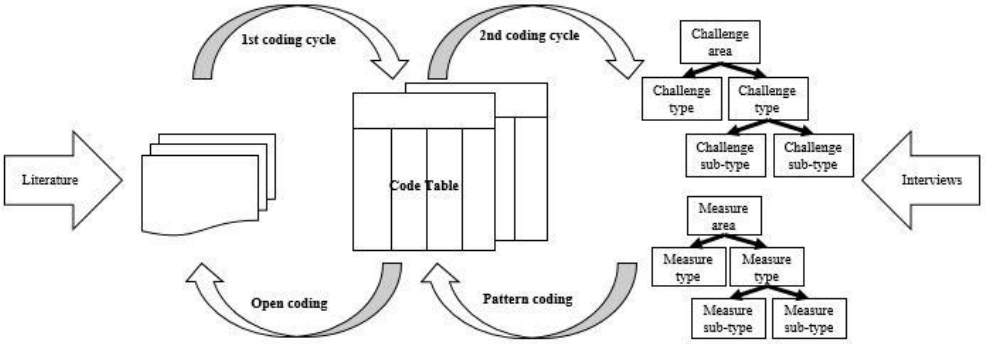

Figure 2. Coding process

Table 1. Challenge areas (adapted from [1])

Challenge area	**Description**
Culture	Challenges of this type are organizational challenges that can be traced back to the corporate culture being shaped by management behavior and attitudes as well as the cultural values and norms that exist within the company
Business/Operation	Challenges of this area can be attributed to both ineffective and inefficient uses due to operating without clear and suitable specifications/ objectives regarding the ECS project, as well as missing or poor general work management.
Technology in Use	Challenges of this area deal with the handling and management of work and working with the ECS technology itself. This includes personal adoption hurdles due to, for instance, lack of awareness and knowledge about the newly introduced ECS, poor quantity, quality and organization of the ECS content and information management processes, as well as poor integration of the ECS into the IT and work environment.
Benefits	Challenges of this type address the questionable benefits of using an ECS, with perceived disadvantages outweighing the perceived advantages of it. As an example, users might perceive a disproportionally high workload required for using the ECS.
Attitude/ Behavior	In contrast to the challenge area Culture, the challenge area Attitude/ Behavior addresses individual and not organizational level challenges. Employees may show inflexibility regarding the use of a new system, may not properly collaborate within the system for various individual characteristics and attitudes, or give only little priority to ECS use.

Table 2. Measure areas

Measure area	**Description**
Preparation	Measures of this type refer to the preparation in terms of both technical and human aspects. By seeding content in the system, for instance, employees might be attracted to using the ECS and its content. Thus, considering the current corporate and cultural situation and clarifying where the ECS journey shall be headed might help in designing the ECS project.
Guidance	Measures of this area aim to guide the employees in using the ECS. For this purpose, training, guidelines/ policies, or support might be considered suitable.
Optimization	Measures of this type aim to enhance and monitor the quality of ECS content and user performance.
Influence	Measures of this type address the employees' perceptions about the introduced ECS and their usage behavior. Stimulating self-motivation, providing gratification or the communication of individual benefits when using ECS might lead to success.
Prerequisite	Measures of this type aim to facilitate system adoption and use by establishing an environment that favors an enterprise collaboration culture. This could be achieved by valuing openness or establishing management commitment, for instance.

As stated, both challenge areas and measure areas include groups and sub-groups of challenges and measures, respectively. Four additional challenge codes were identified from the company interview transcripts; these were not found as part of the in-depth literature analysis. Three were added to the hierarchical collection of challenge codes and one to the hierarchical collection of measure codes already identified and categorized from literature. The new challenge codes are *Insufficient understanding of relevance*, *Overload*, and *Growing complexity*, as depicted in Table 1 showing the identified and categorized challenges. The new measure code is *Access control*, as can be taken from Table 2 showing the identified and categorized measures. All new codes are labelled with an asterisk (*) in the Tables 3 and 4. Although it is not the aim of this research to compare different ECS initiatives, it is assumed that challenges such as *Overload*, referring to employees being overwhelmed with work so they forget about using the ECS, are typical of startup companies which have often limited resources and the time to market as a primary driver of development [33].

The interviews revealed that the challenges both case companies had encountered during the introduction and use of the ECS partially overlap. Both companies only experienced a sub-set of the challenges identified from literature with *Low support*, *Lack of specific project goals*, *Lack of activity*, *Low quality*, *High effort* being perceived as particularly detrimental to ECS adoption. The company that had introduced MS SharePoint (Company A) additionally perceived *Missing alignment of structures*, *Low ECS skills, knowledge, and experiences*, and *Poor management of multiple tool/system usage* as highly challenging. The company that had introduced Atlassian Confluence (Company B) also classed *High time exposure*, *Productivity killer* as well as *Insufficient understanding of relevance*, *Overload*, and *Growing complexity* with the challenges of greatest concern. Interestingly, there was sometimes a mismatch between the perceived challenges of the Chief Executive Officer (CEO) and the key user, which shows that different actors may have different views of the ECS that was introduced and used in the respective company. While for instance, *Lack of processes* was mentioned by the key user of Company B as a perceived challenge, the CEO of this company did not perceive this challenge at all. Accordingly, the perceived need for taking action by means of appropriate measures to address ECS adoption challenges was dependent on the individual interviewee. Therefore, it is recommended that companies consider multiple views for successful ECS adoption as the diffusion of social software within the company is substantially linked to different groups of current and potential users [55]. Both companies applied some of the measures coded from the analyzed literature but not to intentionally address specific ECS adoption challenges. Among others, *Training the practical application of social features*, *Rules of conduct*, *Creation of personal profiles*, *Open communication*, *Inclusion of all employees from the beginning*, and *Minimizing mistrusting practices* were used. Although these measures were not used deliberately, the interviewees took the view that by applying these measures some challenges could have been prevented. One employee said:

> *"Yeah, all the problems like 'Poor anonymity' or 'Sense of missing rewards' are not fulfilled because mistrust is minimized […] This all arises out of our corporate culture which is very open and informal." (Employee, Company B)*

It is also important to note that each organization having introduced an ECS might use a different approach to managing ECS adoption challenges. While, for instance some organizations might reject the use of gamification measures, such as *Awarding a specific status* to employees for their contribution efforts publicly in the ECS, others might consider such measures particularly useful. Depending on the network of actors and the context in which the ECS is embedded, gamification measures might foster a competitive situation unpleasant for the users [53] or meet the need for rewards and thereby support system adoption [24]. Similarly, there is debate about whether the use of *Financial incentives* [24] or too much *Guidance* is conducive to the adoption of corporate social software [42]. The introduction of ECS is further complicated by the fact that organizations can encounter and be unprepared for ECS adoption challenges at different stages in the adoption process. When Company A introduced MS SharePoint the employees were initially very motivated to use it. The management also supported the employees to help them use the system and the usage rate was initially high. Over time, however, the challenge *Missing alignment of structures*, which refers to the mismatch between the organizational structure and the social software approach, led to a gradual decrease in usage. Through the development of the classification of adoption challenges it was confirmed that challenges occur at different points in time and to different stakeholder groups. The following section deals with the spatiotemporal aspects of challenges and the related measures to address these challenges.

Table 3. Classification of ECS adoption challenges

Challenge Area	Type of challenge	Sub-type of challenge
Culture	Missing commitment from the executives	Low acceptance [19], [24], [26], [34]
		Low support [29], [34]
		Insufficient understanding of relevance*
	Values and norms impeding change	Ingrained processes [20], [21]
		Resistance to changes [26], [35], [29], [36]
Business/Operation	Inappropriate project goals [34]	
	Lack of specific project goals [21], [35]	
	Missing alignment of structures [20], [22], [24], [29], [37]	
	Lack of processes [24], [26], [35], [38]	
	Overload*	
Technology in use	Inefficient content	Lack of activity [24], [25], [39], [40]
		Low quality [22], [23], [39]
	Lack of competence	Uncertainties about social SW usage [19], [24]
		Low ECS skills, knowledge, and experiences [20], [21], [23], [24]
	System inefficiencies	Poor management of multiple tool/system usage [27]
		Low awareness about the system's existence [29], [41]
		Growing complexity*
	Misuse of time and computing resources [26]	
Benefits	Perceived costs	High time exposure [20], [23], [26], [29]
		High effort [21], [23], [42]
		Productivity killer [23], [43]
	Perceived lack of protection	Privacy concerns [21], [39]
		Poor anonymity [23], [28]
	Sense of missing rewards [22]	
	Sense of loss of power [22], [24]	
Attitude/Behavior	Inflexibility	Reliance on other systems [21]
		Reluctance to learn another system [20], [21]
	Ineffective collaboration processes	Reluctance to modify other's content [21], [44]
		Low self-confidence [24]
		Avoidance of other's content and knowledge [24], [34]
		Employees underperforming [24]
	Little priority of collaboration [20], [21]	

Table 4. Classification of ECS adoption measures

Measure Area	Type of measure	Sub-type of measure
Preparation	Target-actual comparison	Analysis of employees' readiness and willingness for change [26], [34]
		Clarification of user expectations [2], [24]
		Business assessment [20], [45]
		Identification of CSFs and definition of performance measures [25], [26]
		Training needs analysis [46]
	System preparation	Seeding of content as a foundation [23], [25], [40]
Guidance	Training	Teaching the concept of ECS [19], [24]
		Training the practical application of social features [19], [24]
		Training about key use cases and collaboration scenarios [24], [27], [34], [47], [48]
	Guidelines/ Policies	Guidance on the structure of the social software tools [23]
		Guidance of the categorization of content [23], [24], [46]
		Rules of conduct [23], [26], [49]
		Policies for security and privacy protection [26]
	Support [23], [25]	
Optimization	Intervening	Implemented processes for reducing redundant information [21]
		Implemented procedure for misuse of time and computing resources [24], [26], [21]
		Access control*
	Monitoring	Usage of performance measures [26]
Influence	Marketing	Propagation of the new way of working [19], [24]
		Communication of target groups [23]
		Communication of overall business goals [19], [23], [50]
		Communication of set short-term goals and achievable short-term wins [24]
		Propagation of benefits [24]–[26], [34], [41]
		Development and marketing of an ECS brand name [51]
	Stimulating self-motivation	Discovering enjoyment [52], [53]
		Creation of personal profiles [24], [25]
	Providing gratification	Awarding a specific status [24]
		Usage of gamification elements assessing one's individual behavior (only for private viewing) [53]
		Usage of feedback mechanisms for reused content [23]
		Financial incentives [19], [24]
Prerequisite	Valuing openness, sharing, transparency	Involving all stakeholders [24], [34], [54]
		Establishing a balance between anonymity and individual accountability [50]
		Privileging open communication [23], [26], [50]
	Management commitment	Strong involvement and support from the top management [23], [41], [28]
		Visible executive sponsorship/endorsement [19], [23], [48]
	Procuring confidence	Inclusion of all employees from the beginning [34]
		Actively addressing employees' fears and social concerns [22], [41]
	Trust	Minimizing mistrusting practices [50]

4.2 Spatiotemporal characteristics of ECS adoption challenges and measures

Based on the descriptions of the identified codes it was possible to further analyze the adoption challenges to understand their spatiotemporal characteristics and impact on the ECS adoption process. For this purpose, the code descriptions were thoroughly read and another first coding cycle using attribute coding including In Vivo coding [32] was initiated allowing to capture essential characteristics of the challenges. After some iterations the following attribute codes and descriptors emerged:

- AFFECTING ENTITY: MANAGEMENT
- AFFECTING ENTITY: ORGANIZATION
- AFFECTING ENTITY: EMPLOYEES
- AFFECTED ENTITY: PIONEERS
- AFFECTED ENTITY: FIRST FOLLOWERS
- AFFECTED ENTITY: SECOND FOLLOWERS
- TIMING: PRE-INTRODUCTION PHASE
- TIMING: INTRODUCTION PHASE
- TIMING: POST-INTRODUCTION PHASE
- IMPACT: WITHHOLDS FROM USAGE
- IMPACT: AFFECTS EFFECTIVENESS OF USAGE

Both entity groups accountable for the identified challenges (*affecting entity*) and entity groups affected by the identified challenges (*affected entity*) were found. The descriptors *management*, *organization*, and *employees* were gathered for the affecting entity. Since the adoption of the ECS is meant to take place among the organization and its actors who can influence its diffusion [55], the affected entity is differentiated into distinctive adoption profiles with each representing one or two adopter categories proposed by Rogers [56]. Rogers suggests five adopter categories, namely innovators, early adopters, early majority, late majority, and laggards, to classify the individual or other unit of adoption into groups of actors with different sets of personality traits. To simplify the assignment of the identified ECS challenges to certain adoption profiles, the categories proposed by Rogers are clustered and renamed accordingly. Innovators and early adopters are represented by *pioneers*, early majority by *first followers*, and late majority and laggards by *second followers*. These descriptors also avoid the term laggards which is sometimes considered a negative label, since this adopter group has no strong pro-innovation bias [56]. Although it is assumed that the time at which an ECS adoption challenge occurs can be different from organization to organization, three time phases are coded to offer some orientation and show that challenges are not time-independent: *pre-introduction phase*, *introduction phase*, *post-introduction phase*. In addition, two primary types of impact that challenges have on the ECS adoption process were identified: *obstructs usage* and *affects effectiveness of usage*. Table 5 shows examples of the identified ECS adoption challenges and their spatiotemporal characteristics in terms of actors, timing, and impact type.

The challenge *Low support*, in which the management does not encourage the employees to use the ECS, might particularly obstruct usage. This can especially impact those with a relatively long innovation-decision period (first followers) when the system has not yet been fully integrated into daily work (introduction phase).

The challenge *Resistance to changes*, describing the low willingness to embrace the ECS due to fear of cultural change, is likely to impact those that are highly skeptical and traditional (second followers) and thus avoid using the system (obstructs usage). This challenge best fits the introduction phase when the cultural change process has not yet been completed and might be particularly the case in organizations where there is a general rejection of change.

The challenge *Lack of specific project goals*, referring to the situation in which the management has either not defined or communicated specific goals of the ECS project, particularly might lead to low motivation to use the just introduced system (introduction phase; obstructs usage). Once the users of the system have developed use cases and experienced

personal benefits from ECS use, this challenge might not be as serious as it had been. Therefore, this challenge might not so much negatively affect second followers but pioneers who are the first to adopt the ECS and first followers who adopt it just before the average employee of the company.

The challenge *Low quality*, which refers to content that is subject to immense uncontrolled growth, can only arise when the system is already introduced and used (post-introduction phase) by the employees. Low quality content that cannot be reused or does not add value might particularly affect the effectiveness of usage.

Table 5. Spatiotemporal aspects of exemplary ECS adoption challenges

Sub-type of challenge	**Actors**		**Timing**	**Impact**
	Affecting entity	**Affected entity** (adoption profile)		
Low support: The management does not properly promote and encourage the employees to use the ECS.	management	first followers	introduction phase	obstructs usage
Resistance to changes: Low willingness to embrace the system in discussion due to fear of cultural change.	organization	second followers	introduction phase	obstructs usage
Lack of specific project goals: A lack of specific project goals may lead to the assumption that ECS use does not lead towards fulfilling goals, and thus possibly to low motivation.	management	pioneers; first followers	introduction phase	obstructs usage
Low quality: Content edited in a willful or destructive manner to include irrelevant information (vandalism) or content that is subject to immense, uncontrolled growth. As a result the content may not be reused, add value or employees may encounter problems in terms of navigation, orientation and search.	employees	non-specific	post-introduction phase	affects effectiveness of usage

Just as challenges can occur at different times, ECS adoption measures can also be applied at different phases in the adoption process [24]. Through the identification and classification of measures it could be seen that measures can be preventive or counteractive in nature depending on whether they are applied before an organization encounters a certain challenge or after. This may also be linked to the approach an organization has taken. Who is implementing a certain challenge might or might not be prescribed, but depending on the nature of the measure different groups of actors with certain skills, experiences, and traits might be suitable. The measure codes were therefore also analyzed further to illustrate their diverse spatiotemporal characteristics. Again, the code descriptions were thoroughly read and attribute coding including In Vivo coding [32] was used to capture both the time a measure can be applied and its implementing entities. As for the challenges, the time periods *pre-introduction*, *introduction*, and *post-introduction phase* were considered suitable. For the implementing entity a variety of different actor groups (roles) were identified: *management*, *coaches/mentors/trainers*, *champions*, *employees*, *community/content managers*, *IT department*, *marketing*, *support agents/staff*, *community members*, and *initial project team*.

Thus, the following attribute codes and descriptors were assigned to the identified ECS adoption measures:

- TIMING: PRE-INTRODUCTION PHASE
- TIMING: INTRODUCTION PHASE
- TIMING: POST-INTRODUCTION PHASE
- IMPLEMENTING ENTITY: MANAGEMENT
- IMPLEMENTING ENTITY: COACHES/MENTORS/TRAINERS
- IMPLEMENTING ENTITY: CHAMPIONS
- IMPLEMENTING ENTITY: EMPLOYEES
- IMPLEMENTING ENTITY: COMMUNITY/CONTENT MANAGERS
- IMPLEMENTING ENTITY: IT DEPARTMENT
- IMPLEMENTING ENTITY: MARKETING
- IMPLEMENTING ENTITY: SUPPORT AGENTS/STAFF
- IMPLEMENTING ENTITY: COMMUNITY MEMBERS
- IMPLEMENTING ENTITY: INITIAL PROJECT TEAM

Table 4 shows examples of the identified ECS adoption measures and their spatiotemporal characteristics in terms of actors and timing.

Table 6. Spatiotemporal aspects of exemplary ECS adoption measures

Sub-type of measure	**Actor: Implementing entity**	**Timing**
Teaching the concept of ECS: Showing new ways of working and the potential of enterprise social software for day-to-day business. Teaching employees the concept of ECS may facilitate ECS adoption.	coaches/mentors/trainers, champions	introduction phase
Development and marketing of an ECS brand name: The development and marketing of an ECS brand name to achieve name recognition and increase system awareness.	management, marketing, initial project team	pre-introduction phase, introduction phase
Usage of feedback mechanisms for reused content: Usage of feedback mechanisms by which community members instantly receive feedback whenever other members use their contributions.	IT department	post-introduction phase

The measure *Teaching the concept of ECS* is typically applied by trainers but can also be applied by champions who are known for stewarding the adoption process by encouraging others to use the social software based on their own experiences [19], [20]. This measure might be particularly important at the beginning of the ECS project (introduction phase) when the ECS is not yet widely used for daily work.

The measure *Development and marketing of an ECS brand name*, which is used to increase system awareness, can be implemented at any time. However, it may be most effective when having a brand name right from the start. Thus, it is sensible to already have developed the name before introduction and to market it alongside the system introduction.

The measure *Usage of feedback mechanisms for reused content*, where users receive feedback whenever other users make use of their contributions, is a technical task (e.g. through implementation of post tracking, automatic notifications and usage analytics) and therefore most suitable for the IT department as the implementing entity. By nature, it would make the most sense if the platform already has enough users (post-introduction phase) so that such mechanisms do not lead to demotivation in the case of little reused content.

It is important to note that the division of time into pre-introduction, introduction and post-introduction phase does not properly consider the speed with which the ECS is adopted or that different groups within the organization may be concurrently in different phases. However, it helps to show that organizations are likely to encounter different challenges at different times and that different measures might be implemented at different times. The following section builds on the gained insights into the spatiotemporal aspects of ECS challenges and measures and the specific nature of ECS as sociotechnical systems to discuss theoretical and analytical issues relevant for the research program's future studies on ECS adoption, appropriation, and use.

5. Interpretation

Traditional enterprise software like ERP systems or groupware can be described as purpose-specific end-user software developed and introduced to address an existing corporate problem. They are typically employed for clearly defined usage scenarios and within specific business contexts as well as often used on a mandatory basis usually after a set go-live date. This often requires a planned approach to managing change in a revolutionary context [8], [28]. In accordance with [8], [47], [57]–[61], enterprise collaboration systems are, unlike traditional enterprise software, often introduced ad-hoc to create potential and used on a voluntary basis. Since social software is particularly malleable and thus does not have prescribed forms of usage, companies are confronted with interpretive flexibility [62]. There are multiple interpretations with regard to how and for what purpose social software can be used. ECS can support a variety of work practices that may not follow a specific business purpose, and, therefore, can be part of the organization for any business process. The potentials of ECS are explored over time through use and the actual benefits emerge through experimentation and appropriation. Thereby, the form of usage, which evolves over time, depends on the context it is embedded in and that likewise is subject to change. Since ECS are designed through use, including experimenting with its capabilities, organizations cannot fully anticipate a priori the route of ECS use, the adoption challenges they will encounter and the benefits that will actually unfold. This means that they cannot easily plan for in advance how the system is to be used. Although benefits are expected [57] organizations often lack a clear vision of how to ensure benefits realization [9] which is considered to be due to diverse options for using ECS (multiple interpretations). This uncertainty is linked to a variety of ECS adoption challenges. The challenges *Insufficient understanding of relevance*, *Uncertainties about social SW usage*, or *Employees underperforming* are some examples to name but a few.

The analysis of ECS adoption challenges and measures shows that they are indeed multifaceted in terms of time and space. The examples used in this article to illustrate their diverse nature highlight the complexity of ECS projects in which organizations and their different stakeholders can encounter a multitude of challenges over time. In the course of this, some challenges that, for example, prevent certain groups of actors from usage when the system is introduced, such as *Low support*, might later be nonexistent anymore when the employees have learned how to use the ECS and what (personal) benefits can be realized through use. Likewise, the measure *Usage of feedback mechanisms for reused content* might only be suitable for certain contexts and when the ECS adoption process is already at an advanced stage. Enterprise collaboration systems can be seen as sociotechnical systems that incorporate human and non-human actors, i.e. hardware and software as well as people, processes and organizational aspects [47]. The entanglement of human and material practices, including different ECS adoption challenges, changes over multiple time frames and settings. Organizations can try to address certain challenge in a preventive or counteractive manner but they have to accept and deal with uncertainty.

The power of users to impose new meaning on technology particularly applies to ECS, as they are designed through use. However, the way ECS use and its related challenges evolve over time and context lacks scientific attention. Since there is often the need to justify IT investment decisions, researchers tend to look at what companies expect from the ECS introduction, i.e. which benefits are expected (e.g., [29], [41], [58]). There is also a range of studies focusing both on ECS challenges and success factors as well as related adoption and appropriation strategies and methods (e.g., [19], [24], [61], [63]). Such studies were primarily used as a basis for this article. Although it is acknowledged that there is no universal solution for the successful adoption of ECS and gaining value from ECS, the findings of such studies are not only fragmented as stated before but are also prone to disregard the sociotechnical nature of ECS and the way it is

shaped. It is now time to address this drawback and consider the temporal and spatial facets of ECS that may lead to unexpected outcomes. Since ECS use is still in its relatively early days, there is the unique opportunity to track the evolution of it from the early implementation and learn from practice. Therefore, future studies of this research program aim to examine and understand what happens when such sociotechnical systems are evolving, i.e. how ECS are designed through use over time including contextual, technological and organizational events as well as changing work practices, stakeholders, challenges, measures, expectations and benefits. This will allow conclusions on why an ECS, a new form of information infrastructure [64], can be successfully used even if initial expectations are not met. The goal is not to generalize but to explore ECS use through in-depth, longitudinal case studies and to learn from the experiences organizations collect. Since this exploration of ECS use is a long-term endeavor that requires the consideration of multiple time frames and settings, there is a strong need to draw on different theoretical perspectives that provide analytical cues to the relevant sites and settings for investigation and that account for the complex and dynamic relationship between the social and the technical elements of ECS. For this purpose, it is planned to collect data from enterprises that have introduced ECS. This process is now underway with companies that are participants in our multi-organization practice-based research community [65].

6. Concluding remarks

A literature review on the adoption of enterprise social software and enterprise collaboration systems revealed that related research is currently fragmented and provides few in-depth empirical cases. To address this issue, a meta-analysis of ECS and ESS literature was conducted to provide an overview of identified and classified adoption challenges and measures. This in-depth literature analysis and synthesis was supplemented by triangulating interviews with companies. Two startup companies were willing to speak openly about their experiences with the introduction of ECS. Through the interviews additional challenges and measures that had not been identified as part of the literature analysis could be found. Both research and practice showed that ECS adoption challenges and measures can be linked to different time phases of the ECS project and different stakeholder groups. To illuminate the diverse nature of ECS challenges and measures, examples of both challenges and measures and their spatiotemporal characteristics were provided.

This article does not propose any mapping between specific ECS adoption challenges and specific measures, because it is assumed that the evolution of each ECS project is unique and there is no generally valid solution for the effective adoption of ECS. While this article successfully aggregates the findings of many localist studies it only broaches the diversity and multifacetedness of ECS adoption challenges and measures. It does not show in detail what happens when such sociotechnical systems are moving through time and space. Based on the findings of this article it was, however, possible to identify the theoretical and analytical imperatives for studying sociotechnical change of ECS and thus for gaining richer insights into the adoption, appropriation and use of ECS.

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