Evaluating the individual and organizational impact of enterprise content management systems

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Abstract

Purpose – The purpose of this paper is to gain a deeper comprehension of the nature of enterprise content management systems (ECMS) success by exploring factors that are important in the context of ECMS success, i.e. how these factors can be measured, and how they are interrelated.
Design/methodology/approach – The paper develops a success model specific to the enterprise content management (ECM) domain that builds on the DeLone and McLean information systems (IS) success model. The model is empirically tested by means of structural equation modeling applying the partial least squares approach and using data collected in an online survey.
Findings – The results show that ECMS positively affects organizational content management in terms of efficiency, collaboration and compliance. It also provides evidence that the use of the ECMS alone does not provide impact to the organization, but needs to be moderated either by the impact of the ECMS on the user or the users' satisfaction of the ECMS.
Practical implications – For practitioners, the model identifies the factors that influence the success of ECMS. Practitioners can monitor these factors as performance indicators to improve users' satisfaction with the ECMS and, thus, the success of their ECMS. Furthermore, the results can support practitioners in understanding the multiple facets of ECMS success to improve how they plan and prepare for ECM investments.
Originality/value – The study's results contribute to theory by extending and empirically testing the D&M IS success model in a new domain and system context. The presented research is the first to empirically validate a comprehensive ECMS success model that extends knowledge related to ECM by examining the relationship between the quality dimensions and the success measures.

Keywords Enterprise content management, Individual impact, Information systems success, Organizational impact

Paper type Research paper

1. Introduction

The dynamic development of new technologies like e-mail and the internet has resulted in highly efficient ways for organizations to communicate and exchange information with customers and business partners (Gunasekaran *et al.*, 2002). The downside of this development is that organizations now have a steeply rising amount of information and number of documents to control. A study published by IDC (Turner *et al.*, 2014) estimated that the worldwide amount of information created and replicated double every two years and will reach 44 trillion gigabytes by 2020. Managing this large amount of information is challenging, especially considering the wide variety of types and formats in which information exists and the diverse types of devices used to access it. As a response to this challenge, several concepts for organizational information management have emerged, such as document management and (web) content management.

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The latest successor to these approaches is enterprise content management (ECM). ECM integrates several extant information management approaches to support organizational processes and work practices and manages content over its entire life cycle. As such, ECM is an important facilitator for business process management, as content and high content quality usually play an important role in the management and execution of organizational processes (Frappaolo, 2008). Also processes link the different content life cycle phases with each other, and therefore business processes are the backbone of ECM (Kampffmeyer, 2006).

Technology is an important enabler of ECM. ECM systems (ECMS) can refer either to a single ECM suite that provides all functionalities required to manage an organizations content or to a single information technology (IT) system or a combination of systems, such as document management systems or web content management systems (Simons and vom Brocke, 2014). As such, ECMS are a class of IT that supports the enterprise-wide management of content over its entire life cycle. ECMS vendors often promise that ECMS can solve organizational information management problems and improve organizational performance by reducing time to market, enhancing knowledge sharing and collaboration, and increasing worker and process efficiency (Pullman and Gu, 2008). Because of these benefits, ECMS have received considerable attention from organizations, reflected through a steadily increasing ECMS market and prediction of revenue of $9.3bn in 2017 (Radicati Group, 2013). Naturally enough, organizations are interested in learning whether their considerable investments in ECMS are returning the benefits promised, but determining the return on ECMS investments is not an easy task (Allen, 2007) because the benefits of ECMS are not always easily measurable in monetary terms (AIIM, n.d.). Therefore, the benefits of investments in ECMS, as is the case with information systems (IS) in general, are rarely systematically evaluated after their implementation (Gable and Rai, 2009).

Although the field of ECM has gained increasing attention from research in the last 10 years, the investigation of ECMS' impact on organizations has not. Therefore, we have only a vague understanding of what drives ECMS success or how its success (or lack thereof) can be measured. This research gap has also been uncovered by other researchers. Simons and vom Brocke (2014) concluded that "the impact of ECM on individuals, groups, and organizations has rarely been investigated empirically" (p. 6), while Alalwan and Weistroffer (2012) stated that "[r]esearch is needed to address how ECM performance can be evaluated" (p. 454), Munkvold *et al.* (2006) found a need to evaluate "the impacts of comprehensive ECM programs" (p. 93) and Rickenberg *et al.* (2012) called for validation of "ECM benefits empirically and quantitatively" (p. 9). Therefore, the purpose of our study is to contribute to IS research by developing a more precise understanding of organizational ECMS success. More specifically, our research explores what factors explain ECMS success, how they are interrelated and how they can be measured. Thus, the goal of this study is to develop and empirically evaluate a success model that is specific to the ECM domain with a particular focus on the organizational impact of ECMS, particularly the impact of ECMS on certain objectives that have been reported in the ECM literature.

2. Foundations

2.1 Enterprise content management

When the ECM concept emerged at the beginning of the millennium, there was no agreement on what it covers. Smith and McKeen (2003) noted that, "if there's one thing that all the experts agree on, it is that no one really knows exactly what ECM really is" (p. 648, citing Gilchrist, 2001). While ECM was first understood as a technological solution, during the last decade its definition has broadened to include non-technological perspectives. Now, more than a decade later, ECM can be understood as "the strategies, processes, methods, systems, and technologies that are necessary for capturing, creating, managing, using, publishing, storing, preserving, and disposing content within and between organizations" (Grahlmann *et al.*, 2012, p. 272). As such, ECM is an approach to information management with an enterprise-wide focus and that crosses organizational boundaries by including entire supply chains

(Simons and vom Brocke, 2014). The ECM definition already suggests that ECM plays an important role in business processes. On the other side, organizational processes play an important role in ECM as the successful customization and implementation of ECMS require a deep understanding of content-related activities (vom Brocke, Simons and Cleven, 2011). As such, the boundaries of the concepts are still fuzzy (Chambers, 2007).

ECMS are the technical facilitators of the management of an enterprise's content (Grahlmann *et al.*, 2012). The ECMS market contains a plethora of vendors that offer monolithic ECM suites as well as single IS that focus on particular types of content and applications and offer various ECM capabilities. Among the core ECM components and capabilities of ECMS are document management (e.g. check-in/check-out and version control), image-processing applications (e.g. capturing, transforming and managing images of paper documents), content workflow (e.g. supporting business processes, routing of content, assigning work tasks and states), records management (e.g. long-term retention of content, ensuring legal, regulatory and industry compliance), web content management (e.g. administrating and controlling of web content through the use of certain management tools) and social content (e.g. document sharing, collaboration and knowledge management (KM)) (Gartner, 2014).

While research and practice have paid some attention to the reasons for organizational ECM interest and investments, we have only a vague understanding of what constitutes the success of ECM in organizations, what organizations actually gain through ECM and to what extent they realize their specific ECM objectives (e.g. compliance and enhanced collaboration) by implementing ECMS. Only little research has been conducted to investigate what dimensions influence the success of ECM and what effect ECM has on the individual or the organization. Therefore, an ECMS success model can be of value to both practitioners and researchers. For researchers, an ECMS success model can help to identify the dimensions of ECMS success and to determine the causality and relationships among these dimensions. Practitioners can benefit from an ECMS success model by using the resulting survey tool to evaluate their ECM success after implementing ECMS.

2.2 IS success

The evaluation of IS success has received considerable attention in IS research (Urbach *et al.*, 2009). This IS research stream "evaluates the effective creation, distribution, and use of information via technology" (Petter *et al.*, 2012, p. 342), but defining the term "IS success" is not an easy task. The literature presents several definitions, but the definition of the term depends to a great extent on the stakeholder's perspective (Urbach *et al.*, 2009). For an organization the success of IS might be based on increasing profits, whereas success for an individual employee might mean the simplification of daily tasks (Urbach *et al.*, 2009).

To clarify the nature of IS success, DeLone and McLean (1992) carried out a literature review from which they derived a comprehensive IS success model. Other theories and models that emerged at around the same time to address the measurement of IS success included Seddon's (1997) IS success model, which extends the D&M IS success model (DeLone and McLean, 1992), and the technology acceptance model (Davis, 1989) and its extensions, which evaluate the technologies' level of acceptance. A decade after DeLone and McLean (2003) presented their D&M IS success model, they extended and updated it by adding a service quality dimension that reflects the increasing role of organizations in providing support for end users and by merging two constructs that referred to the impact of IS on the individual and the organizational level into one net benefits construct. With these two modifications, the updated D&M IS success model comprised six interrelated constructs: information quality, system quality, service quality, (intention to) use, user satisfaction and net benefits.

Since then, the D&M IS success model has been discussed, modified and applied in various IS research streams, some of which can be considered ECM related. For example, Kulkarni *et al.* (2007) developed and tested a KM success model based on the D&M IS success model

(DeLone and McLean, 1992, 2003), and Paré *et al.* (2005) evaluated a success model for a picture-archiving and communication system (PACS) from multiple users' perspectives in a health-care setting. Their study showed that different user groups, such as radiologists, technologists and clinicians, have different views concerning the factors that influence PACS success (Paré *et al.*, 2005). Adeyinka and Mutula (2010) developed a model for evaluating WebCT course content management systems success, a system that manages teaching and learning by supporting the procedures of content creation, storage and retrieval, transfer, delivery and application, in an educational setting. Urbach *et al.* (2010) developed and evaluated a success model for employee portals, arguing that two major purposes of employee portals are the technical support of business processes and enabling collaboration among users, so they extended the D&M IS success model to include the quality dimensions of collaboration and process quality. Gable *et al.* (2003) developed a model for enterprise systems success using the dimensions information quality, system quality, individual impact and organizational impact.

These ECM-related studies were all based on the D&M IS success model (DeLone and McLean, 1992, 2003), so we can assume that the D&M IS success model can serve as a foundation for explaining ECMS success as well. To our knowledge, no theoretical model for explaining the success of ECMS has been proposed. Although these ECM-related studies present important sub-dimensions of ECM, such as content archiving, storage and retrieval, none of them covers the full spectrum of ECM. In addition, these models are specific to the context in which the studies were conducted (e.g. picture archiving in hospitals, content management in an educational setting) and when considering the six components of the IT systems classification as proposed by Seddon *et al.* (1999), they refer to the assessment of single IT applications in a single context. However, ECM is usually realized through various integrated technologies and applications that reflect multiple aspects of ECM, so a deep evaluation of the factors that drive the success of ECMS as a specific class of IT applications is needed. In addition, the extant studies cited here do not include specific ECM objectives as factors for measuring the success of ECMS on the organizational level, a criticism that is in line with the finding of two literature studies that suggested that the organizational impact of IS has received much less attention in research than has the individual impact (Petter *et al.*, 2008; Urbach *et al.*, 2009). Therefore, there is a need to clarify the nature of ECMS success from the organizational perspective, not just from the individual perspective.

3. Research model

This section presents the development of our research model. The model builds on and extends the D&M IS success model (DeLone and McLean, 1992, 2003). Because it has been tested and proven in many IS contexts, we kept as many of the elements of the original D&M IS success model as possible. However, as DeLone and McLean (1992) pointed out, because IS success is a multidimensional concept, its measurement should involve measures that are suitable to the research objective and method, organizational context and level of analysis. Therefore, we extended the D&M IS success model with constructs specific to the ECM domain. In the following paragraphs, we introduce all constructs of our ECMS success model and provide rationales for our assumptions about the relationships between them.

The system quality construct refers to the characteristics of the IS that produces the information (DeLone and McLean, 1992). System quality has been shown to be an important success factor in many contexts, including ECM-related areas (Kulkarni *et al.*, 2007; Halawi *et al.*, 2008; Adeyinka and Mutula, 2010). Therefore, we assume that system quality is also a valid factor in measuring ECMS success, because ECMS with poor technical performance or with missing technical functionalities like search and retrieval would hinder the user's performance of daily tasks because of extra time and effort required.

Service quality was suggested as another construct for measuring IS Success (Pitt *et al.*, 1995; DeLone and McLean, 2003). It was argued that the development of IT requires

organizations to provide both the information products and support for the end users (DeLone and McLean, 2003). Because service quality is a construct from the D&M IS success model (DeLone and McLean, 2003) and because ECM-related studies have shown that it is a valuable measure for assessing IS success (e.g. Adeyinka and Mutula, 2010), we include service quality in our ECMS success model.

Finally, the quality of information has received some attention in the ECM literature, and studies that have investigated ECM drivers and objectives have reported the need to improve or maintain information quality through organizational ECM initiatives (e.g. vom Brocke, Simons, Herbst, Derungs and Novotny, 2011; Päivärinta and Munkvold, 2005). Additionally, information quality has been shown to be an effective IS success measure in many contexts, including ECM-related domains (e.g. Adeyinka and Mutula, 2010; Urbach *et al.*, 2010). Therefore, we assume that information quality is also a valid construct in our ECMS success model.

We added the final quality dimension, process quality, to the ECMS success model after our pilot study because it (and the literature, e.g. Smith and McKeen, 2003; Tyrväinen *et al.*, 2006) showed that ECMS are often expected to support and simplify organizational work processes. Our initial model did not reflect process support, so we added the fourth quality dimension of process quality, which was originally introduced by Urbach *et al.* (2010).

The construct use is another important factor in measuring IS success because a system that is not used cannot create value for an individual or an organization. In the context of ECMS, we believe use is an appropriate measure, whether the use is voluntary or mandatory. Therefore, we assume use to be an important indicator of ECMS success, especially because ECMS functionalities such as create or store reflect different content life cycle phases.

Further, user satisfaction is likely to be another important success dimension because a user who is not satisfied with the ECMS is unlikely to use them. However, ECMS may not positively affect all employees, especially in the beginning. In addition, user satisfaction has been shown to be a valuable success measure in ECM-related success studies (e.g. Adeyinka and Mutula, 2010; Paré *et al.*, 2005; Kulkarni *et al.*, 2007), Therefore, we include user satisfaction as a separate construct in our ECMS success model.

It has been argued that measuring the dependent variable of IS success – often called impact or net benefits – can be done on many levels (Herbst, Urbach and Brocke, 2014; Seddon, 1997; DeLone and McLean, 2003). In their original model, DeLone and McLean suggested assessing the impact of IS on both the individual level and the organizational level (DeLone and McLean, 1992). Subdividing the impact of IS in this way is reasonable because different entities might perceive success differently (Urbach *et al.*, 2009). Therefore, we argue that, in the context of ECM, both the individual impact and the organizational impact of ECMS are relevant to explain ECMS success.

Unlike many other information management concepts, ECM aims to manage unstructured information on an enterprise level, so implementing ECMS implies benefits for the entire organization. Because of ECMS' wide scope, their implementation usually involves considerable financial investment, so organizations want to be able to determine the success of such projects by measuring the level of achieving the goals. We conducted a literature review to identify the organizational objectives/drivers for ECM investments and identified three major drivers: efficiency, collaboration and compliance. These three objectives were also confirmed in Rickenberg *et al.*'s (2012) literature review. Table AI shows the references that mention these ECM objectives either directly or indirectly by mentioning some of their aspects. We measure the organizational impact of ECM as the extent to which the three ECM objectives are met through using ECMS.

Organizations are always searching for new ways to reduce costs and increase efficiency (Andersen, 2007). While the impact of tools like intranets and KM systems on organizational efficiency has been shown (Iverson and Burkart, 2007), ECMS' impact on organizational efficiency remains uncertain. Typical characteristics of organizational efficiency that we

encountered in the context of ECM in our literature study include reducing costs (e.g. Munkvold *et al.*, 2006; Scott *et al.*, 2004), search times (e.g. vom Brocke, Simons and Cleven, 2011) and the time and effort required for content-related activities like reporting and publishing (e.g. Scott *et al.*, 2004; Sprehe, 2005), and improving the use of organizational content (Iverson and Burkart, 2007; vom Brocke, Simons, Herbst, Derungs and Novotny, 2011; Smith and McKeen, 2003). Because pure financial measures for assessing organizational efficiency (Maltz *et al.*, 2003) are elusive and because they are also easy to manipulate (Gable *et al.*, 2003), we focus on non-financial efficiency measures gathered from characteristics encountered in the ECM literature.

The second ECM objective identified in our literature analysis is collaboration, which plays an important role in content creation (Podean *et al.*, 2011) and its subsequent management. Content is often created by a group of people to be shared with people across the organization. The content-creation process can be broken into various tasks that must be performed in close collaboration between internal and sometimes external stakeholders (Iverson and Burkart, 2007). Eliminating departmental content silos where content is created and managed in isolation is important for organizations that must comply with legal regulations (Rockley *et al.*, 2003) and that want to improve knowledge sharing and communication within as well as beyond organizational boundaries (vom Brocke, Simons and Cleven, 2011).

The last of the three ECM-specific objectives is compliance, which has been mentioned frequently as one of the main drivers for organizations to engage in ECM (e.g. Rickenberg *et al.*, 2012; Usman *et al.*, 2009). Legal regulations like the Sarbanes–Oxley Act and international privacy laws make it essential for organizations to be able to maintain their transaction-related records and information (ARMA International, 2013). The literature mentions compliance challenges related to the management of enterprise content from undesired content and knowledge loss (vom Brocke, Simons, Herbst, Derungs and Novotny, 2011) to storage of content in private folders (Nordheim and Päivärinta, 2006), errors in products and services (vom Brocke, Simons, Herbst, Derungs and Novotny, 2011), and unauthorized disclosure, modification and destruction of content (Chiu and Hung, 2005). Such content management problems can lead to inadequacies in record-keeping, which can threaten an organization's very existence (ARMA International, 2013).

Table I gives an overview of the ECMS constructs and their meaning in the context of this study.

Construct	Origin	Definition
System quality	DeLone and McLean (1992, 2003)	Users' perception of the technical performance of ECMS
Use	DeLone and McLean (1992, 2003)	The usage of different ECMS functionalities
User satisfaction	DeLone and McLean (1992, 2003)	Users' subjective attitudes and feelings of pleasure or displeasure about ECMS
Service quality	Pitt *et al.* (1995), DeLone and McLean (2003)	The overall support provided to users in the context of the ECMS
Information quality	DeLone and McLean (1992, 2003)	The quality of the information that is provided by the ECMS
Process quality	Urbach *et al.* (2010)	The quality of support for work processes provided through the ECMS
Individual impact	DeLone and McLean (1992)	The extent to which ECMS influence the users' individual capabilities and effectiveness while performing their jobs
Efficiency	Derived from ECM literature	The organizational content management performance
Collaboration	Derived from ECM literature	The cooperation among people concerning the creation, sharing, availability and overall management of content
Compliance	Derived from ECM literature	Acting in accordance with established laws, protocols and standards concerning the management of content

Table I.
ECMS success constructs

In the following, we outline the development of our hypotheses.

Concerning the relationship between the quality constructs and use as well as user satisfaction (e.g. Adeyinka and Mutula, 2010; Paré *et al.*, 2005; Kulkarni *et al.*, 2007; DeLone and McLean, 1992, 2003), we followed the suggestions of previous research assuming a positive relationship. It is likely that a bad ECMS quality and those with missing core functionalities will not be used, and for the same reason a user will not be satisfied with the system. For the construct service quality this assumption makes sense as well. ECMS changes how people work. It is likely that, especially in the beginning but also over time, questions and problems will arise concerning correct ECMS use and work-practice-related changes, and only if these questions and problems are appropriately addressed will a user be able of using the ECMS and experience the system in a positive way. Concerning information quality, it has to be assumed that ECMS that provide users with low-quality information products are of no benefit, so there is no need for users to use such ECMS. And if ECMS do not provide high-quality information, users are unlikely to be satisfied. A positive relationship between process quality and the constructs use and user satisfaction can also be assumed in the context of ECM. ECMS are meant to support organizational work practices, but a system that fails to do so adds no value to the users' work practice, making it unlikely that a user will use the system or that he or she will be satisfied with it.

The constructs use and user satisfaction are predicted to have a positive relationship with each other (DeLone and McLean, 1992, 2003). To be satisfied with ECMS, a user must first use a system. We can also assume that, with increasing use of ECMS, users get to know the systems and develop routines for using them for their own benefits (e.g. improving personal work performance), increasing ECMS satisfaction. A satisfied user is likely to use ECMS more often than an unsatisfied user (DeLone and McLean, 1992, 2003). Also, in their original IS success model, DeLone and McLean (1992) predicted a positive relationship between individual impact and use and between individual impact and user satisfaction. The rational for this assumption is that a user's using ECMS or the user's satisfaction with ECMS will lead to individual benefits. In their employee portal success model, Urbach *et al.* (2010) predicted that process quality has a positive influence on use and on user satisfaction, which can also be assumed in the context of ECMS.

We identified all three constructs – efficiency, collaboration and compliance – as specific goals that organizations pursue through the implementation and use of ECMS, so their realization can be seen as an organizational benefit. In their original model, Delone and Mclean (1992) hypothesized that the impact of IS on an individual's performance will eventually have some impact on the organization. This argument is reasonable because a user who benefits from using an ECMS also saves this time and effort for the organization. However, it can be assumed that ECMS use and the users' satisfaction with the ECMS not just influences the individual but at the same time the organization independent of the impact of the ECMS on the individual. While individual ECMS use might be beneficial for an organization in terms of a higher level of compliance or an increased level of efficiency, it might imply at the same time additional effort for a user's daily routines by, for example, requiring the addition of metadata to information or scanning paper documents (Herbst, Simons, vom Brocke and Derungs, 2014) and as such not influencing a user's impact positively. A summary of our hypothesis for the ECMS success model is given in Table II.

Our overall research model for evaluating the success of ECMS, including the hypotheses to be tested, is shown in Figure 1.

4. Research method

4.1 Instrument development

We followed the recommendations of DeLone and McLean (2003) and other researchers to ensure validity by relying on tested and proven measures, when they were available, to

No.	Hypothesis
H1	A high level of system quality is associated with a high level of ECMS use
H2	A high level of system quality is associated with a high level of user satisfaction with the ECMS
H3	A high level of service quality is associated with a high level of ECMS use
H4	A high level of service quality is associated with a high level of user satisfaction with ECMS
H5	A high level of information quality is associated with a high level of ECMS use
H6	A high level of information quality is associated with a high level of user satisfaction with ECMS
H7	A high level of process quality is associated with a high level of ECMS use
H8	A high level of process quality is associated with a high level of user satisfaction with ECMS
H9	A high level of use is associated with a high level of user satisfaction with ECMS
H10	A high level of user satisfaction is associated with a high level of ECMS use
H11	A high level of ECMS use is associated with a high level of users' individual impact
H12	A high level of user satisfaction with ECMS is associated with a high level of individual impact
H13	A high level of individual ECMS impact is associated with a high level of organizational efficiency
H14	A high level of individual ECMS impact is associated with a high level of organizational collaboration
H15	A high level of individual ECMS impact is associated with a high level of organizational compliance
H16	A high level of ECMS use is associated with a high level of organizational efficiency
H17	A high level of ECMS use is associated with a high level of organizational collaboration
H18	A high level of ECMS use is associated with a high level of organizational compliance
H19	A high level of user satisfaction with ECMS is associated with a high level of organizational efficiency
H20	A high level of user satisfaction with ECMS is associated with a high level of organizational collaboration
H21	A high level of user satisfaction with ECMS is associated with a high level of organizational compliance

Table II.
Hypothesis

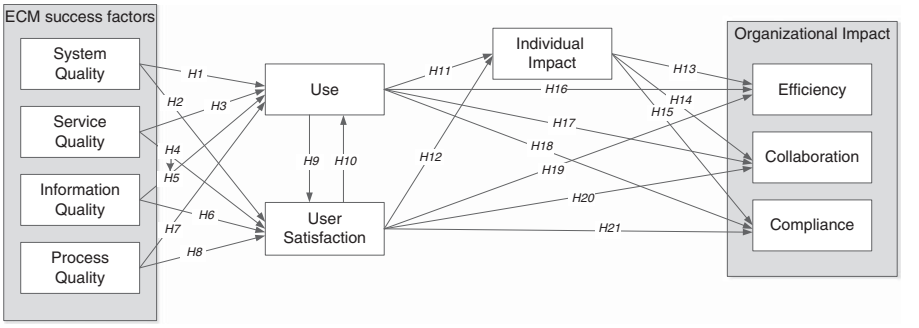

Figure 1.
The ECMS success model

conceptualize the constructs in our model. We adopted items from previous studies and adjusted them to the ECM context and added new items if not all aspects of the domain were covered by existing ones. We identified no appropriate set of items for the new constructs efficiency, compliance and collaboration, so we developed new items based on factors identified in the ECM literature. We engaged in a scale-development process proposed by Recker and Rosemann (2010) to develop and test the ECMS success measures. Our activities included expert interviews, a card-sorting and item-ranking approach (Moore and Benbasat, 1991), as well as a pilot study with 60 ECMS users. Based on the results of these steps, we defined our final survey instrument. Table III presents the final set of items that we used in our study.

4.2 Data collection

We compiled an online survey in English, German and French, ensuring consistency among the three language versions by translating the questions back and forth among the languages. For the data collection, we contacted several companies and public administrations, providing

Construct	Items	References
Information quality	Relevancy, usefulness, reliability, timeliness, accuracy	Items adapted from Bailey and Pearson (1983), Urbach *et al.* (2010) and Wang *et al.* (2007)
System quality	Ease of navigation, ease of use, user friendliness, ease of information access, retrieval functionalities	Items adapted from Bailey and Pearson (1983), Urbach *et al.* (2010) and Wang *et al.* (2007), new item derived from Grahlmann *et al.* (2012)
Service quality	Responsiveness, reliability, assurance, availability, quality of training	Items adapted from Urbach *et al.* (2010), Wang *et al.* (2007) and Pitt *et al.* (1995)
Process quality	Traceability, accuracy, ease of initiation, reliability, completeness	Items adapted from Urbach *et al.* (2010)
Use	Extent of using typical functions, frequency of using the ECMS	Items adapted from Urbach *et al.* (2010) and Iivari (2005)
User satisfaction	User expectations, effectiveness, efficiency, overall satisfaction, pleasure of use	Items adapted from Lin (2007), Urbach *et al.* (2010) and Wang *et al.* (2007)
Individual impact	Job efficiency, job effectiveness, job performance, task performance, productivity	Items adapted from Urbach *et al.* (2010)
Efficiency	Efficient reuse, efficient use, faster publishing, reduced search time	New items derived from Dilnutt (2006), Päivärinta and Munkvold (2005), Scott *et al.* (2004), Smith and McKeen (2003), Munkvold *et al.* (2006), vom Brocke, Simons, Herbst, Derungs and Novotny (2011), and Iverson and Burkart (2007)
Collaboration	Comfort, knowledge sharing, joint content creation, resolving content silos	New items derived from Munkvold *et al.* (2006), Podean *et al.* (2011), Rockley *et al.* (2003) and Urbach *et al.* (2010)
Compliance	Content deletion, local content storage, change traceability, content protection, history recording	New items derived from Chiu and Hung (2005), Munkvold *et al.* (2006), Nordheim and Päivärinta (2006) and vom Brocke, Simons, Herbst, Derungs and Novotny (2011)

Table III. ECM success measures

them a description of the study and offering them to conduct this study in their companies to evaluate their ECMS. Four companies/institutions agreed to participate (Table IV).

Each of the organizations invited between 30 and 1,000 users to participate in the survey. The survey was designed for both users and nonusers of the company's ECMS. Users had to fill in the entire survey, and nonusers were directed to a short version of the survey that explored the reasons for not using the system. Because both users and nonusers were invited to participate in the survey and because we used only the users' responses for our data analysis, we cannot derive an exact response rate for the four cases. Still, we tried to avoid non-response bias as much as possible by following the recommendations of Rogelberg and Stanton (2007) concerning, for example, layout, informing participants, etc.

We also checked the responses to the organizational studies for non-response bias by applying the Mann and Whitney (1947) *U*-test to test for differences in the groups of early (first half of the survey period) and late (second half) respondents. The results did not indicate any differences, so non-response bias is not likely to be an issue in our study. The four organizational studies resulted in 225 valid data sets after data cleaning, which is an acceptable number for our study (Chin, 1998).

No.	Branch	Employees (approx.)	Turnover in Euro (approx.)
1	Ceramics	8,000	750m
2	Dental	3,200	700m
3	Enterprise software	74,000	17bn
4	Education	1,600	–

Table IV. Participating companies

We also tested the data for common method bias (CMB), which occurs when variance is attributable to the method of measurement rather than to the constructs the measures represent (Podsakoff *et al.*, 2003). We tested the data for CMB by applying Harman's single-factor test (Podsakoff *et al.*, 2003; Malhotra *et al.*, 2006), which is built on an exploratory factor analysis (EFA) to investigate the unrotated factor solution. The solution resulted in ten factors with an eigenvalue greater than 1.0 that explained 65.6 percent of the total variance. The first factor explained 32.1 percent of the variance, which is less than a third of the variance explained. Because the solution did not provide only a single factor and because the first factor of the EFA solution did not explain the majority of the variance (Malhotra *et al.*, 2006), we concluded that CMB is not an issue in our study.

5. Analysis and results

The model we derived is a relatively complex model that incorporates many constructs with interrelationships and involves latent variables. Therefore, we empirically evaluated our model using the structural equation modeling (SEM) technique, specifically the partial least squares (PLS) algorithm. PLS is particularly suitable for this data analysis because of its ability to work with reflective and formative constructs (Chin, 1998), because it requires no data distribution form (Fornell and Bookstein, 1982), and because it makes lower demands on the required sample size then covariance-based SEM (Urbach and Ahlemann, 2010). This section describes the model validation of both measurement models and the structural model. We used the software packages SmartPLS 2.0.M3 (Ringle *et al.*, 2005) and IBM SPSS Statistics 21 (IBM Corp., 2012) for the statistical analyses and calculations.

5.1 Assessment of measurement models

Our ECMS success model consists primarily of reflective constructs; only use was operationalized formatively. We followed the recommendations of Straub *et al.* (2004), Lewis *et al.* (2005) and Urbach and Ahlemann (2010) to validate the measurement models by testing the reflective measurement model for unidimensionality, internal consistency reliability, indicator reliability, convergent validity and discriminant validity and the formative measurement model for indicator and construct validity.

We tested for unidimensionality by performing an EFA that shows whether an item loads high on only one factor and whether all items load highest on the one factor they are supposed to measure. In conducting the EFA, we used principal axis factoring as the extraction method and applied a promax rotation with Kaiser normalization. The results of the factor analysis (Table AII) showed one item that did not load on its intended factor, so we eliminated the item from the set of variables and repeated the EFA. The final results demonstrate an appropriate level of unidimensionality, as all items load high on only one factor. Except for six loadings, all loadings have a value above 0.600, which is considered high. Only one factor has a loading below 0.400 and five item loads between 0.400 and 0.600. However, because these items still load highest on their corresponding factors, we kept them for further analysis.

We also tested the data for internal consistency reliability. This can be assessed by two measures: Cronbach's α (CA) and composite reliability (CR). CA measures the degree to which a set of items measures a single latent construct (Henson, 2001). CR, the other measure for internal consistency reliability has been suggested as the preferred measure of internal consistency reliability because it overcomes some of the deficiencies of CA (Chin, 1998). All of the construct's CA and CR values meet the recommended threshold of 0.700 (Nunnally and Bernstein, 1994). Four of the constructs show values above 0.950, which might suggest the presence of a CMB (Straub *et al.*, 2004), but our tests for CMB showed that this was unlikely.

Next, we tested the items for indicator reliability, by drawing on the item loadings by means of confirmatory factor analysis, as provided by SmartPLS. The recommended threshold for reliable items is 0.700, which was met by all items except one, which we

excluded it from further analysis. To test for significance of the indicator loadings, we used bootstrapping with the minimum sample size of 5,000, as recommended by Hair *et al.* (2011). The results indicate that all loadings are above 3.29 and as such are significant at the 0.001 level (Table AIII).

Further we assessed convergent reliability through the average variance extracted (AVE) criterion as proposed by Fornell and Larcker (1981). The results in Table V show that all our constructs met the recommended threshold above 0.500, suggesting that all constructs have a reasonable level of validity.

The finale criterion for measuring the reflective constructs is discriminant validity. We used two criteria to measure discriminant validity: the cross-loadings of the items and the Fornell–Larcker criterion. The cross-loadings indicate that the loading of each indicator is the highest on its designated construct and that each construct loads highest on its associated items (Table AIV). To determine whether all measures differ from each other, we assessed the Fornell–Larcker criterion. Table VI shows that all squared roots of the AVE meet this criterion, suggesting that the constructs significantly differ from each other.

Next, we assessed the formative measurement model. Our model contains only one formative construct, use. As recommended by Henseler *et al.* (2009), we examined the indicator validity and the construct validity to assess the formative construct. To assess the indicator validity, we examined the weights of the items and the variance inflation factor (VIF). Of the six use items, the weights of two items do not meet the recommended threshold of 0.100 and four of the items do not meet a minimum significance level of 0.010 (Hair *et al.*, 2011) (Table AV). However, we decided to keep the items although the threshold was not met because eliminating items from a formative construct would exclude a unique descriptive part of the construct and as such altering its meaning (Jarvis *et al.*, 2003). We also tested the use items for multicollinearity, through the VIF, which measures to what degree the variance is inflated. To exclude multicollinearity, the items must meet the commonly accepted VIF

	Cronbach's α	Composite reliability	Average variance extracted
Collaboration	0.876	0.915	0.730
Compliance	0.870	0.906	0.658
Efficiency	0.894	0.927	0.761
Individual impact	0.971	0.977	0.896
Information quality	0.879	0.912	0.675
Process quality	0.938	0.953	0.802
Service quality	0.934	0.950	0.793
System quality	0.929	0.947	0.781
User satisfaction	0.958	0.967	0.856

Table V.
Internal consistency and convergent validity

	CL	CP	EF	II	IQ	PQ	SE	SQ	US
CL: collaboration	*0.854*								
CP: compliance	0.475	*0.811*							
EF: efficiency	0.753	0.586	*0.872*						
II: individual impact	0.692	0.410	0.710	*0.947*					
IQ: information quality	0.403	0.246	0.439	0.450	*0.822*				
PQ: process quality	0.651	0.462	0.658	0.674	0.425	*0.895*			
SE: service quality	0.443	0.241	0.404	0.304	0.353	0.484	*0.890*		
SQ: system quality	0.562	0.376	0.645	0.646	0.498	0.590	0.375	*0.884*	
US: user satisfaction	0.713	0.432	0.737	0.780	0.429	0.664	0.439	0.760	*0.925*

Table VI.
Inter-construct correlations with square root of average variance extracted (AVE)

threshold of less than 10 (Diamantopoulos and Winklhofer, 2001), which all of the use items met. Therefore, multicollinearity is not likely to be an issue in this construct.

Finally, we tested the formative constructs for construct validity by testing for discriminant validity. We used the correlations between the formative construct use and all the other constructs and found reasonable discriminant validity because all correlations between the use construct and the other constructs are less than 0.700 (Table AVI).

5.2 Assessing the structural model

Having validated our measurement model, we assessed the appropriateness of our structural model and tested our hypothesis. Because PLS cannot test mutual relationships simultaneously, such as that between use and user satisfaction in our model, we had to test two models: Model A, which hypothesizes that use influences user satisfaction (*H9*), and Model B, which hypothesizes that user satisfaction influences use (*H10*). The results of our analysis of both models are shown in Figure 2. We used bootstrapping with 5,000 samples, as suggested by Hair *et al.* (2011), to test the significance of the resulting path coefficients.

We followed the recommendations of Urbach and Ahlemann (2010) in using the coefficient of determination (R^2), path coefficients (β) and effect size (f^2) to assess the structural model. Both models explain a great portion of the variance of the latent constructs. User satisfaction ($R^2_A = 0.671, R^2_B = 0.655$) and individual impact ($R^2_A = 0.662, R^2_B = 0.664$) explain more than half of the variance. This applies also for efficiency ($R^2_A = 0.596$, $R^2_B = 0.597$) as well as collaboration ($R^2_{A/B} = 0.562$) of the three organizational-impact dimensions. Of the three organizational-impact constructs, compliance has the lowest level of variance explained, with a rather weak level of R^2 ($R^2_{A/B} = 0.203$). Of the constructs originating of the D&M IS success model, has use the lowest R^2 ($R^2_A = 0.215$, $R^2_B = 0.249$) in both models.

In the next step, we assessed the path coefficients between the model's latent variables. In particular, we checked the path coefficients for their signs, as well as their magnitude. We applied the threshold of 0.100, which assumes a substantial impact in the model (Urbach and Ahlemann, 2010), and also determined that the path coefficient should be significant at least at the 0.050 level. To assess the significance of the path coefficients, we applied the bootstrapping technique with 5.000 samples (Hair *et al.*, 2011). Of the paths between use and the quality constructs, only two paths information quality → use ($\beta_A = 0.173, \beta_B = 0.181$) and process quality → use ($\beta_A = 0.264, \beta_B = 0.165$) reach the threshold of 0.100 and are significant at a minimum of 0.050 level. That applies to the paths between the quality constructs and the user satisfaction construct too, only two paths – system quality → user satisfaction ($\beta_A = 0.535, \beta_B = 0.555$) and process quality → user satisfaction ($\beta_A = 0.257$,

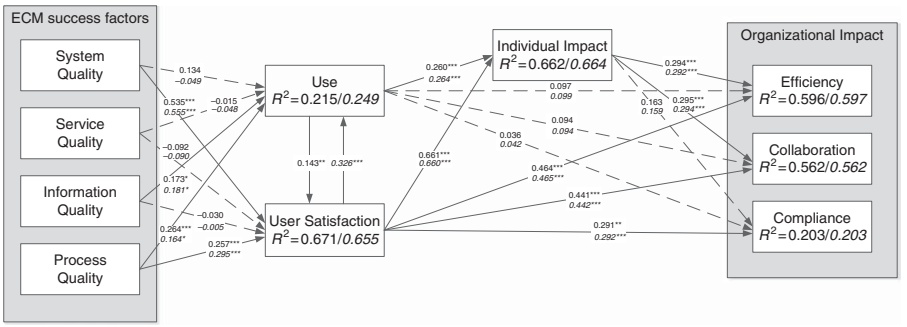

Figure 2.
Results of the structural analysis

Notes: Upper path coefficient represents model A and the italic lower ones represent model B. *$p<0.050$; **$p<0.010$; ***$p<0.001$

$\beta_B = 0.295$) – show a value above 0.100 at a significance level of at least 0.050. None of the paths between use and the three organizational-impact constructs reach the threshold of 0.100 and as such cannot be supported, while all paths between user satisfaction and the organizational-impact constructs efficiency ($\beta_A = 0.464$, $\beta_B = 0.465$), collaboration ($\beta_A = 0.441$, $\beta_B = 0.442$) and compliance ($\beta_A = 0.291$, $\beta_B = 0.292$) are above the threshold and significant at least 0.050 and thus are supported by the data. Except the path between individual impact and compliance ($\beta_A = 0.163$, $\beta_B = 0.159$) which is not significant, show all other path coefficients in our model values above 0.100 – most are above 0.200 – with user satisfaction → individual impact having the highest value ($\beta_A = 0.661$, $\beta_B = 0.660$), system quality → user satisfaction the second highest value ($\beta_A = 0.535$, $\beta_B = 0.555$) and user satisfaction → efficiency the third highest value ($\beta_A = 0.464$, $\beta_B = 0.465$).

Finally, we calculated the effect size of one variable to another by calculating the Cohen's (1988) effect size f^2. The effect size is calculated by assessing the increase in R^2 of the variable connected relative to the variable's unexplained variance (Chin, 1998). Effect sizes f^2 of 0.020, 0.150 and 0.350 determine whether the effect on the endogenous variable is small, medium or large, respectively (Chin, 1998; Wong, 2013). All paths that are significant in our model show at least a small effect size. The results of the assessment of the hypotheses are summarized in Table VII.

6. Discussion

Most our hypotheses are supported by the results of our study. However, only half of the paths between use and the quality dimensions and between user satisfaction and the quality dimensions are supported; the supported paths are system quality → user satisfaction, process quality → user satisfaction, information quality → use and process quality → use. No paths between service quality, use and user satisfaction could be confirmed. These results suggest

Hypothesis		β	f^2	Support	Effect size
H1	System quality → use	0.134/−0.059	0.013/0.001	No	–
H2	System quality → user satisfaction	0.535***/0.555***	0.495/0.512	Yes	Large
H3	Service quality → use	−0.015/−0.048	0.000/0.002	No	–
H4	Service quality → user satisfaction	0.092/0.090	0.018/0.017	No	–
H5	Information quality → use	0.173*/0.181*	0.029/0.026	Yes	Small
H6	Information quality → user satisfaction	−0.030/−0.005	0.002/−0.001	No	–
H7	Process quality → use	0.264***/0.165*	0.050/0.018	Yes	Small
H8	Process quality → user satisfaction	0.257***/0.295***	0.109/0.141	Yes	Small
H9	Use → user satisfaction	0.143**/–	0.048/–	Yes	Small
H10	User satisfaction → use	–/0.326***	–/0.046	Yes	Small
H11	Use → individual impact	0.260***/0.264***	0.157/0.164	Yes	Medium
H12	User satisfaction → individual impact	0.661***/0.660***	1.018/1.031	Yes	Large
H13	Individual impact → efficiency	0.294***/0.292***	0.073/0.071	Yes	Small
H14	Individual impact → collaboration	0.295***/0.294***	0.066/067	Yes	Small
H15	Individual impact → compliance	0.159/0.163	0.009/0.008	No	–
H16	Use → efficiency	0.097/0.099	0.016/0.016	No	–
H17	Use → collaboration	0.094/0.094	0.014/0.014	No	–
H18	Use → compliance	0.036/0.042	0.001/001	No	–
H19	User satisfaction → efficiency	0.464/0.465	0.209/0.210	Yes	Medium
H20	User satisfaction → collaboration	0.441/0.442	0.176/0.176	Yes	Medium
H21	User satisfaction → compliance	0.291/0.292	0.042/0.043	Yes	Small

Notes: *,**,***Significant at $p < 0.050$; $p < 0.010$; $p < 0.001$

Table VII. Results of hypotheses testing

that the quality dimensions in general play a minor role on the success of ECMS. Only four of the eight paths could be confirmed by the data. Use is influenced only by information quality, process quality and user satisfaction. The relationship between information quality and use seems logical: many organizations have issues with the quality of their information and often organizations hope to improve their information quality through ECM (e.g. vom Brocke, Derungs, Herbst, Novotny and Simons, 2011; Munkvold *et al.*, 2006). If an ECMS holds high-quality information, users are more likely to use the ECMS to retrieve this information. This might be similar with the relationship between process quality and use. Next to information quality, organizations often implement ECMS to simplify and improve their processes (e.g. Smith and McKeen, 2003; Päivärinta and Munkvold, 2005; O'Callaghan and Smits, 2005). If an ECMS is part of a user's processes, it is more likely that he or she uses or must use the ECMS to execute the process successfully. This might also explain the non-significant impact of system quality on use: if an ECMS is part of a user's processes or if an ECMS is the only source for certain kind of information in an organization a user might just not have the option to avoid the use of an ECMS. Other ECM-related success studies show similar findings. Urbach *et al.* (2010), for example, could not find support for the relationships between use and the quality dimensions of system, service, information as well as process quality.

The analysis of our model shows that only two quality constructs, system quality and process quality, have a significant impact on the user satisfaction construct. A meta-study of IS success articles confirmed that there is a strong support between system quality and user satisfaction, and ECM-related success studies have also confirmed this finding (e.g. Kulkarni *et al.*, 2007; Urbach *et al.*, 2010). The additional quality construct process quality was suggested by Urbach *et al.* (2010), whose study supported the relationship between process quality and user satisfaction, although their effect size on the path was lower than the results in our study. Therefore, support of an employee's work processes appears to influence his or her satisfaction with the ECMS. Interestingly, process quality is the only independent variable which influences both use and user satisfaction and as such seem to play an important role for ECMS success.

The constructs information quality and service quality have no influence on user satisfaction. The missing support between service quality and user satisfaction is not surprising, given that a meta-analysis among IS success studies shows only mixed results for this relationship (Petter *et al.*, 2008) and that ECM-related studies (e.g. Urbach *et al.*, 2010; Paré *et al.*, 2005) could not confirm a relationship. Perhaps the missing support for this relationship is because service requests usually appear after a system is newly implemented or after a user has just received access to the system, after which service requests continuously decrease. We determined that most our respondents had at least one year of experience with the ECMS, so they probably do not need service support often anymore. In contrast to the majority of IS success studies (Petter *et al.*, 2008), our study did not confirm the relationship between information quality and user satisfaction. This is not surprising as the goal of ECMS is usually to deliver high-quality information. Therefore, it can be assumed that the information quality is already high (This supposition is also indicated by a high index value of 5.29 on a seven-point Likert scale and a STD of 1.108, see Table AVII).

Use and user satisfaction both have a considerable effect on individual impact, the impact of the ECMS on the individual user. While use has only a medium effect on individual impact, the effect of user satisfaction on individual impact is large. This result is in line with the original model suggested by DeLone and McLean (1992, 2003) and a meta-analysis of previous success studies (Petter *et al.*, 2008). The results also show that use has no direct influence on the three organizational-impact dimensions efficiency, collaboration and compliance. However, the data further suggest that efficiency and collaboration are influenced only by the individual impact which results from ECMS use. To test this assumption, we conducted a mediation analysis with SEM (Gunzler *et al.*, 2013) and the results confirm a complete

mediation between use and efficiency as well as use and collaboration through individual impact. An explanation for the missing impact of use on the organizational-impact constructs could be of how ECMS use was assessed. In this study, we assessed use through the extent users are using different functionalities of the ECMS as well as the frequency of use. However, neither use of functionalities nor the frequency of use gives any evidence about the quality of ECMS use. An ECMS can be used on a very basic level, for example, a user might upload a certain document to the system, maybe because he has to do so, but he might not add any metadata to the document which would make the document easier to find and assign it to specific people or cases. In this case the ECMS use quality would be rather low and as such probably has no impact on the organization. This is also in line with the fact that all paths between user satisfaction and the three organizational-impact dimensions efficiency, collaboration and compliance are supported by our data. So, the impact of the ECMS on the organization is not just influenced by the ECMS' impact on the individual but also on the users' satisfaction with the ECMS. This means a high satisfaction of the user with the ECMS not just influences the performance of the individual itself, but at the same time it leads to a higher organizational efficiency, collaboration and increased level of compliance. Therefore, to realize the three ECM objects efficiency, collaboration and compliance, organizations should put attention to the users' satisfaction with the ECMS and in particular check for system's and process quality as these factors influence users' satisfaction.

The results of the data show a strong R^2 value for two of the three impact constructs, efficiency, and collaboration, and a rather weak R^2 of compliance, yet suggesting that all three constructs are valid factors for explaining ECMS success. Furthermore, it is likely that ECMS can help organizations to increase the efficiency of their content management, to raise their collaboration capabilities in terms of content management, and to improve their compliance concerning content handling. The majority of ECM-related success studies have not assessed the organizational impact at all (e.g. Paré *et al.*, 2005; Adeyinka and Mutula, 2010; Kulkarni *et al.*, 2007) or have done so only by a single construct (e.g. Urbach *et al.*, 2010). However, using only a single construct for this purpose does not allow the researcher to draw conclusions concerning whether the IS can help to achieve the goals an organization was pursuing by implementing ECMS or not. Therefore, organizational impact should be assessed in terms of the organization's specific goals, which is in line with the finding of Delone and Mclean (2003) in their e-commerce example, where they stated that "net benefits measures must be determined by context and objectives" (p. 25).

In summary, information quality, system quality, process quality, use, user satisfaction, individual impact, collaboration, efficiency and compliance are important factors in evaluating the success of ECMS, while service quality is less important, if it has an effect at all. The results also suggest that the D&M IS success model (DeLone and McLean, 2003, 1992) is a suitable lens through which to study ECMS success if the model is respecified in terms of the quality dimensions and the dimensions of the organizational impact.

7. Conclusion

This paper proposes a respecified ECMS success model that is grounded in the D&M IS success model (DeLone and McLean, 2003, 1992). We extended the D&M IS success model by one quality dimension, process quality, as suggested by Urbach *et al.* (2010) and refined the organizational-impact construct by adding three sub-constructs that reflect specific organizational ECM objectives reported in the literature: efficiency, collaboration and compliance. Our results indicate that only three antecedent factors are important to ECMS success: information quality, system quality and process quality, while process quality is the only factor that influences both, ECMS usage and users' satisfaction with the ECMS. Concerning the three organizational-impact dimensions, our results suggest that assessing ECMS success based on specific ECM objectives is beneficial, as doing so would reveal more

detail about the impact of ECMS on organizations. The results also show that the organizational impact in terms of efficiency, collaboration and compliance is not directly influenced by ECMS use but mediated through individual impact. However, the three impact dimensions are influenced by the users' satisfaction with the ECMS.

Our research has some limitations, one of which concerns our explanation for our unconfirmed hypotheses. Although we provided some explanations for these missing links, our data did not allow us to test our explanations. Future research should investigate the reasons for the missing relationship between the constructs by means of exploratory research.

The data collection process also led to some limitations. The study builds on convenience sampling of organizations. Data collection through random sampling would have allowed for a higher degree of generalizability. Another limitation lies in the selection of the participants. The organizations selected their participants directly and the researchers had no control over this step.

The results of our research show that only three of the independent variables, information quality, system quality and process quality, influence the success of ECMS. This suggests that further research is needed to assess the factors that determine ECMS success in more detail, for example, by investigating the critical success factors for ECM that have been presented in the literature (e.g. Wiltzius *et al.*, 2011). The research also shows that ECM positively affects the content management in terms of efficiency, collaboration and compliance.

Developing an ECMS success model contributes to academia and practice in several ways. For practitioners, the model provides three antecedent factors that influence the success of ECMS. Practitioners can monitor these factors as performance indicators to improve users' satisfaction with the ECMS and, thus, the success of their ECMS, possibly using the survey instrument to assess these factors. Furthermore, the dimensions proposed in our model as well as the relationships between the success dimensions can support practitioners in understanding the multiple facets of ECMS success to improve how they plan and prepare for ECM investments. In addition, the three dimensions of the organizational impact – efficiency, collaboration and compliance – allow organizations to justify their ECM investments and to better monitor the effect of the ECMS on the organization.

Our research also contributes to theory by extending and empirically testing the D&M IS success model in a new domain and system context. Our research is the first to test empirically and validate a comprehensive ECMS success model that extends knowledge related to ECM by examining the relationship between the quality dimensions and the success measures. Our research shows that only three quality dimensions – information quality, system quality and process quality – affect the success of ECMS, suggesting that additional influencing dimensions should be investigated. We also shed some light on the organizational perspective by adding specific ECM objectives to the model. Most IS success studies have been conducted on the individual level, neglecting the organizational perspective. We evaluate the organizational impact of ECMSs, adding more specific organizational-impact constructs to the model that represent certain organizational ECM goals because having only one organizational-impact construct is not sufficient to theorize on the effect of an ECMS. As a result, our model contributes to clarifying what organizations can gain by implementing ECM.

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Appendix 1. Literature

Objectives	References
Efficiency	Andersen (2007), Iverson and Burkart (2007), Dilnutt (2006), Kwok and Chiu (2004), Päivärinta and Munkvold (2005), Scott *et al.* (2004), Smith and McKeen (2003), Sprehe (2005), vom Brocke, Simons and Cleven (2011) and vom Brocke, Simons, Herbst, Derungs and Novotny (2011)
Collaboration	Andersen (2007), Iverson and Burkart (2007), Dilnutt (2006), Munkvold *et al.* (2006), Nordheim and Päivärinta (2006), vom Brocke, Simons and Cleven (2011) and vom Brocke, Simons, Herbst, Derungs and Novotny (2011)
Compliance	Andersen (2007), Chiu and Hung (2005), Iverson and Burkart (2007), Dilnutt (2006), Kwok and Chiu (2004), Munkvold *et al.* (2006), Nordheim and Päivärinta (2006), Päivärinta and Munkvold (2005), vom Brocke, Simons and Cleven (2011) and vom Brocke, Simons, Herbst, Derungs and Novotny (2011)

Table AI.
ECM objectives

Appendix 2. Measures

The items were measured using a seven-point Likert scale, using two different parameters: agreement (1 = "strongly disagree" and 7 = "strongly agree") and frequency (1 = "never" and 7 = "very frequently").

C.1. Information quality: (scale type: agreement)

Please assess the quality of the information provided by your organization's ECMS. This includes all available information and documents that support your job:

- IQ1: Information and documents provided by our ECMS are relevant to the intended task.
- IQ2: Information and documents provided by our ECMS are useful.
- IQ3: Information and documents provided by our ECMS are reliable.
- IQ4: Information and documents provided by our ECMS are correct.
- IQ5: Information and documents provided by our ECMS are up-to-date.

C.2. System quality: (scale type: agreement)

Please assess the quality of your organization's ECMS:

- SQ1: Our ECMS is easy to navigate.
- SQ2: Our ECMS is easy to use.
- SQ3: Our ECMS is user-friendly.
- SQ4: Our ECMS enables easy access to information and documents.
- SQ5: Our ECMS provides appropriate functionalities for retrieving documents and information.

C.3. Service quality: (scale type: agreement)

Please assess the service quality of the personnel responsible for supporting the ECMS in your organization:

- SE1: The responsible service personnel are always willing to help whenever I need support with our ECMS.
- SE2: The responsible service personnel provide services related to our ECMS at the promised time.
- SE3: The responsible service personnel have sufficient knowledge to answer my questions in respect to our ECMS.
- SE4: The responsible service personnel are available for consultation about our ECMS.
- SE5: The responsible service personnel provide high-quality training concerning our ECMS.

C.4. Process quality: (scale type: agreement)

Please assess the process support of your organization's ECMS:

- PQ1: Our ECMS supports the easy initiation of work processes.
- PQ2: Our ECMS supports the work processes in a way that allows one to trace them.
- PQ3: Our ECMS supports the work processes accurately.
- PQ4: Our ECMS supports the work processes reliably.
- PQ5: Our ECMS supports the work processes fully.

C.5. Use: (scale type: frequency)
Please indicate how frequently you use the ECMS to perform the following tasks:

- UE1: Retrieve information and documents.
- UE2: Share information and documents.
- UE3: Edit information and documents.
- UE4: Delete information and documents.

Please answer the following questions concerning your own use of your organization's ECMS:

- UE5: How frequently do you use your organization's ECMS?

How many minutes in a typical work day do you spend using your organization's ECMS?

- UE6 Minutes per working day (Free input – rescaled to a 1–7 scale).

C.6. User satisfaction: (scale type: agreement)
Please indicate to what degree you agree with each of the following statements regarding your satisfaction with your organization's ECMS:

- US1: Our ECMS has met my expectations.
- US2: I am satisfied with the effectiveness of our ECMS.
- US3: I am satisfied with the efficiency of our ECMS.
- US4: I am pleased with the experience of using our ECMS.
- US5: Overall, I am satisfied with our ECMS.

C.7. Individual impact: (scale type: agreement)
Please assess to what degree you agree with each of the following statements regarding the individual benefits you derive from using your organization's ECMS:

- II1: Our ECMS enhances my job efficiency.
- II2: Our ECMS enhances my job effectiveness.
- II3: Our ECMS improves my job performance.
- II4: Our ECMS enables me to accomplish tasks more quickly.
- II5: Our ECMS increases my productivity.

C.8. Collaboration: (scale type: agreement)
Please assess the following statements concerning the impact of your organization's ECMS on the collaboration in your organization:

- CL1: Our ECMS supports knowledge sharing within our organization.
- CL2: Our ECMS supports a comfortable communication within our organization.
- CL3: Our ECMS supports the joint creation of creative information and content.
- CL4: Our ECMS helps our organization eliminate the isolated creation of information and documents by functional areas.

C.9. Efficiency: (scale type: agreement)
Please assess the following statements concerning the impact of your organization's ECMS on the efficiency of your organization:

- EF1: Our ECMS improves our organization's performance by efficiently reusing existing documents and information.

- EF2: Our ECMS enables our organization to use content and information more efficiently.
- EF3: Our ECMS supports the organization in publishing documents and content faster.
- EF4: Our ECMS helps our organization reduce the search times for documents and information.

C.10. Compliance: (scale type: agreement)

Please assess the following statements concerning the impact of your organization's ECMS on the compliance of your organization:

- CP1: Our ECMS enables our organization to manage the deletion of information and documents in accordance with legal and business requirements.
- CP2: Our ECMS helps our organization reduce the risk that critical information is stored on local hard drives.
- CP3: Our ECMS helps our organization track changes in critical information and documents properly.
- CP4: Our ECMS supports our organization in protecting information and documents against unauthorized use.
- CP5: Our ECMS enables our organization to record the history of organizational transactions.

Appendix 3. Exploratory factor analysis

	Factors								
	1	2	3	4	5	6	7	8	9
IQ01						0.637			
IQ02						0.589			
IQ03						0.748			
IQ04						0.938			
IQ05						0.782			
SQ01				0.914					
SQ02				0.853					
SQ03				0.740					
SQ04				0.815					
SQ05				0.636					
SE01	0.961								
SE02	0.868								
SE03	0.942								
SE04	0.967								
SE05	0.766								
PQ01							0.466		
PQ02							0.681		
PQ03							0.940		
PQ04							0.916		
PQ05							0.886		
US01								0.624	
US02								0.554	
US03								0.610	
US04								0.579	
US05								0.703	
II01		0.863							
II02		0.912							
II03		1.033							
II04		0.877							
II05		0.994							
CL01									0.935
CL02									0.810
CL03									0.392
CL04									0.474
EF01					0.709				
EF02					0.951				
EF03					0.675				
EF04					0.878				
CP01			0.732						
CP02			0.806						
CP03			0.791						
CP04			0.944						
CP05			0.768						

Table AII.
Assessment of unidimensionality

Notes: Extraction method: principal axis factoring; rotation method: promax with Kaiser normalization. For better readability only values above 0.30 are displayed

Appendix 4. Item loadings

Construct	Item	Loading	*t*-value
Collaboration	CL01	0.875	58.745
	CL02	0.875	48.528
	CL03	0.868	49.042
	CL04	0.797	25.367
Compliance	CP01	0.838	30.675
	CP02	0.797	22.609
	CP03	0.808	24.470
	CP04	0.830	32.136
	CP05	0.781	18.708
Efficiency	EF01	0.915	67.616
	EF02	0.919	80.443
	EF03	0.824	33.645
	EF04	0.826	33.787
Individual impact	II01	0.943	112.947
	II02	0.946	105.457
	II03	0.952	101.808
	II04	0.928	61.916
	II05	0.964	170.724
Information quality	IQ01	0.798	25.453
	IQ02	0.852	31.878
	IQ03	0.848	32.117
	IQ04	0.845	30.928
	IQ05	0.761	22.601
Process quality	PQ01	0.864	42.920
	PQ02	0.877	41.385
	PQ03	0.926	79.932
	PQ04	0.931	83.364
	PQ5	0.878	43.048
Service quality	SE01	0.923	82.910
	SE02	0.898	55.500
	SE03	0.915	75.551
	SE04	0.901	46.050
	SE05	0.810	26.005
System quality	SQ01	0.921	94.565
	SQ02	0.907	50.733
	SQ03	0.908	67.862
	SQ04	0.867	55.695
	SQ05	0.811	30.694
User satisfaction	US01	0.915	62.371
	US02	0.912	68.717
	US03	0.909	65.444
	US04	0.936	90.003
	US05	0.954	145.283

Table AIII.
Indicator reliability

Appendix 5

Table AIV.
Cross-loadings

	CL	CP	EF	II	IQ	PQ	SE	SQ	US
CL01	*0.875*	0.326	0.600	0.585	0.303	0.535	0.364	0.447	0.583
CL02	*0.875*	0.344	0.681	0.609	0.348	0.556	0.424	0.485	0.638
CL03	*0.868*	0.452	0.626	0.602	0.378	0.599	0.370	0.516	0.597
CL04	*0.797*	0.508	0.666	0.565	0.349	0.531	0.354	0.473	0.618
CP01	0.344	*0.838*	0.427	0.303	0.126	0.377	0.206	0.252	0.321
CP02	0.442	*0.797*	0.498	0.380	0.220	0.373	0.233	0.330	0.411
CP03	0.396	*0.808*	0.499	0.326	0.275	0.381	0.199	0.353	0.361
CP04	0.383	*0.830*	0.492	0.338	0.234	0.403	0.198	0.329	0.385
CP05	0.346	*0.781*	0.449	0.302	0.126	0.334	0.130	0.248	0.249
EF01	0.700	0.552	*0.915*	0.661	0.449	0.618	0.367	0.574	0.692
EF02	0.688	0.473	*0.919*	0.659	0.430	0.583	0.366	0.584	0.682
EF03	0.650	0.477	*0.824*	0.596	0.324	0.550	0.357	0.547	0.598
EF04	0.582	0.549	*0.826*	0.553	0.313	0.543	0.317	0.543	0.591
II01	0.665	0.402	0.694	*0.943*	0.391	0.652	0.264	0.620	0.758
II02	0.681	0.380	0.679	*0.946*	0.435	0.629	0.278	0.606	0.757
II03	0.624	0.413	0.645	*0.952*	0.461	0.652	0.262	0.576	0.698
II04	0.633	0.355	0.662	*0.928*	0.411	0.612	0.316	0.635	0.734
II05	0.666	0.390	0.679	*0.964*	0.437	0.643	0.321	0.618	0.742
IQ01	0.299	0.177	0.309	0.399	*0.800*	0.315	0.264	0.439	0.354
IQ02	0.334	0.227	0.315	0.424	*0.853*	0.361	0.279	0.430	0.348
IQ03	0.337	0.201	0.389	0.361	*0.847*	0.372	0.306	0.422	0.376
IQ04	0.288	0.196	0.360	0.299	*0.844*	0.311	0.316	0.366	0.312
IQ05	0.391	0.206	0.432	0.350	*0.761*	0.381	0.287	0.376	0.362
PQ01	0.606	0.381	0.552	0.619	0.320	*0.863*	0.451	0.565	0.607
PQ02	0.576	0.439	0.569	0.578	0.383	*0.877*	0.405	0.550	0.575
PQ03	0.586	0.424	0.634	0.630	0.414	*0.926*	0.423	0.514	0.606
PQ04	0.563	0.398	0.610	0.598	0.421	*0.931*	0.436	0.527	0.610
PQ05	0.580	0.428	0.582	0.587	0.368	*0.878*	0.450	0.483	0.570
SE01	0.402	0.210	0.388	0.297	0.324	0.459	*0.923*	0.365	0.436
SE02	0.390	0.165	0.333	0.245	0.284	0.395	*0.898*	0.300	0.381
SE03	0.416	0.212	0.372	0.259	0.322	0.436	*0.915*	0.342	0.412
SE04	0.361	0.222	0.360	0.270	0.338	0.442	*0.901*	0.354	0.379
SE05	0.405	0.268	0.342	0.282	0.299	0.417	*0.811*	0.300	0.337
SQ01	0.502	0.341	0.561	0.598	0.429	0.549	0.392	*0.921*	0.705
SQ02	0.475	0.316	0.522	0.539	0.452	0.510	0.347	*0.908*	0.671
SQ03	0.503	0.302	0.560	0.560	0.389	0.527	0.363	*0.908*	0.678
SQ04	0.518	0.322	0.598	0.583	0.478	0.515	0.296	*0.867*	0.668
SQ05	0.486	0.385	0.610	0.573	0.454	0.505	0.252	*0.811*	0.633
US01	0.640	0.347	0.629	0.680	0.376	0.572	0.427	0.677	*0.915*
US02	0.654	0.416	0.694	0.743	0.440	0.627	0.390	0.657	*0.912*
US03	0.659	0.396	0.695	0.713	0.325	0.637	0.362	0.698	*0.909*
US04	0.656	0.432	0.698	0.739	0.443	0.611	0.416	0.748	*0.936*
US05	0.690	0.402	0.691	0.732	0.397	0.622	0.435	0.733	*0.954*

Appendix 6. Formative constructs

	Weight	*t*-value	VIF
UE01	0.173	1.244	1.163
UE02	0.800	7.251	1.208
UE03	−0.199	1.428	1.379
UE04	0.351	3.088	1.130
UE05	−0.086	0.558	1.250
UE06	0.210	1.731	1.175

Table AV. Assessment of formative construct use

Appendix 7

	CL	CP	EF	II	IQ	PQ	SE	SQ	US
CL	1.000								
CP	0.475	1.000							
EF	0.753	0.586	1.000						
II	0.692	0.410	0.710	1.000					
IQ	0.403	0.246	0.439	0.450	1.000				
PQ	0.651	0.462	0.658	0.674	0.425	1.000			
SE	0.443	0.241	0.404	0.304	0.353	0.484	1.000		
SQ	0.562	0.376	0.645	0.646	0.498	0.590	0.375	1.000	
US	0.713	0.432	0.737	0.780	0.429	0.664	0.439	0.760	1.000

Table AVI. Inter-construct correlations

Appendix 8. Path coefficients

Hypothesis		β(A)	*t*-value(A)	β(B)	*t*-value(B)
H1	System quality → use	0.134	1.637	−0.049	0.515
H2	System quality → user satisfaction	0.535	9.978	0.555	10.646
H3	Service quality → use	−0.015	0.209	−0.048	0.708
H4	Service quality → user satisfaction	0.092	1.892	0.090	1.804
H5	Information quality → use	0.173	2.221	0.181	2.367
H6	Information quality → user satisfaction	−0.030	0.458	−0.005	0.077
H7	Process quality → use	0.264	3.575	0.164	1.985
H8	Process quality → user satisfaction	0.257	4.306	0.295	4.899
H9	Use → user satisfaction	0.143	3.212	na	na
H10	User satisfaction → use	na	na	0.326	3.419
H11	Use → individual impact	0.260	5.348	0.264	5.686
H12	User satisfaction → individual impact	0.661	15.586	0.660	15.967
H13	Individual impact → efficiency	0.294	3.322	0.292	3.317
H14	Individual impact → collaboration	0.295	3.975	0.294	3.885
H15	Individual impact → compliance	0.163	1.446	0.159	1.431
H16	Use → efficiency	0.097	1.505	0.099	1.556
H17	Use → collaboration	0.094	1.551	0.094	1.524
H18	Use → compliance	0.036	0.438	0.042	0.517
H19	User satisfaction → efficiency	0.464	6.223	0.465	6.253
H20	User satisfaction → collaboration	0.441	6.914	0.442	6.897
H21	User satisfaction → compliance	0.291	2.705	0.292	2.762

Table AVII. Structural paths of Models 1 and 2

Appendix 9

Table AVIII. Index value and standard deviation

	Index value	STD
Collaboration	4.471	1.526
Compliance	4.325	1.278
Efficiency	4.483	1.393
Individual impact	4.137	1.604
Information quality	5.296	1.108
Process quality	4.372	1.388
Service quality	4.963	1.357
System quality	4.239	1.542
Use	4.240	1.204
User satisfaction	4.233	1.457

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