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An empirical investigation of employee portal success

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A B S T R A C T

Employee portals are utilized by many companies to improve companies' information exchange, communication, and employee collaboration, as well as to better support their business processes. Owing to limited IT budgets and the need to justify investments in employee portals, assessing the benefits of these is an important field in research and practice. Thus, the purpose of this study is to gain a better understanding of employee portal success. We introduce a theoretical model for this that is based on the DeLone and McLean IS Success Model. Furthermore, we develop hypotheses regarding the associations between different models' success dimensions and test them using more than 10,000 employees' responses collected in a survey of 22 companies. Our results indicate that besides the factors contributing to IS success in general, other success dimensions – like the quality of the collaboration and process support – have to be considered when aiming for a successful employee portal. The study's findings make it possible for practitioners to understand the levers with which to improve their employee portals. By empirically validating a comprehensive success model for employee portals, the study's results advance theoretical development in the area of collaboration-centered systems and present a basis for further research in this field.

1. Introduction

The ways employees handle information, communicate, share knowledge, as well as execute business processes have significantly changed with the emergence of web-based technologies and the subsequent spreading of employee portals. Over the past decade, company intranets have been transformed from collections of static web pages into highly integrated and interactive information systems (IS). Whereas first-generation intranets only provided a comfortable interface to information, today's employee portals build a "single point of access" by enabling the front-end integration of information, communication, knowledge sharing, applications, and business processes within corporations. Technically speaking, an employee portal offers a browser-based user interface providing access to personalized information, resources, and applications. In many cases, an employee portal is the primary tool through which employees do their work. Ideally, employee portals yield organizations and employees different benefits, such as reducing information overload, lowering organizational costs, improving corporate communication and knowledge management (KM), as well as enhancing employee productivity (Tojib et al., 2006).

Today, many companies, especially large ones, offer their employees a portal. A 2006 US study by Forrester Research, Inc. indicated that 46% of large companies ran an employee portal, and another quarter planned to establish one by 2008 (Forrester, 2006). The use of employee portals has been growing steadily and, despite many companies' restricted IT budgets, investments in portal solutions are still growing. However, portal projects are usually complex, time and cost-consuming,

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with a high failure risk (Remus, 2006). And although IT departments and decision-makers have to justify portal investments, a significant number of companies do not assess their portal implementations' actual benefits (Brown et al., 2007). Companies that do so, often use monetary indicators and cost-benefit analysis methods (White, 2003). These success-measurement approaches do not, however, take intangible impacts and intervening environmental variables into account. A portal's success cannot, however, be measured by just its reach, and practitioners should not simply rely on "hit counts" as measures of success (Damsgaard and Scheepers, 1999). Clearly, a comprehensive measurement of portal success would also need to consider a portal's intangible effects to detect areas of potential improvements and justify present and future investments in portal solutions.

The purpose of this study is to gain a better understanding of employee portal success. Existing research on employee portals investigates single aspects of success, but none of these studies make use of a comprehensive, integrated approach (e.g., bin Masrek, 2007; de Carvalho et al., 2008; Hussein et al., 2008; Tojib et al., 2008; Yang et al., 2005). To date, various studies have tested the original version of the DeLone and McLean IS Success Model (D&M IS Success Model) (DeLone and McLean, 1992, 2003) (e.g., Almutairi and Subramanian, 2005; Iivari, 2005; McGill et al., 2003). Other studies use this model – often in combination with other theoretical models – as a basis for deriving new research models that are applicable to the relevant problem domains' specific requirements (e.g., Chang and King, 2005; Garrity et al., 2005; Nelson et al., 2005). Popular IS types to which the D&M IS Success Model has been applied are: Enterprise systems (e.g., Gable et al., 2003), traditional knowledge management systems (KMS) (e.g., Kulkarni et al., 2007), and personal productivity tools (e.g., Mao and Ambrose, 2004). However, in our literature review, we could not find any IS success studies specifically addressing the success of enterprise portals in general or of employee portals in particular. Consequently, we present our development and empirical assessment of a success model whose core principle is based on the D&M IS Success Model and which considers employee portals' specific requirements. To this end, we modified the proposed success dimensions for application in the employee portal context and extended the original model with additional success dimensions. Hypotheses were developed on the associations between the different success dimensions and tested, using data collected in a survey of the employees of 22 companies across different industries participating in a benchmarking study.

The next section describes employee portals' theoretical foundations and offers a review of the literature on measuring IS and portal success. In the subsequent section, we explain how we developed our theoretical model, discuss the characteristics of its constructs, and present our hypotheses. The method section outlines our approach to operationalizing the constructs and collecting empirical data. In the analysis and results section, we report on the measurement models' and structural model's assessment by means of structural equation modeling. The discussion section summarizes the results and outlines this research's implications, limitations, and contribution.

2. Foundations

The starting point for our research was the existing research in the field. We thus reviewed relevant literature on employee portals, information systems success measurement, and existing approaches for evaluating portals. In the following, we firstly introduce the relevant literature before coming to a conclusion and choosing the aspects that we find relevant.

2.1. Employee portals

Employee portals can be regarded a specific type of *enterprise portals*. The latter will therefore be discussed first. In this context, we use the terms *corporate portal*, *enterprise information portal*, *business portal*, and *enterprise portal* interchangeably (Dias, 2001).

An early definition of a portal in the corporate context appeared in a Merill Lynch report (Shilakes and Tylman, 1998). In this report, an enterprise (information) portal is considered an application that primarily integrates the company's information and provides users with a single interface to this corporate information. Subsequent definitions tend to include the integration of collaborative applications such as e-mail and calendars (Eckerson, 1999). Currently, enterprise portals do not only integrate information and simple tools, but also business applications and processes (Chan and Liu, 2007; Daniel and Ward, 2005). As such, they have also become the dominant front-end to KMS (Benbya et al., 2004). Thus, amongst others, weblogs, social networks, collaboration functionality such as electronic discussion forums, virtual team rooms, and instant messaging/awareness have become typical features of state-of-the-art enterprise portals to support corporate KM. To summarize, the perception of portals has changed over time, as reflected in the different publications in the field (e.g., Chan and Liu, 2007; Chan and Chung, 2002; Daniel and Ward, 2005; Detlor, 2000; Shilakes and Tylman, 1998). During the past few years, enterprise portals have evolved from low-end intranets into highly integrated IS. Today, such portals enable the front-end integration of information, communication, applications, and business processes. As the software market offers various technological platforms for enterprise portals, which are mostly customized to each organization's specific requirements, each organization usually utilizes a unique implementation. However, during the past years, a typical set of features has emerged that is shared by most state-of-the-art enterprise portals. In terms of their target user group, enterprise portals can be classified as supplier, customer, or employee portals. Ideally, these three types have the same technical infrastructure. If so, organizations effectively have one portal with different "windows," that give each user group access to specific functions that are relevant to it.

Before portal technology was available, the web-based intranet was a popular tool for building workforce commitment (Azzone and Bianchi, 2000). Although it yielded benefits for organizations in this regard, these intranets lacked personalization, offered poor navigation, and did not provide centralized access to information, which often led to losses in productive employee time. To overcome these problems, organizations began to implement employee portals (Tojib et al., 2006). An *employee portal* is therefore a web-based interface to access personalized information, resources, applications, and e-commerce options with which employees can, in turn, access a range of internal and external sources through a network connection in a password-protected setting (Sugianto and Tojib, 2006). As a specific realization of the generic concept enterprise portals, an employee portal explicitly targets an organization's internal personnel. In addition, business applications are increasingly integrated into employee portals. Thus, in many organizations, the role of the employee portal has become crucial, especially when an entire business process can be completed by means of the portal. In some organizations, an employee portal is the primary tool through which employees do their work (Tojib et al., 2006). Ideally, employee portals provide organizations and employees with a number of benefits. These include structured access to enterprise information, common and personalized views, as well as collections of portal elements; improvement in organizational information gathering, as well as knowledge acquisition and management; improvement in employee productivity and in corporate communication; and a reduction in human resources' organizational costs (Dias, 2001; Sugianto and Tojib, 2006).

2.2. IS success measurement

The measurement of IS success or effectiveness has been widely investigated by the IS research community. A while back, the IS literature provided several definitions and measures of IS success. As DeLone and McLean stated, there were nearly as many measures as there were studies (1992). Consequently, there was no ultimate definition of IS success. In order to provide a more general and comprehensive definition, one that covers these different perspectives, DeLone and McLean (1992) reviewed the existing understandings of IS success and their corresponding measures, classifying them into six major categories. They then created a multidimensional measuring model with interdependencies between the different success categories, which became a dominant model for measuring IS success (Hu, 2003).

Ten years after the publication of their first model, and based on the evaluation of the many contributions to it (e.g., Rai et al., 2002; Seddon, 1997; Seddon and Kiew, 1994), DeLone and McLean proposed an updated IS Success Model (DeLone and McLean, 2003) that coped with the measurement challenges of the growing e-commerce world. The updated model consists of six interrelated dimensions of IS success: Information, system and service quality, (intention to) use, user satisfaction, and net benefits. This model can be interpreted as follows: A system can be evaluated in terms of the information, system and service quality; these characteristics affect subsequent use or intention to use, and user satisfaction. As a result of using the system, certain benefits will be achieved. The net benefits will (positively or negatively) influence user satisfaction and further information system use.

Petter et al. (2008) provide a review of recent literature on measuring IS success. They summarize the measures applied and examine the relationships that comprise the D&M IS Success Model in an individual and organizational context. In another review, Urbach et al. (2009) explore the current state of IS success research by analyzing and classifying recent empirical articles with regard to their theoretical foundation, research approach, and research design. The results show that the dominant research analyzes the impact that a specific type of IS has by means of users' evaluations obtained from surveys and structural equation modeling. The D&M IS Success Model is the main theoretical basis of the reviewed studies. Several success models for evaluating specific types of IS – like KMS (Kulkarni et al., 2007) or enterprise systems (Gable et al., 2003) – have been developed from this theory.

2.3. Portal evaluation

Existing measurement approaches to assess portal success in practice usually utilize monetary indicators. Typical examples are return on investment (ROI), total cost of ownership (TCO), and other cost-benefit analysis methods (White, 2003). Building business cases on the basis of such indicators is questionable, because non-monetary impacts and intervening variables are not taken into account.

There is little documented empirical research on employee portal success measurement. Some studies investigate single aspects of employee portal success, but none of the studies we reviewed took a comprehensive, integrated approach. In order to measure user satisfaction with employee portals, Sugianto et al. (2007) and Tojib et al. (2008) proposed using the B2E Portal User Satisfaction (B2EPUS) model, which is based on the End-User Computing Satisfaction measure (EUCS) developed by Doll and Torkzadeh (1988). Bin Masrek (2007) proposed another approach to assessing user satisfaction with campus portals, which is based on an extract of the updated D&M IS Success Model (DeLone and McLean, 2003). A similar framework for investigating corporate intranet effectiveness has been proposed by Masrek et al. (2007) and Hussein et al. (2008). Focusing on the user-perceived service quality of web portals, Yang et al. (2005) developed and validated an instrument based on different conceptual models in the areas of IS and technology adoption. Finally, based on the Technology Acceptance Model (TAM) (Davis, 1989), de Carvalho et al. (2008) analyzed the effects of technological and organizational features on intranet and portal usage.

In our review of the IS success literature, we found no study specifically aimed at comprehensively examining the success of employee portals. We thus developed a first version of a new measurement model for employee portal success, building on the above-mentioned studies. To include further relevant aspects in our model, we extended our literature review by analyzing studies focusing on the evaluation of web-based systems (WBS), which are similar to employee portals (e.g., Bharati and Chaudhury, 2004; Cheung and Lee, 2005; Garrity et al., 2005; Huang et al., 2004; McKinney et al., 2002; Molla and Licker, 2001). Furthermore, since employee portals are common front-ends to KMS, also we reviewed empirical studies focusing on KMS success (e.g., Clay et al., 2005; Jennex and Olfman, 2003; Kulkarni et al., 2007; Wu and Wang, 2006). We took all of these sources into consideration when developing our final model, which we present next.

3. Theoretical model

Since employee portals are widespread but there is no known comprehensive, integrated theoretical framework for measuring their success, we developed a new theoretical model, whose core principle is based on the D&M IS Success Model (DeLone and McLean, 2003), for assessing employee portal success. We believe that the D&M IS Success Model is a sound basis for application in the employee portal context, because it is a comprehensive evaluation framework, whose proposed associations have been validated by a large number of empirical studies. Furthermore, there are many validated measures that can be reused to assess the proposed success dimensions. The model has been applied to several types of IS; and web-based systems other than employee portals have been evaluated using this model. Finally, the D&M IS Success Model is currently the dominant evaluation framework in IS research (Urbach et al., 2009).

3.1. Constructs

We studied the definitions of the D&M IS Success Model's success dimensions, contrasted them with employee portals' specific properties, and merged the different points of view into a revised classification scheme. Consequently, we included the following success dimensions in our theoretical model:

- *System quality*, which consists of measures of an employee portal as a system in itself. It considers performance characteristics, functionality, and usability, among others (McKinney et al., 2002). Accordingly, system quality can be regarded as the degree to which the system is easy to use to accomplish tasks (Schaupp et al., 2006).
- *Information quality*, which focuses on the quality of an employee portal's output (i.e. the quality of the information that the portal provides) and its usefulness for the user. Information quality has been shown to be an important success factor when investigating overall IS success, especially in the context of web-based systems (McKinney et al., 2002).
- *Service quality*, which includes measures of the overall support related to an employee portal and delivered by the service provider. In this context, the success dimension covers aspects such as responsiveness, reliability, empathy, and competence of the responsible service personnel (Chang and King, 2005; Pitt et al., 1995).
- *Use*, which measures the perceived actual use of an employee portal by a company's staff. To assess use in this context, we propose measuring the perceived length of time that the different functionalities, such as retrieving and publishing information, communicating, collaboration, networking, and executing work processes, are used. Since we assume that portal use is non-mandatory (Tojib et al., 2008), we believe that perceived use is a sufficient indicator. Thus, we do not measure the intention to use the portal as a surrogate for portal use.
- *User satisfaction*, which is the affective attitude to a portal of an employee who interacts directly with it (Doll and Torkzadeh, 1988; Tojib et al., 2006). User satisfaction is considered one of the most important measures when investigating overall IS success. The proposed success dimension evaluates adequacy, efficiency, effectiveness, and overall satisfaction with the portal.
- *Individual impact*, which subsumes measures of the perceived individual benefits that employees gain through the use of a portal. These benefits cover aspects like task performance, job efficiency, and overall usefulness (Davis, 1989).
- *Organizational impact*, which is the final dependent variable in our model. We include measures such as quality improvement, cost reduction, and competitive advantage in this success dimension (Sabherwal, 1999). Although the difficulty of measuring the organizational impact of individual IS initiatives has been discussed and demonstrated by many researchers (e.g., Gelderman, 1998; Goodhue and Thompson, 1995), we believe that utilizing an employee portal has an organizational impact in addition to an individual impact on the user level and should therefore be accounted for.

Furthermore, we extended the original model where employee portals' characteristics were not fully covered. Employee portals are not only utilized for the exchange of information, but also to electronically support business processes (Martini et al., 2009). Accordingly, besides the established success factors, employee portal success is additionally determined by the quality with which the employee portal supports an organization's business processes. Although it could be argued that process quality is already covered by the system quality dimension, we believe that these two success dimensions are distinct. From our point of view, process quality – contrary to the more technical-oriented system quality – not only depends on the employee portal's ability to support business processes, but also on the system's customization to those business processes. Consequently, an employee portal that demonstrates a high level of (technical) system quality, does not necessarily support business processes adequately and efficiently, and vice versa. Thus, we added an additional success dimension to consider this circumstance:

- *Process quality*, which summarizes measures capturing the quality of an employee portal's support of an organization's processes such as approvals, applications for leave, meeting room reservations, procurement requests, time registration, travel expense reports, and invoice releases. The quality of process support should be measured in terms of efficiency, reliability, accuracy, and other criteria (Martini et al., 2009; Puschmann and Alt, 2005).

Another feature which is specific to employee portals is its ability to support collaboration between users (Benbya et al., 2004). As common front-ends to KMS, employee portals are employed to enable employees to collaborate, enhance communication, and improve knowledge sharing as well as social networking (Smolnik et al., 2005). Similar to the other quality dimensions within our model, we expect the quality of the collaboration support to influence the success of employee portals. As with the inclusion of process quality as a distinct success dimension, we argue that collaboration quality is not sufficiently covered by any of the other quality dimensions. Thus, in contrast to Kulkarni et al. (2007), who suggested that system quality also covers collaboration aspects, we treat collaboration quality as a separate success dimension:

- *Collaboration quality*, which covers the quality of an employee portal's support of collaboration between its users. It evaluates the extent to which the utilization of employee portals, for example, enhances communication and improves the effectiveness and efficiency of information sharing as well as of social networking (Benbya et al., 2004; Detlor, 2000; Raghavan, 2002).

In order to control for distinctive characteristics' influence within the sample, we identified a set of control variables that we think might impact our model's effectiveness level.

- *Knowledge-intensity of tasks*: Since employees who usually perform knowledge-intense tasks could obtain greater benefit than the operations personnel, we will control for the knowledge-intensity of the respondents' tasks. The construct will be measured in terms of the level of complex knowledge and understanding, as well as the amount of information required to fulfill work tasks (Eppler et al., 1999).
- *Process standardization*: Employees who usually perform highly repetitive and standardized work processes could leverage process supporting portals' potential more than employees in a job characterized by a high degree of individualism. Thus, we will control for the degree of the respondents' work process standardization, which will be assessed by aspects such as the repetitiveness, transparence, and comprehensibility of the employees' work processes (Wüllenweber et al., 2008).
- *Management support*: The organizational culture regarding using an employee portal is likely to differ from company to company. In some companies, supervisors encourage employees to use the portal, while in other companies there may be organizational barriers to using a portal. Consequently, we control for management support, which we evaluate through the leadership team's encouragement of and support for the usage of such a portal (Kulkarni et al., 2007; Sharma and Yetton, 2003).

3.2. Hypotheses

Based on the previous findings of DeLone and McLean (2003) and related studies, as well as on our two additional success dimensions, we propose a theoretical model which assumes that system, information, process, collaboration and service quality are linked to an employee portal's user satisfaction and usage. Furthermore, we propose that these, in turn, influence the portal's benefits.

Most of our hypotheses have been directly derived from the D&M IS Success Model. In addition, we expect the two newly added success dimensions – process and collaboration quality – to influence our model's effectiveness level (use, user satisfaction, individual impact, and organizational impact). More concrete, following the arguments of Martini et al. (2009) and Puschmann and Alt (2005), we hypothesize that the higher users perceive the process quality to be, the more satisfied they are with the employee portal. Similarly, we hypothesize, that the higher the process quality, the more the employee portal is used. Following the arguments of Benbya et al. (2004), we hypothesize that regarding the collaborative features, the higher users perceive the collaboration quality to be, the more satisfied they are with the employee portal. Likewise, we hypothesize, that the higher the collaboration quality, the more the employee portal is used. This leads to the set of hypotheses that will be tested within this study, as presented in Table 1.

Our theoretical model for assessing employee portal success is shown in Fig. 1. Each of the arrows represents one of the hypotheses to be tested. We transformed the theoretical model into a structural equation model, which we tested empirically.

4. Research methodology

Quantitative methods, particularly surveys, are considered superior to qualitative approaches with respect to generalizability (Johnson and Duberley, 2000, p. 51). For this reason, we used surveys to collect data for our theoretical model's empir-

Table 1
Hypotheses.

H1a	System quality has a positive influence on the use of an employee portal
H1b	System quality has a positive influence on user satisfaction with an employee portal
H2a	Information quality has a positive influence on the use of an employee portal
H2b	Information quality has a positive influence on user satisfaction with an employee portal
H3a	Process quality has a positive influence on the use of an employee portal
H3b	Process quality has a positive influence on user satisfaction with an employee portal
H4a	Collaboration quality has a positive influence on the use of an employee portal.
H4b	Collaboration quality has a positive influence on user satisfaction with an employee portal
H5a	Service quality has a positive influence on the use of an employee portal
H5b	Service quality has a positive influence on user satisfaction with an employee portal
H6a	Portal use has a positive influence on user satisfaction with an employee portal
H6b	User satisfaction has a positive influence on the use of an employee portal
H7	Portal use has a positive influence on the individual impact of an employee portal
H8	User satisfaction has a positive influence on the individual impact of an employee portal
H9	Individual impact has a positive influence on the organizational impact of an employee portal

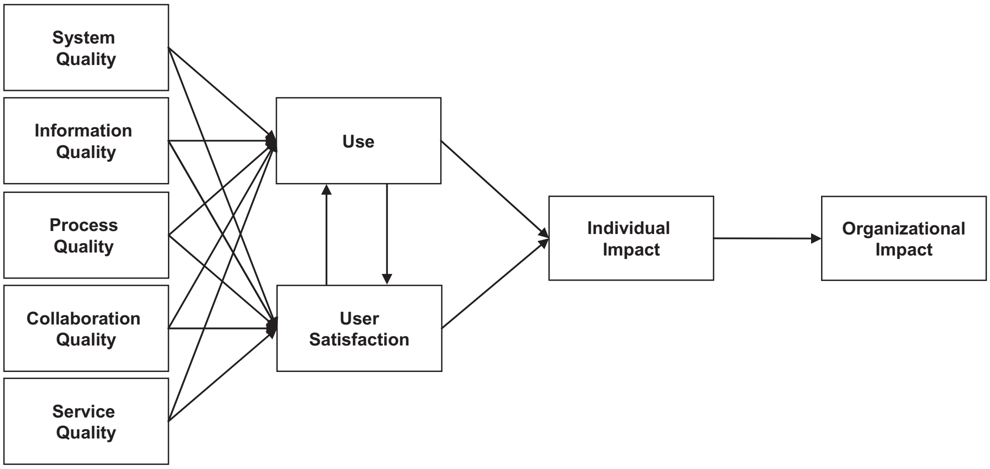

Fig. 1. The model to be tested.

ical assessment. Consequently, we are in line with the majority of studies on IS success research, which apply survey-based research to test hypothesized relationships (Urbach et al., 2009).

4.1. Construct operationalization

In order to operationalize the conceptual model's constructs, we followed various authors' recommendation to use tested and proven measures, if available, to enhance validity (e.g., Bharati and Chaudhury, 2004; DeLone and McLean, 2003; Kankanhalli et al., 2005; Sugianto and Tojib, 2006). Thus, we adapted items identified in previous studies and modified them for use in the employee portal context, if required. Where there were no items, and they needed to be created, we paid particular attention to first doing a pilot test and subsequently verifying the constructs' *discriminant validity* to avoid biases resulting from common method variance (Majchrzak et al., 2005). In order to account for our assumption that users may typically not be able to differentiate between the original portal features and those of the accessible back-end systems and that an employee portal is usually individually customized to an organization's specific requirements and, thus, differs from those of other organizations, we designed our survey questions by capturing the various aspects and functionalities of an employee portal at a meta-level (e.g., asking for general feedback to collaboration support). Accordingly, we developed our survey items with the objective that all respondents be able to answer all of the survey questions, regardless of the features provided by a specific employee portal.

After surveying the literature for existing constructs, initial item pools were created for each of these. We added additional items where important aspects of a construct's content domain have not been covered. In order to ensure the *content validity* of the item pool, we discussed the choice of items with a group of four IS experts, from both academia and practice, who are knowledgeable in the field of employee portals. Based on the experts' feedback, the choice of items, as well as the wording was refined. In a further step, we used a card-sorting and item-ranking approach similar to the one adopted by Davis (1989), Moore and Benbasat (1991), and Kankanhalli et al. (2005). Instead of cardboard cards, we used a computer-based spreadsheet solution to support the sorting procedure. Eight experts, other than those involved in the discussion before, participated as judges. They were each asked to assign each item to one of the constructs, or to an "ambiguous/unclear" category. Additional space was provided on the spreadsheet for comments on and suggestions for the items. The results of this approach were basically satisfying. However, we dropped several items and modified the wording of others to comply with the judges' feedback.

Finally, as presented in Table 2, we selected the most appropriate items for each of the constructs for the field test. All 12 constructs used within this study were measured using a seven-point Likert-type scale (1 = strongly disagree, 7 = strongly agree) (see Appendix A).

All the remaining items were combined into draft survey instruments for pre-testing. We thereafter developed two separate questionnaires for data collection. The management survey collected data on the organizational impact variable. The end-user survey was designed to gather data on our research model's remaining constructs. The reasoning behind the two surveys is that the end-users interact with employee portals on a daily basis and, thus, have the necessary knowledge to evaluate variables directly related to these systems. Management, on the other hand, would have deeper knowledge of the organizational performance and could assess the employee portal's effect on it. In order to ensure the quality of the questionnaires design and presentation, we discussed the drafts within our research team and modified them according to the group's feedback. As a final pre-test prior to using the survey in the field, the draft questionnaires were trialed with a group of 16 information systems PhD students and four faculty members serving as test users. Based on their feedback, we finalized the questionnaires' appearance and instructions.

4.2. Research setting

Our study was conducted in 22 internationally acting companies (Table 3). We acquired these companies' participation by inviting them and other companies to participate in an international benchmarking study. Participation was encouraged by offering the companies both their individual results and the other participants' anonymized comparative data. Twenty-two companies agreed to participate in the study by registering on the study's website. Thereafter, we contacted the persons responsible for the employee portal in these companies – usually members of the respective corporate communications or KM department – and discussed further procedures.

4.3. Data collection

We provided each of the 22 companies with a hyperlink to the online end-user survey, asking them to distribute it via e-mail to all or a subset of their employee portal's users. In order to minimize bias caused by differences in addressing the survey participants, we also provided the companies' coordinating persons with invitation templates. In these templates,

Table 2
Selected measures.

Construct	Items	No. of items	References
System quality	Navigation, searchability, structure, usability, functionality, accessibility	6	Items adapted from Ahn et al. (2004) and McKinney et al. (2002)
Information quality	Usefulness, understandability, interestingness, reliability, completeness, timeliness	6	Items adapted from Lin and Lee (2006), McKinney et al. (2002), and Yang et al. (2005)
Process quality	Efficiency, reliability, accuracy, ease of initiation, understandability, traceability, completeness	7	New items derived from Puschmann and Alt (2005) and Martini et al. (2009)
Collaboration quality	Ease of use, comfort, effectiveness, efficiency of different collaborative features	7	New items derived from Benbya et al. (2004), Detlor (2000) and Raghavan (2002)
Service quality	Responsiveness, empathy, reliability, assurance	4	Items adapted from Chang and King (2005) and Pitt et al. (1995)
Use	Extent of using different features	8	New items derived from Almutairi and Subramanian (2005)
User satisfaction	Adequacy, efficiency, effectiveness, overall satisfaction	4	Items adapted from Seddon and Kiew (1994)
Individual impact	Task performance, job performance, productivity, job effectiveness, job simplification, usefulness	6	Items adapted from Davis (1989)
Organizational impact	Enhancement of operations, quality improvement, enhancement of coordination and collaboration, competitive advantage, overall success	6	Items adapted from Sabherwal (1999)
Knowledge-intensity	Level of complex knowledge and understanding, amount of information required, overall knowledge-intensity	3	New items derived from Eppler et al. (1999)
Process standardization	Repetitiveness, transparency, overall process standardization	3	New items derived from Wüllenweber et al. (2008)
Management support	Encouragement, leadership support	2	New items derived from Sharma and Yetton (2003), and Kulkarni et al. (2007)

Table 3
Research setting and responses.

#	Industry	Portal platform	Responses	#	Industry	Portal platform	Responses
1	Consulting	Developed in-house	246	12	Insurance	Teamsite	119
2	Media	Intrexx Xtreme	140	13	Manufacturing	SAP Netweaver	713
3	Automotive	TIBCO	1000 (1470)	14	Aviation	SAP Netweaver	1000 (5246)
4	IT	Developed in-house	257	15	Banking	Developed in-house	46
5	Software	MS Sharepoint	35	16	Pharmaceutical	SAP Netweaver	108
6	Consulting	MS Sharepoint	97	17	IT	Confluence	72
7	Automotive	Intrexx Xtreme	47	18	Communication	Developed in-house	334
8	Banking	RedDot	980	19	Software	SAP Netweaver	225
9	Consulting	SAP Netweaver	25	20	Energy	SAP Netweaver	273
10	Manufacturing	SAP Netweaver	50	21	Banking	Developed in-house	139
11	Development	RedDot	150	22	Consulting	Developed in-house	154
						Total	6210 (10,926)

as well as on the start page of the online survey, we emphasized that all data would be handled with the strictest confidentiality and that the identity of the respondent could not be inferred. We did this, as well as taking other steps, to achieve the best possible response rate. The invitations to the employee portal users were sent out at the beginning of the survey period. In some companies, participation was also advertized by other internal announcements. Two weeks later, we asked the companies' contact persons to send their employees a reminder. All the companies again requested their employees to participate. After an overall survey period of six weeks, we closed the online survey. In addition to the end-user survey, we sent out the management survey to each of the companies to gather data on the organizational impact, as well as further information on the employee portals such as technical details, their functionality, and applications integrated. At the end of the survey period, we received the completed management questionnaires from all of the 22 companies.

In total, 10,926 employee portal users completed the online survey. We considered only fully completed questionnaires for further analysis. However, because answering our survey did not require any specific set of employee portal features, the portion of incomplete questionnaires was rather low. Since the sample sizes of the different companies varied greatly, we further limited the number of responses per company to 1000 in order to avoid an overemphasis of single companies in our results. Accordingly, in two cases we randomly chose 1000 surveys from those submitted. Finally, we used a sample of 6210 responses for the subsequent analysis. Table 3 shows the number of responses from the different companies. An average response rate of 36.7% was achieved, which is considerably above the minimum of 20% recommended by Malhotra and Grover (1998). The respondents' demographic characteristics are shown in Table 4.

Non-response bias generally occurs when some of the target respondents do not participate in the survey and, thus, cause an unreliable representation of the selected sample. Even with a large number of responses and high response rates, strong hypothetical differences in the non-response group can produce misleading conclusions that do not generalize the entire target group and, consequently, limit a study's external validity. Therefore, it is necessary to address the issue of non-response before, during, and after data collection (King and He, 2005; Van der Stede et al., 2005). Before and during the data collection, we followed the recommendations by Rogelberg and Stanton (2007) on minimizing non-response: We designed the survey carefully, emphasized the importance of the respondents' participation and our high estimation of the respondents' opinions, as well as persuading the participating companies to send out reminder notes. After the data collection, we assessed the non-response bias by verifying that the responses of early and late respondents within each of the companies did not differ significantly. The idea behind this approach is that late respondents are more likely to resemble non-respondents than early respondents (Armstrong and Overton, 1977). We defined early respondents as those who responded within the first half of the survey period, while late respondents did so within the second half. Since response data are not normally distributed in all of the 22 samples and group sizes differ, we used the non-parametric Mann–Whitney test (Mann and Whitney, 1947) to test for differences between the two groups. All comparisons between the early and late responses showed no significant differences. Thus, we assume that the study is not affected by a significant non-response bias.

Common method bias (CMB) occurs when a significant amount of spurious covariance shared among variables is attributable to the common method used in collecting data (Buckley, 1990; Malhotra et al. 2006). Given the perceptual assessment of both dependent and independent variables in our model, CMB might potentially affect the validity of our results. In order to control for this bias, we used procedural remedies recommended by Podsakoff et al. (2003), such as offering complete anonymity to respondents as well as reducing ambiguity by means of pre-testing and customization. Furthermore, we used statistical remedies to control for CMB. Firstly, we evaluated possible CMB using Harman's single-factor test, which is deemed

Table 4
Respondents' demographic characteristics.

	Age (years)	Gender	Computer use (hours per week)	Experience with portal (months)
Average/STD	38.3/12.2	32.5% female	34.3/28.8	35.9/38.4

the most widespread approach (Malhotra et al., 2006; Podsakoff et al., 2003). Therefore, all of the items used to operationalize the different constructs were subject to an exploratory factor analysis. We thus examined the unrotated factor solution to determine the number of factors necessary to account for the variance in the items. The factor analysis revealed 11 factors with an Eigenvalue greater than 1.0 that account for 77.6% of the total variance. And although the first factor accounts for 34.3% of the variance, we concluded that neither "(1) a single factor emerges from unrotated factor solutions," nor "(2) a first factor explains the majority of the variance in the variables" (Malhotra et al. 2006, p. 1867). Secondly, we conducted the marker variable test (Lindell and Whitney, 2001; Malhotra et al., 2006). In this approach, CMB can be assessed based on the correlations between a marker variable and the research variables. In our case, the results showed that after adjustment for the second-smallest correlation, all significant correlations remained significant. Consequently, having used both procedural and statistical remedies to control for CMB, we posit that CMB did not significantly affect our results.

5. Analysis and results

Using the empirical data from the surveys, the measurement properties were assessed and hypotheses were tested using the partial least squares (PLS) approach (Chin, 1998; Wold, 1985). We chose PLS for the data analysis since, compared to covariance-based approaches, it is advantageous when the research model is relatively complex and has a large numbers of indicators, the measures are not well established, and/or the relationships between the indicators and latent variables have to be modeled in different modes (i.e. formative and reflective measures) (Chin and Newsted, 1999; Fornell and Bookstein, 1982). Furthermore, with regard to analyzing the relatively small sample gathered through the management survey, PLS may be better suited as it has fewer demands regarding sample size and residual distributions (Fornell and Bookstein, 1982; Gefen et al., 2000). Finally, the PLS approach is best suited for management-oriented problems with decision relevance and focus on prediction (Fornell and Bookstein, 1982; Huber et al., 2007). We used the software package SmartPLS (Ringle et al., 2005) for the statistical calculations.

5.1. Assessment of the measurement models

We used reflective indicators for the operationalization of most of the model's constructs. Only *use* and *collaboration quality* were measured formatively. Following the validation guidelines of Straub et al. (2004) and Lewis et al. (2005), we tested the reflective measurement models for unidimensionality, internal consistency reliability, indicator reliability, convergent validity, and discriminant validity by applying standard decision rules. Organizational impact, which was assessed by the companies' management, was analyzed separately on the 22 companies' aggregated level.

Unidimensionality refers to a latent variable's property of having each of its measurement items relate to it better than to any others (Gerbing and Anderson, 1988). In contrast to LISREL (Gefen, 2003), PLS cannot directly measure unidimensionality, but it can be assessed using an exploratory factor analysis (EFA). An EFA's objective is to ascertain whether the measurement items converge in the corresponding constructs (factors), that each item loads with a high coefficient on only one factor, and that this factor is the same for all items that are supposed to measure it. The number of selected factors is determined by the numbers of factors with an Eigenvalue exceeding 1.0. An item loading is usually considered high if the loading coefficient is above .600 and considered low if the coefficient is below .400 (Gefen and Straub, 2005). Using SPSS 15 (SPSS Inc., 2006), we conducted an EFA by means of a principal component analysis (PCA) with varimax rotation and Kaiser normalization (see Appendix B). The results demonstrate a reasonable level of unidimensionality. Almost all of the measurement items load highly on only one factor. However, the items intended to measure *user satisfaction* load moderately on both "their" factor and on the factor that represents *individual impact*. Since both constructs are measured with established operationalizations (Davis, 1989; Seddon and Kiew, 1994) and the affected items load higher on *user satisfaction* than on *individual impact*, we did not rearrange the allocation of these measurement items to the model's constructs. This procedure is in line with Lewis et al. (2005), who suggest keeping items with strongly justified theoretical relevance. However, we further analyzed whether discriminant validity is given for these two constructs as well as for all other constructs.

The traditional criterion for assessing *internal consistency reliability* is Cronbach's alpha (CA), with a high alpha value assuming that the scores of all the items of one construct have the same range and meaning (Cronbach, 1951). An alternative measure to Cronbach's alpha is the composite reliability (CR) (Werts et al., 1974). The composite reliability is recommended by Chin (1998) as the preferred measure since it overcomes some of CA's deficiencies. The CA and CR values of all constructs in our model are, as presented in Table 5, above the generally recommended minimum of .700 (Nunnally and Bernstein, 1994). Two of our model's constructs show CA levels above .950, which "are more suspect than those in the middle alpha ranges" (Straub et al., 2004, p. 401). However, our tests did not show any significant issues with common method bias (see above).

Indicator reliabilitydescribes the extent to which a variable or set of variables is consistent regarding what it intends to measure. The reliability of one construct is independent of and calculated separately from that of other constructs. We determined indicator reliability using a confirmatory factor analysis (CFA) within PLS, with the numbers of factors specified a priori. Items with a loading below .700 are usually considered too unreliable (Chin, 1998). In our model, all loadings are above this threshold, which indicates that more than 50% of each item's variance is caused by the respective construct. The signif-

Table 5
Internal consistency and convergent validity.

Construct	Cronbach's alpha	Composite reliability	Average variance extracted
Individual impact	.964	.971	.848
Information quality	.909	.929	.686
Knowledge-intensity	.923	.951	.866
Management support	.815	.916	.844
Process quality	.953	.962	.781
Process standardization	.787	.875	.699
Service quality	.942	.959	.853
System quality	.920	.938	.716
User satisfaction	.935	.954	.838

icance of the indicator loadings was tested using a bootstrapping procedure with 1000 resamples. All loadings were significant at the .001 level (see Appendix C).

Convergent validity relates to the degree to which individual items reflecting a construct converge in comparison to items measuring different constructs. A commonly applied criterion of convergent validity is the average variance extracted (AVE) proposed by Fornell and Larcker (1981). As indicated in Table 5, all the constructs in our model have AVE indicators above .500, demonstrating that the constructs' variance is greater than the variance caused by the respective measurement errors and, thus, suggesting that all constructs possess adequate reliability (Segars, 1997).

Finally, *discriminant validity* relates to the degree to which the measures of different constructs differ from one another. Whereas convergent validity tests whether a particular item measures the construct it is supposed to measure, discriminant validity tests whether the items do not unintentionally measure something else. In order to assess the constructs' discriminant validity, we compared the items' cross-loadings. These cross-loadings are obtained by correlating the component scores of each latent variable with all items (Chin, 1998). The loading of each indicator is higher for its respective construct than for any of the others. Furthermore, each of the constructs loads highest with its assigned items (see Appendix D). Consequently, it can be inferred that the different constructs' indicators are not interchangeable. To further validate that all the measures do indeed differ, we examined whether the square roots of the AVE extracted for each construct is greater than the interconstruct correlation. Conceptually, this test requires each construct to account for more of the variance in its own indicators than it shares with another construct (Fornell and Larcker, 1981). With respect to our study, the square root of the AVE of each construct is greater than their interconstruct correlations (Table 6). This result provides more evidence that all of the constructs are sufficiently dissimilar.

To assess the measurement model of *organizational impact*, we used the 22 datasets collected through the management survey to analyze the items' loadings and significance levels. The results which we present in Table 7 indicate that all of the six items load higher than .700 significant at the .001 level on the designated construct. All reliability measures are above the recommended thresholds and the investigated constructs shows sufficient dissimilarity to our research model's other constructs.

Table 6
Interconstruct correlations.

	1	2	3	4	5	6	7	8	9
1. Individual impact	**.921**								
2. Information quality	.482	**.828**							
3. Knowledge-intensity	.100	.108	**.931**						
4. Management support	.458	.298	.122	**.919**					
5. Process quality	.489	.568	.036	.256	**.884**				
6. Process standardization	.289	.251	.038	.185	.259	**.836**			
7. Service quality	.376	.481	.108	.298	.418	.161	**.923**		
8. System quality	.529	.658	.035	.275	.599	.260	.427	**.846**	
9. User satisfaction	.727	.577	.062	.410	.566	.309	.433	.696	**.915**

Notes: Diagonal elements represent the square root of the average variance extracted (AVE)

Table 7
Assessment of the construct organizational impact.

AVE	CA	CR	Item	Loading	*t*-Value
.651	.894	.918	ORGI1	.843	14.4196
			ORGI2	.734	14.2521
			ORGI3	.800	13.4114
			ORGI4	.798	11.3884
			ORGI5	.819	24.8884
			ORGI6	.842	26.2067

The constructs *use* and *collaboration quality* were measured using formative measurement models. The results of these models' assessment are presented in Table 8. All items, with the exception of one, show weights higher than .100, with significance at the .050 level, which demonstrates a sufficient level of reliability (Lohmöller, 1989). We did not drop the one item with a weight of only .088 since the threshold of .100 is almost reached. Moreover, dropping an item of a formative model would omit a unique part of the composite latent construct and, thus, change the meaning of the variable (Jarvis et al., 2003). We further checked the measurement models for multicollinearity with the variance inflation factor (VIF). The VIF indicates how much of an indicator's variance is explained by the other constructs' indicators (Cassel and Hackl, 2000; Fornell and Bookstein, 1982). All the values are below the commonly accepted threshold of 10 (Diamantopoulos and Siguaw, 2006; Gujarati, 2003). Consequently, we conclude that multicollinearity is not an issue in our study. Moreover, we followed the suggestion of MacKenzie et al. (2005) to test for discriminant validity between the formative constructs as well. In our study, correlations between the formative and all other constructs of less than .700 (see Appendix E) indicate good discriminant validity (Bruhn et al., 2008).

5.2. Assessment of the structural model

After the validation of the measurement model, the structural model was analyzed and the hypothesized relationships between the constructs were tested. Again, all analyzes related to *organizational impact* were conducted using aggregated data. Since hypotheses H6a and H6b include a mutual influence between *use* and *user satisfaction* that cannot be simultaneously tested, we tested two different models. Model 1 assumes the influence is from *use* to *user satisfaction* (H6a), whereas model 2 works from *user satisfaction* to *use* (H6b). The results of the tests performed on the two structural models are depicted in Fig. 2. The upper path coefficients give the results of model 1 and the lower ones of model 2. We used bootstrapping with 1000 resamples to determine the significance of the paths within the structural model.

The quality of the structural models was evaluated on squared multiple correlations (R^2) and cross-validated redundancy measures (Q^2). Overall, both models explain a considerable portion of the latent variables' variance. More than half of the variance of the endogenous dependent variables *individual impact* ($R^2 = .594$ in both models) and *user satisfaction* ($R^2 = .609$ in model 1 and $R^2 = .601$ in model 2) is explained, which can be considered substantial. The variance of the variable *use* ($R^2 = .350$ in model 1 and $R^2 = .365$ in model 2) is explained to a lesser extent, but is still at a moderate level. Only *organizational impact* shows a weak R^2 ($R^2 = .143$ in both models) (Chin, 1998).

The model's predictive relevance was tested with a non-parametric Stone-Geisser test (Geisser, 1975; Stone, 1974). This test uses a blindfolding procedure (Tenenhaus et al., 2005) to create estimates of residual variances. By systematically assuming that a certain number of cases are missing from the sample, the model parameters are estimated and used to predict the omitted values. Q^2 is a measure of the extent to which this prediction is successful. Positive Q^2 values confirm the predictive relevance of the model in respect of a particular construct. Furthermore, the better the tested model's predictive relevance, the greater Q^2 becomes (Fornell and Cha, 1994). The test results show positive values for *use* ($Q^2 = .140$ in model 1 and $Q^2 = .145$ in model 2), *user satisfaction* ($Q^2 = .502$ in model 1 and $Q^2 = .496$ in model 2), *individual impact* ($Q^2 = .490$ in both models), and *organizational impact* ($Q^2 = .089$ in both models).

Having established the validity of the measurements and confirmed that the quality of the structural model is acceptable, the structural paths were evaluated to test the research hypotheses (see Appendix F). Hypothesized linkages were considered to be supported by the data if the corresponding path coefficients had the predicted sign and were significant at the $p < .050$ level. In order to determine the impact of one construct on another, we calculated the effect size f^2. Values for f^2 between .020 and .150, .150 and .350, and exceeding .350 indicate that an exogenous latent variable has a small, medium,

Table 8
Assessment of formatively measured constructs.

Construct	Item	Weight	*t*-Value	VIF
Collaboration quality	COLQ1	.168	2.562	5.405
	COLQ2	.181	2.528	6.536
	COLQ3	.208	3.241	3.546
	COLQ4	.255	4.731	1.678
	COLQ5	.101	1.993	2.445
	COLQ6	.136	2.519	2.660
	COLQ7	.212	3.502	3.175
Use	USE1	.359	6.670	1.280
	USE2	.088	1.719	1.616
	USE3	.283	4.667	1.957
	USE4	.198	3.360	1.916
	USE5	.159	2.890	1.443
	USE6	.106	1.927	1.664
	USE7	.128	2.115	2.128
	USE8	.245	4.511	1.337

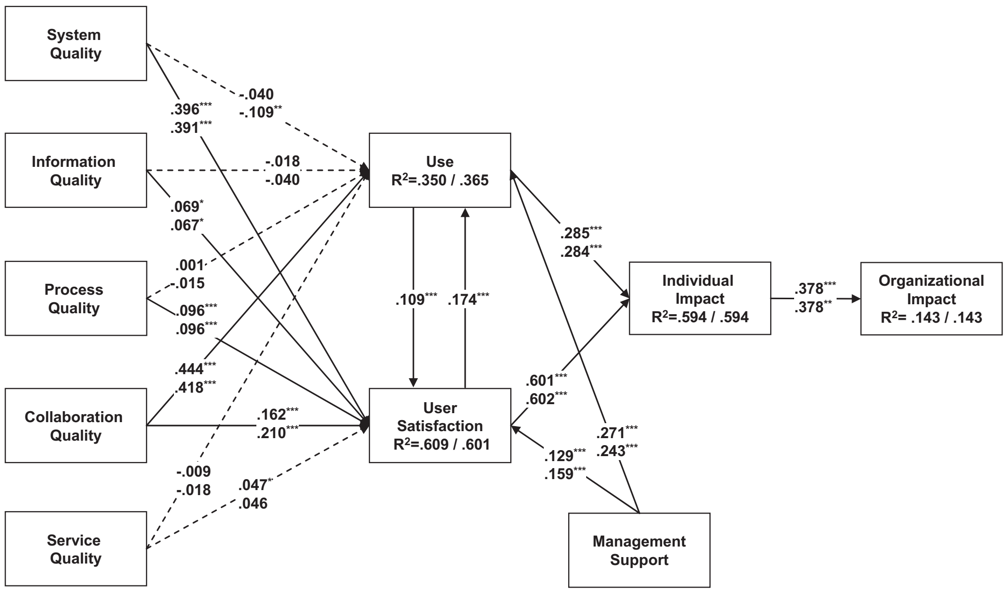

Fig. 2. Results of the structural analysis. * significant at $p < .050$; ** significant at $p < .010$; *** significant at $p < .001$.

Table 9
Results of hypotheses tests.

Hypothesis		β	f^2	Support	Effect size
H1a	System quality → use	$-.040/-.109^{**}$	.002/.006	No	–
H1b	System quality → user satisfaction	$.396^{***}/.391^{***}$	.182/.173	Yes	Medium
H2a	Information quality → use	$-.018/-.040$	.002/.002	No	–
H2b	Information quality → user satisfaction	$.069^{*}/.067^{*}$	.020/.023	Yes	Small
H3a	Process quality → use	.001/.015	.000/.000	No	–
H3b	Process quality → user satisfaction	$.096^{***}/.096^{***}$	.023/.020	Yes	Small
H4a	Collaboration quality → use	$.444^{***}/.418^{***}$	.142/.120	Yes	Small
H4b	Collaboration quality → user satisfaction	$.162^{***}/.210^{***}$	.033/.158	Yes	Small
H5a	Service quality → use	$-.009/-.018$	.000/.000	No	–
H5b	Service quality → user satisfaction	$.047^{*}/.046$	.005/.003	No	–
H6a	Use → user satisfaction	$.109^{***}/–$	.020/–	Yes	Small
H6b	User satisfaction → use	$–/.174^{***}$	–/.022	Yes	Small
H7	Use → individual impact	$.285^{***}/.284^{***}$	.160/.160	Yes	Medium
H8	User satisfaction → individual impact	$.601^{***}/.602^{***}$	.729/.729	Yes	Large
H9	Individual impact → organizational impact	$.378^{***}/.378^{***}$	n/a	Yes	n/a

Path-β: * significant at $p < .050$; ** significant at $p < .010$; *** significant at $p < .001$ Effect size: >.350 large; >.150 and ⩽.350 medium; >.020 and ⩽.150 small (Chin, 1998; Cohen, 1988)

or large effect on an endogenous latent variable (Chin, 1998; Cohen, 1988; Gefen et al., 2000). In our model, all significant structural paths show at least small effect size. The findings regarding the 15 hypotheses are summarized in Table 9.

The two control variables *knowledge-intensity of tasks* and *process standardization* had no significant influence on our results. The third control variable *management support*, however, significantly influences both *use* ($\beta = .271$, $p < .001$, $f^2 = .082$ in model 1; $\beta = .243$, $p < .001$, $f^2 = -.011$ in model 2) and *user satisfaction* ($\beta = .129$, $p < .001$, $f^2 = .033$ in model 1; $\beta = .159$, $p < .001$, $f^2 = .053$ in model 2). We further analyzed control variables' potential moderating effects on the structural model's paths using the product-indicator approach for measuring interaction effects proposed by Chin et al. (2003). None of out three controls showed a significant moderating effect on any of the structural paths.

6. Discussion and conclusion

Most of the hypotheses derived from the D&M IS Success Model are supported by our study. The paths from *system* and *information quality* to *user satisfaction*, between *use* and *user satisfaction*, from *use* and *user satisfaction* to *individual impact*, as well as from *individual impact* to *organizational impact* emerged as hypothesized by the original model. However, the paths from *system* and *information quality* to *use*, as well as from *service quality* to *use* and *user satisfaction* were not significant. Instead, our results support most of the hypotheses involving the two newly added success dimensions. The paths from *collaboration quality* to *use* and *user satisfaction*, as well as from *process quality* to *user satisfaction* are supported. Only the path

Table 10
Total effects on individual impact.

Rank	Construct	Total effect
1	Collaboration quality	.253/.255
2	System quality	.224/.224
3	Management support	.173/.172
4	Process quality	.058/.058
5	Information quality	.035/.032
6	Service quality	.025/.025

from *process quality* to *use* is not significant. Furthermore, the control variable *management support* has a significant impact on *use* and *user satisfaction*.

The empirical results of our study indicate that *collaboration quality* is the only quality dimension that significantly influences both *use* and *user satisfaction*. Thus, the quality of the employee portal's collaborative features seems to be an important success factor. If available, these features are utilized by the users and lead to a higher overall satisfaction with the portal. Accordingly, providing additional collaborative features and/or improving existing ones may directly increase *use* and *user satisfaction* and, consequently, the *individual and organizational impacts* gained from using employee portals.

Our finding that *system*, *information,* and *process quality* do not significantly influence the perceived actual *use* is inconsistent with several other comparable studies (e.g., Hsieh and Wang, 2007; Rai et al., 2002). However, also other studies have found that these associations are not significant (e.g., McGill et al., 2003). This may be explained by assuming that despite the non-mandatory nature of employee portals, certain tasks can only be done and certain information only gathered through the portal. Accordingly, *use* could be regarded as quasi-mandatory, although it is not required by any organizational policy, which would inflate the significance of *use* in the model. In such a case, our test of the relationship between the three quality dimensions and *use* would be limited since we did not control for voluntariness as a moderating effect, as very recently suggested by Wu and Lederer (2009).

However, our results confirm that *system, information*, and *process quality* have a significant impact on *user satisfaction* and can therefore be considered further success factors. However, the impact of *information quality* on *user satisfaction* is relatively low. This is surprising, since the relationship is strongly supported in the literature (e.g., Iivari, 2005; Wu and Wang, 2006). Our explanation for this finding is that, as assessed by the users of the 22 companies involved in this study, *information quality* has already been on a high level for quite some time and, thus, no longer strongly influences *user satisfaction*. The assumed habituation effect is supported by the high index value[1] of the specific latent variable (5.289 on a seven-point Likert-type scale) with a low standard deviation (STD .321).

Supporting the criticism of some authors on the inclusion of this construct (Rosemann and Vessey, 2008; Seddon, 1997), our results indicate that *service quality* has no significant impact on *use* and *user satisfaction*. This finding is consistent with other authors' results (Chiu et al., 2007; Choe, 1996). Our results do not surprise us, since we did not expect the service personnel's support to play an important role in the context of employee portals. In order to analyze the importance of *service quality*, we asked the users to assess how often support is demanded with regard to the employee portal. With an average result of 3.150 (STD 1.766) on a seven-point Likert-type scale, the demand is relatively low. However, with an index value of 5.272 (STD .462), *service quality* is considered high on average.

Consistent with the proposed associations of the D&M IS Success Model (1992, 2003), our results indicate that *use* and *user satisfaction* are interdependent and both influence the *individual impact* gained by using an employee portal. The strong, significant impact of *user satisfaction* on *individual impact* supports the suggestion that *user satisfaction* may serve as a valid surrogate for *individual impact* (Iivari, 2005; Ives et al., 1983). The influence of *individual impact* on *organizational impact* is also significant. Of course, as indicated by the low R^2 of *organizational impact*, many more factors influence the final dependent variable in our model.

Our control variable *management support* shows a significant impact on *use* and *user satisfaction*. Accordingly, a leadership team that actively encourages and supports the utilization of the employee portal positively influences *use* and *user satisfaction* and, consequently, the impact gained from using the system. The variables *knowledge-intensity of tasks* and *process standardization* showed neither significant interrelation with any of the constructs within in our model, nor moderating effects on the model's paths. This can be explained by all of the 22 companies' survey participants being a homogenous group of employees who can be labeled "white collar workers."

To further ascertain the factors that influence the model's effectiveness level the most, we determined the total effects of each of our model's exogenous latent variables *on individual impact*. The total effect is the sum of a particular latent variable's direct effect and all its indirect effects on another (Henseler et al., 2009). Although *organizational impact* is the final dependent variable in our model, we calculated the total effects on *individual impact* in order to consider the intra-organizational variance by using the non-aggregated dataset. Since our model only captures a single direct link from individual to organizational impact, the analysis's conclusion is not affected.

Table 10 presents the exogenous constructs ranked according their total effect on individual impact. From a research perspective, these results further demonstrate that the three newly added variables, which complement the ones adopted from

[1] The index value for a latent variable is calculated by a weighted average of scores from the corresponding measurement items (see Appendix G).

the D&M IS Success Model, are among the four most influential dependent variables in our model. These findings support our perception that the original model's success dimensions do not fully capture the characteristics of an employee portal as a specific type of IS. From a practical perspective, this ranking can serve practitioners as a basis for prioritizing their activities when improving their employee portal. Accordingly, collaboration quality should be the field of action with the highest priority, as it promises to have the highest impact on the employees' daily work.

6.1. Limitations and future research

Our research has a few limitations. Some of the hypothesized relationships are not supported. Above, we presented possible explanations for our results; however, the data do not allow us to test those explanations. Future research is needed to further explore these findings. The assumed habituation effect with regard to information quality seems especially worth investigating further.

Our research is further limited in that we used a convenience sample of companies for the data collection. A random sample from a pool of companies would have increased the generalizability of the results, but was not possible due to the limited number of companies participating in the benchmarking study.

The analyzes with respect to organizational impact were conducted on an aggregated level using only 22 datasets, which is a small sample size for testing a relatively complex model (Chin, 1998). A larger number of participating companies would have increased the validity of these results.

With regard to inviting employees to participate in the survey, the participating companies were instructed to choose a sample that was as representative of the whole workforce as possible. However, by leaving the survey distribution to the companies, we had very little control over the sampling process.

Given the perceptual assessment of both dependent and independent constructs in the model, CMB might potentially affect the validity of our results. Although we used both procedural remedies and statistical tests to control for this potential issue, we cannot fully assure that our results are unbiased in this regard.

We collectively analyzed the user perceptions of employee portals based on different technological platforms, each of which has been individually customized to the organization's requirements. Thus, we based our assessment on typical employee portals with a state-of-the-art range of features when we developed and operationalized our theoretical model. Furthermore, to account for our assumption that the respondents may not be able to delineate the employee portal boundary from that of the back-end systems accessible through it, we designed our survey questions by capturing the different aspects and functionalities of an employee portal at a meta-level that abstracts from individual systems and implementation details. Thus, we tried to avoid that users may unknowingly comment on individual systems which are accessible through the employee portal but are, in fact, only a single element among many that alltogether constitute a portal's feature set. Accordingly, specific features which are important parts of some (as opposed to all) organizations' employee portals – such as e-learning – have not been accounted for. Nevertheless, we believe that this approach is reasonable and necessary to achieve generalizable implications. As a learning, it seems advisable for the analysis of comparable compound systems to use a generalizable set of functionalities on a meta-level. In this respect, it is important to carefully design the survey instrument and the item wording as well as to deliver clear scope definitions of the (meta-)features to be analyzed.

Finally, our study's results reveal that how well an employee portal supports collaboration between its users is an important determinant of success. To account for the key role of collaboration, future research can, for example, further explore the role of employee portals' collaborative features for fostering communities of practice or other forms of community within organizations.

6.2. Implications

Keeping the limitations of the study in mind, our results contribute to both theory and practice. From a practical point of view, our model offers a means for organizations to evaluate and predict the success of employee portals. Employee portal success, like the success of any other IS, is multidimensional and interdependent in nature. Owing to our results, practitioners now know more about the levers that help to improve their employee portals and can prioritize their investments accordingly. Our results indicate that besides the known factors contributing to the success of IS in general, other success dimensions, like the quality of the collaboration and the process support, have to be considered when aiming for a successful employee portal. Furthermore, an organizational culture should be established in which the management actively encourages the use of the employee portal to increase user satisfaction with and use of the employee portal and to ultimately increase its individual and organizational impact.

Our contribution to theory is the extension and further empirical testing of the D&M IS Success Model in a different setting and system context than in previous studies as recommended by various authors (e.g., DeLone and McLean, 2003; Iivari, 2005). Consequently, this study is among the first to empirically validate a comprehensive success model for employee portals. Our results indicate that the quality dimensions of the D&M IS Success Model (DeLone and McLean, 2003) are not sufficient to fully capture the factors influencing the success of state-of-the-art collaboration-centered systems such as employee portals. Thus, our study advances the theoretical development in the area of such systems, serving as a basis for future research in this field. Moreover, by using an established IS theory as the theoretical basis for a benchmarking study, our study is an attempt to apply rigorous research to a practical, highly relevant problem.

Appendix A. Measures

All items were measured using a seven-point Likert-type scale, where 1 = very low, and 7 = very high. The reliability indicator Cronach's alpha is reported for each of the constructs that have been operationalized reflectively. Additionally, inter-item correlations are reported for two-item factors.

A.1. System quality (Cronbach's alpha = .920)

Please assess the system quality of your organization's employee portal.

SYSQ1: Our employee portal is easy to navigate.
SYSQ2: Our employee portal allows me to easily find the information I am looking for.
SYSQ3: Our employee portal is well structured.
SYSQ4: Our employee portal is easy to use.
SYSQ5: Our employee portal offers appropriate functionality.
SYSQ6: Our employee portal offers comfortable access to all the business applications I need.

A.2. Information quality (Cronbach's alpha = .909)

Please assess the quality of the information provided by your organization's employee portal. These comprise all available information supporting your job. Examples are retrievable documents, organizational news, process descriptions, and department-specific information.

INFQ1: The information provided by our employee portal is useful.
INFQ2: The information provided by our employee portal is understandable.
INFQ3: The information provided by our employee portal is interesting.
INFQ4: The information provided by our employee portal is reliable.
INFQ5: The information provided by our employee portal is complete.
INFQ6: The information provided by our employee portal is up-to-date.

A.3. Process quality (Cronbach's alpha = .953)

Please assess the quality of the process support of your organization's employee portal. Work processes supported by the employee portal could, for instance, be approvals, applications for leave, meeting room reservations, procurement requests, time registration, travel expense reports, invoice releases, and campaign planning.

PROQ1: Our employee portal supports the work processes efficiently.
PROQ2: Our employee portal supports the work processes reliably.
PROQ3: Our employee portal supports the work processes accurately.
PROQ4: Our employee portal supports the easy initiation of work processes.
PROQ5: Our employee portal supports the work processes in a way that allows one to understand them.
PROQ6: Our employee portal supports the work processes in a way that allows one to trace them.
PROQ7: Our employee portal supports the work processes fully.

A. 4. Collaboration quality

Please assess the quality of the collaboration support of your organization's employee portal.

COLQ1: Our employee portal enables an easy and comfortable communication with my colleagues.
COLQ2: Our employee portal supports an effective and efficient sharing of information with my colleagues.
COLQ3: Our employee portal enables a comfortable storing and sharing of documents with my colleagues.
COLQ4: Our employee portal allows me to easily and quickly locate my colleagues' contact information.
COLQ5: Our employee portal allows me to enter my competence profile easily and in a structured way.
COLQ6: Our employee portal enables me to identify experts within my organization easily and quickly.
COLQ7: Our employee portal supports an effective networking between the members of my organization.

A.5. Service quality (Cronbach's alpha = .942)

Please assess the service quality of the personnel responsible for the support of your organization's employee portal.

SERQ1: The responsible service personnel are always highly willing to help whenever I need support with the employee portal.
SERQ2: The responsible service personnel provide personal attention when I experience problems with the employee portal.
SERQ3: The responsible service personnel provide services related to the employee portal at the promised time.
SERQ4: The responsible service personnel have sufficient knowledge to answer my questions in respect of the employee portal.

A.6. Use

Please indicate the extent to which you use the employee portal to perform the following tasks.

USE1: Retrieve information.
USE2: Publish information.
USE3: Communicate with colleagues.
USE4: Store and share documents.
USE5: Retrieve your colleagues' contact information.
USE6: Retrieve competence profiles.
USE7: Network with colleagues.
USE8: Execute work processes.

A.7. User satisfaction (Cronbach's alpha = .935)

Please indicate your satisfaction with your organization's employee portal.

USS1: How adequately does the employee portal support your area of work and responsibility?
USS2: How efficient is the employee portal?
USS3: How effective is the employee portal?
USS4: Are you satisfied with the employee portal on the whole?

A.8. Individual impact (Cronbach's alpha = .894)

Please assess the individual benefits derived from using your organization's employee portal.

INDI1: The employee portal enables me to accomplish tasks more quickly.
INDI2: The employee portal improves my job performance.
INDI3: The employee portal increases my productivity.
INDI4: The employee portal enhances my job effectiveness.
INDI5: The employee portal makes it easier to accomplish tasks.
INDI6: The employee portal is useful for my job.

A.9. Organizational impact (Cronbach's alpha = .894)

Please assess the organizational benefits of utilizing your organization's employee portal.

ORGI1: The employee portal has helped my organization improve the efficiency of internal operations.
ORGI2: The employee portal has helped my organization improve the quality of working results.
ORGI3: The employee portal has helped my organization enhance and improve coordination within the organization.
ORG4: The employee portal has helped my organization enhance and improve collaboration within the organization.
ORGI5: The employee portal has helped distinguish my organization from similar organizations.
ORGI6: The employee portal has helped my organization make itself an overall success.

A.10. Knowledge-intensity (Cronbach's alpha = .923)

Please indicate the knowledge intensity of your job.

KNOI1: A high level of complex knowledge and understanding is required to perform my regular work.
KNOI2: I need a great deal of information to accomplish my tasks.
KNOI3: My job can be considered as very knowledge intensive.

Table 11
Assessment of unidimensionality of reflectively measured constructs.

	Component								
	1	2	3	4	5	6	7	8	9
INDI1	.788								
INDI2	.860								
INDI3	.867								
INDI4	.863								
INDI5	.839								
INIDI6	.782								
INFQ1			.774						
INFQ2			.764						
INFQ3			.784						
INFQ4			.753						
INFQ5			.648						
INFQ6			.643						
KNOI1						.928			
KNOI2						.920			
KNOI3						.936			
MANS1								.858	
MANS2								.856	
PROQ1		.738							
PROQ2		.770							
PROQ3		.772							
PROQ4		.740							
PROQ5		.747							
PROQ6		.759							
PROQ7		.743							
PROS1							.837		
PROS2							.726		
PROS3							.842		
SERQ1					.854				
SERQ2					.862				
SERQ3					.844				
SERQ4					.818				
SYSQ1				.778					
SYSQ2				.737					
SYSQ3				.730					
SYSQ4				.759					
SYSQ5				.664					
SYSQ6				.622					
USS1	.513								.538
USS2	.476								.640
USS3	.492								.620
USS4	.490								.558

Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalization. To increase readability, only loadings exceeding .40 are displayed.

A.11. Process standardization (Cronbach's alpha = .787)

Please assess your work processes' degree of standardization.

PROS1: The tasks I have to accomplish to do my job are largely repetitive.
PROS2: The activities of my work processes are transparent and comprehensible.
PROS3: My job is characterized by a high degree of process standardization.

A.12. Management support (Cronbach's alpha = .815, interitem correlation = .719)

Please assess the organizational culture with respect to using the employee portal.

MANS1: My supervisor actively encourages me to use the employee portal.
MANS2: My organization's leadership explicitly supports the employee portal's use.

Appendix B. Exploratory factor analysis

See Table 11.

Appendix C. Item weights

See Table 12.

Appendix D. Cross loadings

See Table 13.

Appendix E. Interconstruct correlations

See Table 14.

Table 12
Indicator reliability of reflectively measured constructs.

Construct	Item	Loading	*t*-Value
Individual impact	INDI1	.902	116.292
	INDI2	.938	173.514
	INDI3	.942	193.517
	INDI4	.943	182.717
	INDI5	.924	137.242
	INDI6	.872	85.323
Information quality	INFQ1	.857	82.290
	INFQ2	.850	67.089
	INFQ3	.856	80.658
	INFQ4	.813	51.903
	INFQ5	.806	61.578
	INFQ6	.787	50.731
Knowledge-intensity	KNOI1	.915	11.003
	KNOI2	.938	9.046
	KNOI3	.939	10.143
Management support	MANS1	.918	130.176
	MANS2	.919	126.150
Process quality	PROQ1	.892	96.465
	PROQ2	.892	83.587
	PROQ3	.855	56.870
	PROQ4	.890	94.305
	PROQ5	.909	108.768
	PROQ6	.887	86.908
	PROQ7	.860	62.961
Process standardization	PROS1	.821	39.991
	PROS2	.829	46.092
	PROS3	.859	58.279
Service quality	SERQ1	.927	121.459
	SERQ2	.938	145.381
	SERQ3	.916	99.019
	SERQ4	.912	95.641
System quality	SYSQ1	.861	85.072
	SYSQ2	.840	77.612
	SYSQ3	.860	90.410
	SYSQ4	.880	101.531
	SYSQ5	.852	80.773
	SYSQ6	.782	51.103
User satisfaction	USS1	.870	84.348
	USS2	.939	182.241
	USS3	.933	152.943
	USS4	.918	152.619

Table 13
Cross loadings of reflectively measured constructs.

	INDI	INFQ	KNOI	MANS	PROQ	PROS	SERQ	SYSQ	USS
INDI1	**.902**	.452	.085	.405	.478	.255	.352	.516	.695
INDI2	**.938**	.430	.082	.422	.445	.281	.337	.470	.653
INDI3	**.942**	.426	.081	.418	.444	.268	.338	.482	.660
INDI4	**.943**	.433	.092	.430	.448	.286	.343	.481	.669
INDI5	**.924**	.460	.090	.410	.463	.266	.357	.508	.682
INDI6	**.872**	.462	.123	.443	.420	.242	.347	.467	.654
INFQ1	.431	**.857**	.116	.268	.482	.210	.398	.558	.492
INFQ2	.374	**.850**	.102	.225	.476	.169	.411	.580	.478
INFQ3	.425	**.856**	.110	.255	.471	.210	.389	.544	.490
INFQ4	.354	**.813**	.131	.254	.440	.168	.408	.479	.407
INFQ5	.422	**.806**	.037	.248	.499	.255	.400	.559	.514
INFQ6	.380	**.787**	.050	.229	.450	.227	.386	.540	.476
KNOI1	.081	.108	**.915**	.102	.042	−.045	.109	.041	.063
KNOI2	.110	.099	**.938**	.125	.027	−.022	.095	.028	.061
KNOI3	.084	.096	**.939**	.110	.033	−.044	.099	.030	.049
MANS1	.425	.248	.081	**.918**	.230	.201	.254	.239	.364
MANS2	.416	.298	.143	**.919**	.240	.139	.294	.266	.389
PROQ1	.469	.513	.030	.242	**.892**	.237	.367	.556	.538
PROQ2	.422	.516	.068	.222	**.892**	.194	.384	.514	.482
PROQ3	.370	.493	.067	.183	**.855**	.183	.384	.468	.432
PROQ4	.450	.492	.018	.224	**.890**	.240	.369	.552	.520
PROQ5	.458	.528	.033	.240	**.909**	.244	.377	.568	.521
PROQ6	.427	.496	.030	.244	**.887**	.235	.360	.528	.501
PROQ7	.415	.477	−.019	.220	**.860**	.262	.351	.510	.493
PROS1	.214	.177	−.033	.112	.173	**.821**	.105	.187	.222
PROS2	.272	.269	.058	.195	.245	**.829**	.176	.261	.301
PROS3	.232	.171	−.137	.146	.224	**.859**	.112	.193	.240
SERQ1	.341	.438	.106	.274	.376	.143	**.927**	.386	.388
SERQ2	.355	.436	.101	.276	.386	.145	**.938**	.392	.407
SERQ3	.343	.445	.101	.265	.390	.149	**.916**	.398	.397
SERQ4	.348	.456	.091	.287	.393	.157	**.912**	.400	.408
SYSQ1	.416	.548	.035	.215	.484	.196	.337	**.861**	.573
SYSQ2	.453	.499	.011	.230	.484	.233	.333	**.840**	.600
SYSQ3	.452	.557	.018	.249	.495	.229	.365	**.860**	.607
SYSQ4	.445	.578	.054	.226	.514	.204	.370	**.880**	.587
SYSQ5	.452	.614	.054	.244	.527	.213	.391	**.852**	.590
SYSQ6	.467	.541	.006	.230	.535	.242	.369	**.782**	.572
USS1	.681	.498	.073	.427	.500	.273	.384	.558	**.870**
USS2	.652	.528	.062	.356	.521	.286	.390	.648	**.939**
USS3	.666	.527	.060	.372	.516	.299	.406	.631	**.933**
USS4	.662	.558	.035	.346	.534	.273	.405	.708	**.918**

Table 14
Interconstruct correlations.

	COLQ	INDI	INFQ	KNOI	MANS	PROQ	PROS	SERQ	SYSQ	USE	USS
COLQ	1										
INDI	.588	1									
INFQ	.533	.482	1								
KNOI	−.007	.100	.108	1							
MANS	.342	.458	.298	.122	1						
PROQ	.576	.489	.568	.036	.256	1					
PROS	.325	.289	.251	−.038	.185	.259	1				
SERQ	.422	.376	.481	.108	.298	.418	.161	1			
SYSQ	.587	.529	.658	.035	.275	.599	.260	.427	1		
USE	.522	.551	.293	.089	.425	.308	.243	.252	.300	1	
USS	.624	.727	.577	.062	.410	.566	.309	.433	.696	.442	1

Appendix F. Path coefficients

See Table 15.

Table 15
Structural paths of models 1 and 2.

Hypothesis		β (1)	*t*-Value (1)	β (2)	*t*-Value (2)
H1a	System quality → use	−.040	.991	−.109	2.492
H1b	System quality → user satisfaction	.396	11.915	.391	11.766
H2a	Information quality → use	−.018	.412	−.040	.919
H2b	Information quality → user satisfaction	.069	1.851	.067	1.799
H3a	Process quality → use	.001	.017	.015	.370
H3b	Process quality → user satisfaction	.096	3.091	.096	3.112
H4a	Collaboration quality → use	.444	9.833	.418	8.235
H4b	Collaboration quality → user satisfaction	.162	5.102	.210	6.813
H5a	Service quality → use	−.009	.288	−.018	.553
H5b	Service quality → user satisfaction	.047	1.791	.046	1.618
H6a	Use → user satisfaction	.109	3.874	n/a	n/a
H6b	User satisfaction → use	n/a	n/a	.174	3.744
H7	Use → individual impact	.285	11.707	.284	11.979
H8	User satisfaction → individual impact	.601	25.485	.602	25.720
H9	Individual impact → organizational impact	.378	5.759	.378	5.563

Table 16
Average index values.

Construct	Index value[a]	STD
Collaboration quality	4.233	.684
Individual impact	4.115	.524
Information quality	5.289	.321
Knowledge-intensity	5.849	.199
Management support	4.383	.712
Organizational impact	4.594	1.203
Process quality	4.499	.266
Process standardization	4.035	.431
Service quality	5.272	.462
System quality	4.579	.371
Use	3.059	.527
User satisfaction	4.537	.438

[a] Index values have been calculated on aggregated datasets.

Appendix G. Index values

See Table 16.

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