MANAGERS AND COLLABORATION TECHNOLOGY: A BUSINESS PERSPECTIVE FOR IMPROVING MANAGEMENT SUPPORT SYSTEMS

Complete Research

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Abstract

Over the last years managers have expanded their role in operations and nowadays they make decisions faster than in the past. Collaboration technology promises to support managers in doing so. Hence, the present situation is favorable for a redesign of management support systems (MSS) incorporating collaboration technology. To examine such technology, we consider "analyst"- and "consumer"-type managers' perspectives and cover collaboration technology for different devices. Based on findings from a literature review and arguments validated in structured manager interviews, we propose four initial design guidelines facilitating collaboration for managers: (1) Coordination: MSS should indicate the availability of other users, send read confirmations, and provide document sharing. (2) Communication: MSS should enable on-topic annotations and sending them to other users "at the push of a button." (3) Cooperation: MSS should provide a comprehensive managerial self-service search function. (4) Devices: For shared documents and textual annotations tablets have become managers most wanted smart device type.

Keywords: Information Systems (IS) Analysis and Design, Human Factor in IS Design, Management Support Systems (MSS), Self-service IS, Collaboration Technology.

1 Introduction

Managers and their information systems (IS) have been a constant topic of interest to researchers over the last five decades (Ackoff, 1967; Elam and Leidner, 1995; Mintzberg, 1972; Rockart and Treacy, 1989; Wixom and Watson, 2010). Given that decision support systems (DSS, Arnott and Pervan, 2008) evolved from a specific concept that originated as a complement to management information systems (MIS) and overlapped in the late 1980s with executive information systems (EIS, Power, 2008), we refer to our object of study as *management support systems* (MSS, Mayer, 2013a). This term covers MIS, DSS, EIS, and—more recently—knowledge management (KMS) and business intelligence (BI) systems for managers (Carlsson et al., 2009).

MSS most often serve as managers' central, hands-on, day-to-day source of information (Clark Jr et al., 2007). The present situation is favorable for a redesign in two respects. Taking the 2008/2009 economic crisis and the ongoing financial turbulences as a reference point, managers have expanded their role in operations—parallel to their strategic leadership (Mayer, 2013b)—and nowadays they make decisions faster than in the past.

Collaboration technology promises to support managers in doing so. On the one hand, faster decision making is driving a demand for such technology per se (Brown et al., 2010). On the other hand, as companies become larger and more dispersed, face-to-face meetings and even telephone calls become less practical.

Collaboration is defined as the sum of task-related activities which are performed by group members to reach common goals (Chen et al., 2006; Cook, 2008; Teufel et al., 1995). Today, the ubiquitous internet and Web 2.0 techniques drive collaboration technology. Among others, it includes instant messaging, video conferencing, really simple syndication (RSS) feeds, and social networking (Riemer et al., 2009) to generate, share, and refine more and more real-time information and communication (Mc Afee, 2006).

The objective of this article is to examine *collaboration technology suitable for incorporation into MSS.* We consider "analyst"- and "consumer"-type managers' (hereafter referred to as consumer and analyst managers) perspectives and cover collaboration technology for different end-user devices (hereafter referred to as devices). We answer two research questions:

- What are managers' preferred collaboration activities?
- Accommodating these preferences, what constitutes appropriate initial guidelines for an MSS design incorporating collaboration technology for managers?

Subject to these considerations, we follow the rising tenets of design science research (DSR) in IS (Hevner and Chatterjee, 2010). We motivate this article in terms of current gaps in MSS design and suggest the integration of collaboration technology to close the gaps. Based on a literature review, we propose nine guidelines that facilitate collaboration for managers. We validate our arguments in structured face-to-face manager interviews and outline four paramount design guidelines facilitating collaboration for managers. The article concludes with a summary and avenues for future research.

2 State of the Art

2.1 Search Strategy

We started our literature review with a journal search focused on IS research outlets provided by the London School of Economics (Willcocks et al., 2008)[1] and complemented them with journals from HCI (AIS, 2013)[2], computer science[3], system and software engineering[4], and finally added proceedings from ICIS, ECIS, AMCIS, and HICSS. We used EBSCOhost, ScienceDirect, Google Scholar, and AIS Electronic Library to access the journals. The Boolean search string combines IS with collaboration technology (Table 1). For IS, the constituent parts of MSS were included and we specified collaboration technology into five keywords (Riemer et al., 2009). For example, articles offered by EBSCOhost including both terms "knowledge management systems" and "collaboration" were analyzed by the authors for their relevance.[5] This search strategy yielded 39 articles. After a final backward and forward search, we found 83 articles to be relevant.

		OR				
AND	**Information systems**	Management support systems	(Group) decision support systems	Executive information systems	Knowledge management systems	Business intelligence systems
	Collaboration technology	Collaboration/ collaborative	Computer-supported cooperative work	Groupware	Media choice	Social software

Table 1. Boolean Search String

2.2 Literature Systematization

Structuring the relevant 83 publications in terms of (1) the elements of IS design theories they employ and (2) the research approach they apply, Figure 1 systemizes our results from literature review.

(1) Elements of IS design theories: Focusing on IS design, decision making is efficient and effective when a problem is presented in line with an individual's approach to problem-solving (Vessey, 1991). In contrast, a design that would meet individual IS use characteristics of all potential managers is untenable from an efficiency perspective. By segmenting different classes of user-group preferences, *IS design for use* (Marchand and Peppard, 2008) provides a way to achieve a balance between "pure" individualization and standardization (Winter, 2011). Based on Walls et al. (1992), we specify this IS design theory by three constitutive elements (Figure 1):

1 This catalog incorporates not only mainstream IS journals, but also social studies. We chose the five top journals from each set, namely: MIS Quarterly, Information Systems Research, Information & Management, Journal of Management Information Systems, and Decision Support Systems, as well as European Journal of Information Systems, Information & Organization, Information Systems Journal, Journal of Organizational and End User Computing, and Journal of Information Technology.
2 International Journal of Human-Computer Studies/Man-Machine Studies, Human-Computer Interaction, International Journal of Human-computer Interaction, and ACM-TCHI.
3 ACM Transactions on Computer Systems, IEEE Transactions on Computers, Journal of Computer and System Sciences, Journal of Information Technology.
4 IEEE Transactions on Software Engineering, ACM Transactions on SE and Methodologies, Journal of Systems and Software, IEEE Software, and Information and Software Technology.
5 We reflected the title and read the abstract of the selected publications to examine if their outcomes will contribute to collaboration technology, managers, arguments, and ways of integrating into MSS.

(a) Exposing managers' (business) perspective on IS, we specify "IS fit" as the way collaboration features accommodate their user-group preferences (Zigurs and Buckland, 1998). Our *user model* covers twofold (Mayer and Mohr, 2011a). An IS user-group analysis segments distinct user groups and their preferences that influence managers' IS use (Zhang et al., 2002). The effects of use occurring to managers while using IS complement our design for use proposal (Benbasat and Nault, 1990).

(b) We define *user requirements* as prerequisites, conditions, or capabilities needed by managers using IS (IEEE, 1990). They consist of functional and non-functional aspects (Sommerville, 2010). The first address "what" collaboration technology is supposed to do or must do (purpose). The latter reflect "how well" it performs its function within its environment (Paech and Kerkow, 2004).

(c) Serving as predefined actions specifying how collaboration in MSS is brought to life, *design guidelines* go beyond mere requirements and contribute to theories specifying how IS should be designed based on kernel theories (Hoogervorst, 2009; Kuechler and Vaishnavi, 2008). They contribute to both models and methods. Models outline concrete systems, specific collaboration technology features, or combinations of these (Gregor, 2006). Complementary methods describe the process of building IS (March et al., 1995).

(2) *Research Approaches in IS*: Research approaches influence the granularity of requirements and design principles identified, from high-level findings to detailed IS features (Urbach et al., 2009).

(a) *Behavioral research* explains phenomena from practice. They rely on observations and apply empirical methods (Urbach et al., 2009). We found structural equation models (SEMs) such as IS success models (De Lone et al., 2003), technology acceptance models (Davis, 1989), and integrated models which merge TAM with findings from user satisfaction research to supply the missing IS characteristics (Wixom and Todd, 2005). These data analysis techniques most often employ surveys and experiments for data collection (Podsakoff et al., 2003). Case studies (to explore an as-is status in practice) are another way of data analysis to conduct behavioral research (Yin, 2009).

(b) *Design science research* covers several outcomes for the conceptual design and implementation of IS to create a better world (Walls et al., 1992). We differentiate between single items and list approaches and frameworks focusing on requirements and design guidelines.

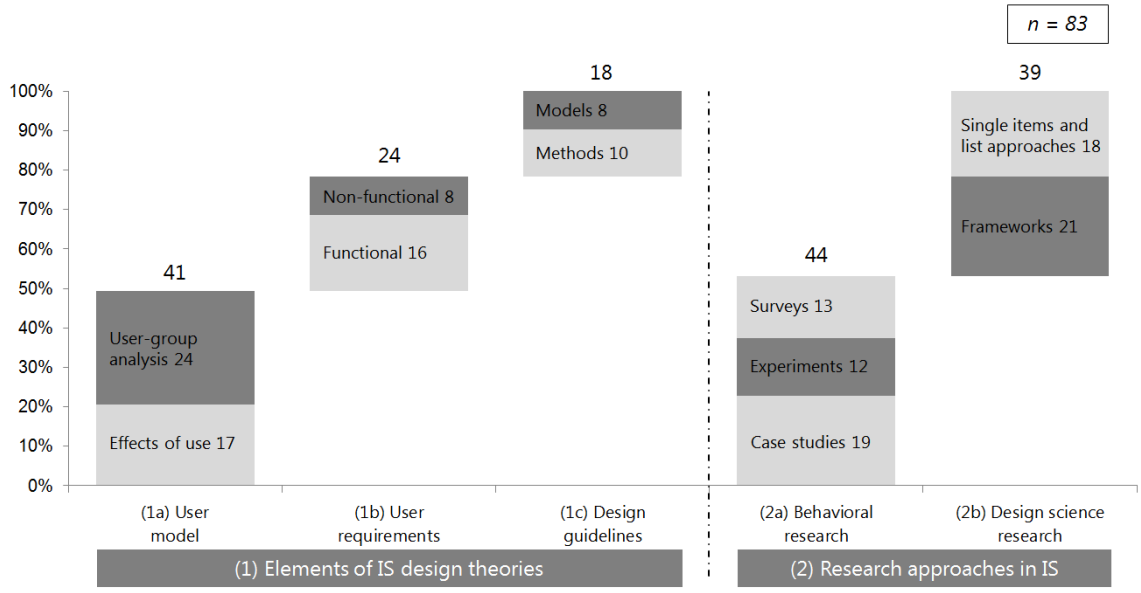

Figure 1. Results of the Literature Review

2.3 Gap Analysis

(1a) User model: With 41 publications, we evaluate the state of the art of IS user models as comprehensive. A first group comprising 24 publications deals with individual cognitive styles and covers techniques for user-group analysis (Figure 1, Mayer and Mohr, 2011a). One of the most popular and widespread techniques is Witkin et al.'s (1977) concept of field-dependence and field-independence. It suggests that field-dependent individuals perceive data in their context as a whole and are less attentive to detail (less analytical). Field-independent people, in turn, pay more attention to details (highly analytical). A second group of 17 publications covers effects of use (Figure 1). These studies either apply the techniques employed in the above group to differentiate characteristics that have an impact on MSS (e.g., women vs. men, Powell and Johnson, 1995) or they utilize an explorative procedure to identify groups of managers and their "typical" MSS usage. The second approach is evident in a study of managers from companies listed in the FT "Europe 500." Updating Witkin et al.'s (1977) concept, Mayer and Stock (2011b) report two basic working styles among managers and their MSS usage. *Analyst managers* seek causal relationships, prefer quantitative data, and pay attention to details (Huysmans, 1970). They might use standard reporting as a MSS entry point, but want to be able to switch to an interactive, deep-dive mode, rather than simple information presentation. *Consumer managers,* in turn, pay less attention to details and rely on content in a predefined order. We integrate these findings from Mayer and Stock (2011b) into our research model as their study is empirically sound since it uses data from a broad survey and their data are still relatively up-to-date.

Considering the use of collaboration technology in detail, the publications we examined frequently focus on the choice of communication channels. However, there is no certainty about managers' benefits. For example, for video conferencing and instant messaging, Lee-Partridge and Snyder (2012) report poor adoption. As they are often cited references, we follow Chen et al. (2006), Cook (2008), and Teufel et al. (1995) and consider ambivalent results from literature research in our model by specifying collaboration in terms of the *coordination, communication, and cooperation function* they entail.

(1b) User requirements: 24 out of 83 relevant publications cover MSS user-requirements. From a functional perspective (Figure 1), they cover the need to offer annotation features (Meyer and Dibbern 2012) and from a non-functional perspective (Figure 1) requirements such as easy-to-use IS handling (Mayer and Mohr, 2011a). Herskovic et al. (2011) and Neyem et al. (2012) emphasize the increasing importance of collaboration technology in a mobile context and furthermore stress that collaboration should not be dependent on the type of device. To gain further insights into managers' expectations, we consider collaboration technology on *smartphones, tablets, and notebooks* in our research model.

(1c) Design guidelines: 18 publications cover methods and models for managers' collaboration (Figure 1). Recent collaboration technology has most often been developed for the consumer market (Nelson, 2010). Although the concept of awareness in collaborative work has been analyzed in models and methods (Belkadi et al., 2013), only a few publications cover current challenges such as information overload or models for mobile collaboration (Pinelle and Gutwin, 2005, Paul and Nazareth, 2010). Gebauer et al. (2010) address the lack of guidelines for MSS design for use in HCI research, but focus broadly on modeling TTF for mobile IS. Benbasat (2010) outlines opportunities that new consumer-driven technology such as social networks offers. Christidis et al. (2012) explore Web 2.0 techniques for companies that address the enhancement of search functions. By testing design guidelines by managers from their *business perspective,* we aim to close this gap in the literature.

(2) Research approaches in IS: The analysis of the applied research approaches reveals a slight preference for behavioral research (2a) compared to design science research in IS (2b). In publications with a behavioral focus (Figure 1), case studies prevail, so that the findings examined are not necessarily applicable to other companies. Thus, we propose *structured face-to-face manager interviews* to expose their business perspective and the managers should be from *different companies* to make our findings diverse and, thus, more relevant than the state of the art (Eisenhardt, 1989).

3 Developing Design Guidelines

Using findings from Chen et al. (2006), Cook (2008), and Teufel et al. (1995), we structure the following nine design guidelines (DG) according to the three collaboration functions they entail (Sect. 3.1-3.3). Table 3 summarizes the guidelines together with their associated characteristics facilitating collaboration for managers we found in our literature review.

3.1 Coordination

Covering collaboration features such as (group) calendars, workflow management, or joint archives for documents, coordination arises in response to tasks divided into working units (Riemer, 2009). Coordination aligns managers' behavior and activities (Heath and Staudenmayer, 2000).

DG 1: MSS should provide information about other users' availability. Presence awareness features enable managers' IS self-service by indicating whether other managers, personal assistants, or other supporting staff are on-/offline (DG 1.1, Mandviwalla and Khan, 1999). Herskovic et al. (2011) call for a list of connected MSS users (DG 1.2).

DG2: MSS should provide information about other users' activities. Belkadi et al. (2013) ask for users' current location and activities (DG 2.1). Following Meyer and Dibbern (2012), especially knowledge workers wish to be informed on colleagues' current activities (DG 2.2), which can help to align their work. Pinelle and Gutwin (2005) note that basic collaboration technology such as (group) calendars can facilitate face-to-face conversation and telephone calls. We examine whether this capability is appreciated by managers as well, or if emailing systems are established covering group calendars, simple task management, and document sharing for manager coordination.

DG3: MSS should support shared documents. Managers often work on interdependent tasks for a joint event such as the next board meeting and therefore need to share documents (DG 3.1) by file transfer or a shared repository (Chen et al., 2006; Neyem et al., 2012). Zhang et al. (2011) state that being informed about new knowledge within and outside the company increases team performance. An example are simple notifications (DG 3.2) which indicate modifications to shared documents (Carroll et al., 2003). This may cover details of modifications (DG 3.3) such as when the latest net sales figures for a board report are updated or comments showing where changes occur, when they were made, and by whom (Tam and Greenberg, 2006). Tee et al. (2009) advise screen sharing (DG 3.4), Power and Sharda (2007) expose joint control of computer screens to enable joint interactions.

3.2 Communication

Communication is defined as the transfer of information by text, image, voice or video, or a combination of these (Cook, 2008). It should be facilitated in synchronous as well as asynchronous mode (Chen et al., 2006). Beside others, collaboration building blocks for textual communication are emails, instant messaging, and newer forms such as weblogs (blogs). Building blocks for combined communication are video chats or conferences.

DG4: MSS should enable annotations. Meyer and Dibbern (2012) address textual annotations on documents, for instance to comment on numbers on a balance sheet, i.e. key performance indicators (KPIs, DG 4.1). Eckerson (2011) exposes annotations on charts and complete report pages to point out exceptions. Lauwers and Lantz (1990) highlight graphical annotations such as drawing on documents to mark, for instance, a balance sheet item or add a net sales split by countries or most important customers (DG 4.2). Riemer et al. (2009) argue that the most sophisticated real-time communication technology is shared office documents (DG 4.3). They enable managers to work synchronously without having to send email attachments back and forth (George, 2003).

DG5: MSS should offer direct messages to colleagues. Herskovic et al. (2011) argue that direct emails "at the push of a button" including MSS screenshots (DG 5.1) are important to enable asynchronous collaboration when two managers work in different time zones. Caporuscio and Inverardi (2003) address a value proposition of emails that it can also be sent to a group of users. According to Kuo (1998), supporting communication is an essential MSS capability. To increase the communication between managers, drag-and-drop of a colleague's icon to relevant information can trigger a direct email and is a new "one-click" collaboration feature (DG 5.2, Averbuch, 2013).

DG6: MSS should provide video conferencing. Managers prefer telephone over email to convey confidential information and to express personal sentiments (Markus, 1994). Video conferencing is the only medium that offers the same synchronicity of face-to-face communication and thus should be suitable for personal conversations at a distance (Dennis et al., 2008). This argument is underlined by Shim et al. (2002) arguing that video conferencing has better capabilities for sharing social cues than text-based communication. However, Lewis et al. (2004) report poor adoption and usage of video conferencing by managers and Lee-Partridge and Snyder (2012) state that face-to-face meetings and email are still managers' preferred modes of communication. Furthermore, MSS should provide video conferencing in a mobile context (DG 6.1) to allow a manager to choose a synchronous communication channel while travelling (Neyem et al., 2012).

DG7: Real-time communication should be integrated into MSS. The value of real-time communication for collaborative work such as *instant messaging (DG 7.1)* is discussed controversially in the literature. According to Ou and Davidson (2011), products such as IBM Sametime that offer instant messaging can play an important role strengthening the connectivity of managers. Nardi et al. (2000) argue for the integration of real-time communication to support informal communication at a distance. Due to its higher synchronicity, real-time communication is better suited for convergence processes than email (Dennis et al., 2008). In turn, it is found to be either not preferred by managers (Lee-Partridge and Snyder, 2012; Palvia et al., 2011), or observed to be hardly used in practice (Leonardi et al., 2012). Compared to email, real-time communication exhibits lower communication quality and effectiveness (Chen et al., 2008) and a decreasing likelihood of agreement, compared to the telephone (Johnson and Cooper, 2009).

3.3 Cooperation with a Broader Group of MSS Users

Complementing our collaboration specifications, we add cooperation activities. Cooperation refers to sharing content with a broader group of people by using IS, while often applying collaboration technology such as company-internal social networking platforms, instant tagging, discussion boards, and weblogs (Riemer et al., 2009).

DG8: MSS should offer syndication. According to Cook (2008), RSS can serve as the primary method of receiving notifications of updates at one place (e.g., when new information is posted in a blog). Thus, users should receive RSS in MSS (DG 8.1). Online forums and blogs can help with answers for particular deviations for which it is initially unclear who in the company can offer help such as a board director, area controller, local management, or even local sales people (Paroutis and Al Saleh, 2009). Syndication of other aggregated information (DG 8.2) enables managers to subscribe to information such as stock market prices and have it displayed in their MSS in pooled form (Zhang et al., 2011). Without this feature, managers need to go to different websites, thus making it harder to compare different perspectives as an aid in decision making.

DG9: MSS should offer a search function. Information access tools are a core affordance of collaboration technology (Mittleman et al., 2008). The more managers have a preference for self-service MSS, the more search functions become important (McAfee, 2006). This should cover a search for content (DG 9.1)—such as in the companies' intranet (Cook, 2008). Averbuch (2013) extends the scope to a search for people (DG 9.2).

4 Validation

4.1 Structured Face-to-Face Manager Interviews

With our focus on managers' (business) perspective, we evaluated our design guidelines in twenty-five *structured face-to-face manager interviews*. Such interviews increase the willingness of interviewees to disclose even detailed and more confidential information and provide a rich understanding of their individual perspective on IS, including reasoning processes (Nadkarni and Shenoy, 2004). More important, interviews most often provide complementary qualitative feedback regarding the questions asked and minimize the risk of misunderstandings in comparison to surveys (Kornmeier, 2007). This is important as—with collaboration technology for managers—we research a (relatively) new IS topic (Sect. 1). The benefit of a *multiple interview approach* is to explore a broad range of expertise and deeper insights than an individual expert can provide (Nadkarni and Nah, 2003; DiCicco-Bloom and Crabtree, 2006). The interviews took place between February and July 2013.

The characteristics of the interviewed managers are summarized in Table 2. They belong to a fair balanced working group of executives ("L1," top-level in company hierarchy) and heads of business or IT/BI departments ("L2," senior vice presidents and professionals) from different stock-listed companies and sectors organized in the competence center "Corporate Management Systems" at University of St.Gallen and Darmstadt University of Technology. They have been meeting three times a year with academia since 2006 to examine trends in managers' IS support.

Position	No	%	Market capitalization [bn USD]	No	%
Executives ("L1")	11	44	≤30	10	40
Business department ("L2")	6	24	30-90	7	28
IT/BI department ("L2")	5	20	90-120	5	20
Other	3	12	>120	1	4
Total	25	100	No response	2	8
Working Style			Total	25	100
Analyst manager	12	48	Frequency of MSS use		
Consumer manager	12	48	Permanent	1	4
No response	1	4	Multiple times a day	5	20
Total	25	100	Once every day	8	32
Sector			2-3 times a week	4	16
Industrial	15	60	Once a week	5	20
Financial services	6	24	No response	2	8
Other sectors	4	16	Total	25	100
Total	25	100			

Table 2. Sample Characteristics of the Managers Interviewed

A pre-test of the questionnaires was performed with two persons to ensure the relevance, completeness, and distinctiveness of the questions as well as an "appropriate" interview duration, bearing in mind that managers have "typically" less time than knowledge workers (or believe they do). We finally found that about 30 minutes in total for each structured interview were appropriate. These two interviews were included in the analysis as no major adjustments relevant to outcome had to be made.

All questions were answered on five-point Likert scale: 1) not important, 2) less important, 3) undecided, 4) important, and 5) very important. *Means (μ)* and *standard deviations (σ)* were calculated for all responses. Following de Winter and Dodou (2010), the data were treated as parametric, which is common in the literature and has an equivalent statistical power to nonparametric procedures. The means

were analyzed for user-group differences with two-tailed two-sample t-tests and the resulting p-values interpreted as follows: $p>0.1$ (not significant, ns), $p<0.1$ (marginally significant), $p<0.05$ significant, and $p<0.01$ highly significant). The managers were interviewed in two ways (Table 3). Firstly, they were requested to estimate their perceived overall as-is and to-be importance of each design guideline DG1-DG9 (column 3 and 4: to-be value: μ and σ) and whether the collaboration technology is already implemented in their companies (column 5 and 6: as-is value: μ and σ). The application of Likert items is appropriate, as different maturity levels of implemented collaboration features in MSS were expected. The difference of the to-be and as-is mean values constituted the current implementation gap (column 7: μ). These gaps were tested for significance (column 8: p-values) assuming paired samples as the same respondent answered for the "as-is" and the "to-be" values.

Secondly, *associated characteristics* of the guidelines (DG 1.1-9.2, column 9 and 10) test complementary insights from our literature review. All means of these characteristics are representing *"to-be" values* (collecting additional "as-is" values was considered too time-consuming for managers). A two-layer analysis was carried out for these features to take two issues into account: On the one hand, we differentiated between the different working styles (analyst vs. consumer managers, based on Sect. 2.3) and, on the other hand, we distinguished between different devices (ibidem, columns 11−23). The means of the two working styles were compared for each device assuming independent samples with unequal variances. The means for collaboration technology on the devices were analyzed separately for the subgroups analyst and consumer managers assuming paired samples. The resulting p-values from the two-layer analysis could not be included into Table 3 and are provided in the text where insightful.

4.2 Results

From both analyst and consumer managers' perspectives four findings stand out. They have to-be values of $\mu \geq 4.00$ (Table 3, column 3) and at the same time, reveal highly significant as-is/to-be implementation gaps (column 8: $p<0.01$): shared documents (DG 3), annotations (DG 4), direct messages to colleagues (DG 5), and self-service search function for managers (DG 9).

Coordination: Shared Documents

The *availability of other MSS users* (DG 1) is important (μ=3.75) with a gap of 1.04 ($p<0.05$, Table 3). Both types of managers evaluate seeing whether other MSS users are on-/offline (DG 1.1) as important with respect to notebooks (analyst managers: 4.17; consumer managers: 4.00) and somewhat important for tablets (3.83; 3.42). Regarding a list of connected MSS users (DG 1.2) there is a distinct difference, as the analyst manager perspective verges in the direction of being important on both tablets (3.45) and notebooks (3.55), whereas consumer managers consider this feature as less important (2.25 and 2.92). For tablets, this difference is highly significant ($p<0.01$), but not for notebooks (ns).

With regard to information of other *MSS users' activities* (DG 2), the interviewed managers were undecided (μ=2.87) and, notably, the as-is was, though not significantly, reported as exceeding the required to-be (gap=–0.45). Seeing the current location of other MSS users (DG 2.1) is irrelevant ($\mu<2.50$) for managers for all devices. Seeing the activities of other MSS users (DG 2.2) is "somewhat useful" (μ=2.92-3.58) for both analyst and consumer managers and for tablets and notebooks.

With a mean of 4.00, *document sharing (DG 3)* is the fourth most important collaboration feature from the managers' business perspective we researched. At 1.35, its implementation gap is the largest one observed for coordination and highly significant ($p<0.01$). Analyzing the device preferences (DG 3.1), analyst managers require this capability on notebooks (4.36) and tablets (4.00), while for consumer managers notebooks (4.60) are strongly preferred ($p<0.01$) over tablets (3.30). The assessment of the notebook as the most important managerial device applies to all other associated characteristics of sharing documents: receive notification (DG 3.2), details of modifications (DG 3.3), and screen sharing (DG 3.4). With respect to seeing details of modifications (DG 3.3), there is no significant difference

between tablets and notebooks for analyst managers, while for consumer managers (3.08; 4.33) the difference was a highly significant ($p<0.01$). In turn, both analyst and consumer managers considered smartphones as inappropriate for screen sharing (DG 3.4: 1.58; 1.42).

Communication: Annotations and Direct Messages to Colleagues

Annotations (DG 4) are conspicuously high in their evaluation ($\mu=4.36$). Furthermore, they exhibit an implementation gap of more than two Likert points which is highly significant (Table 3, column 7 and 8, DG 4: 2.10, $p<0.01$). Textual annotations on KPIs (DG 4.1) using notebooks are the most important communication feature for consumer managers (4.92) in our research model, and more important than for analyst managers which is marginally significant (4.50, $p<0.1$). Drawing on documents (DG 4.2) and synchronous work on shared documents (DG 4.3) is not important to either type of managers on smartphones. While consumer managers feel that there is a difference between notebooks and tablets for all annotation features (DG 4.1-4.3, $p<0.05$), analyst managers significantly prefer notebooks to tablets only for synchronous work on shared documents (DG 4.3, $p<0.05$).

Direct "at the push of a button" messages to colleagues (DG 5) are also high in their evaluation ($\mu=4.32$) and exhibit an implementation gap of more than two Likert points which is highly significant (Table 3, column 7 and 8, DG5: 2.16, $p<0.01$). Direct emails (DG 5.1) are the only collaboration feature for which analyst managers report a mean larger than "4" for all devices. With a marginally significant difference from that perspective ($p<0.1$), consumer managers are only somewhat convinced of this collaboration feature on smartphones (3.08). More important, drag-and-drop icons of relevant colleagues to KPIs (DG 5.2) to initiate a direct message is an appealing feature on tablets and notebooks for both analyst (4.25; 4.33) and consumer managers (4.27; 4.55).

With a mean of 3.83, video conferencing (DG 6) is important to the interviewed managers as well, however, the implementation gap is not significant. For video conferencing in a mobile context (DG 6.1), this is requested by analyst managers using notebooks (4.00) but also tablets (3.83), whereas, though not significantly differing, consumer managers tend towards being neutral for both (both 3.36).

Finally, the interviewed managers were undecided (3.33) if real-time communication should be integrated into MSS (DG7). The implementation in current IS is sufficient (3.23, gap=0.10, ns). A possible explanation could be the "*connectivity paradox*" (Leonardi et al., 2010). While collaboration tools enable flexible teleworking from non-office environments, these tools create a high expectation of constant connectivity.

Cooperation: Self-Service Search Function for Managers

The manager perspective on *syndication* (DG8) was undecided ($\mu=3.09$). Due to its current poor implementation ($\mu=2.14$), this design guideline reveals a highly significant gap (0.94, $p<0.01$). Receiving RSS in the MSS (DG 8.1) is not appreciated by consumer managers ($\mu<3.00$ for all devices), but by analyst managers ($\mu>3.00$ for all devices). With regard to receiving aggregated information on subscribed external and internal content in the MSS (DG 8.2), the same results prevail. Unlike consumer managers, analyst managers consider this feature important for notebooks (3.83, $p<0.05$) and tablets (3.67, ns), but less so for smartphones (3.00, $p<0.1$).

In turn, cooperation is driven by the demand for a *search function (DG 9)* in MSS. It is the most important design guideline ($\mu=4.37$) and yields the largest implementation gap (2.22, $p<0.01$). Search for information (DG 9.1) was evaluated as important by analyst managers for tablets (4.36) and notebooks (4.45). Consumer managers' evaluation differs significantly from analyst managers only for tablets with a mean of 3.27 ($p<0.05$). Search for experts (DG 9.2) was only considered important by analyst managers (3.82 for notebooks and tablets) and significantly less important on smartphones (2.82, $p<0.05$ for both devices). Consumer managers were undecided about this feature for all devices.

Sample size n = 25

Highlighting:
Green: Likert values ≥4
Red: Likert values ≤2

Design guidelines (DG)								Associated characteristics		Analyst manager						Consumer manager						Results:
No.	Description	To-be value		As-is value		Gap		No.	Description	Smartphone		Tablet		Notebook		Smartphone		Tablet		Notebook		μ: mean, σ: standard deviation, ns: not significant
		μ	σ	μ	σ	μ	p-value			μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ	
A. Coordination																						
1	MSS should provide information about other users' availability.	3.75	1.07	2.71	1.27	1.04	<0.05	1.1	See if other users are on-/offline.	2.58	1.68	3.83	1.27	**4.17**	1.19	2.92	1.78	3.42	1.31	**4.00**	1.21	**Both analyst and consumer managers:** Prefer "seeing if other users are on-/offline" (DG 1.1) on notebooks - no significant difference in comparison to tablets (ns), but to smartphones (analyst: p<0.01; consumer: p<0.05). **Consumer managers:** List of connected users (DG 1.2) is less important than for analyst managers (smartphones (p<0.05), tablets (p<0.01), notebooks (ns)).
								1.2	See a list of connected MSS users.	2.36	1.03	3.45	0.93	3.55	1.04	**1.58**	0.67	2.25	0.97	2.92	1.31	
2	MSS should provide information about other users' activities.	2.87	1.06	3.32	1.04	-0.45	ns	2.1	See other users' current location.	2.25	0.87	2.42	0.79	2.33	0.65	**1.42**	0.67	**1.75**	0.97	**1.92**	1.31	**Consumer managers:** Other users' current location (DG 2.1) unimportant for all devices. **Both analyst and consumer managers:** User activities (DG 2.2) "somewhat" important; no significant difference between notebooks and tablets (ns), but between notebooks and smartphones (analyst: p<0.1; consumer p<0.05).
								2.2	See other users' activities.	2.92	1.31	3.50	1.17	3.58	1.24	2.92	1.51	3.42	1.38	3.58	1.38	
3	MSS should support shared documents.	**4.00**	1.17	2.65	1.18	1.35	<0.01	3.1	Enable to share documents.	**1.91**	1.22	**4.00**	1.10	**4.36**	1.21	**1.60**	1.26	3.30	1.49	**4.60**	0.84	**Both analyst and consumer managers:** Prefer notebooks to support all aspects of shared documents (DG3.1-3.3). Smartphones inappropriate for sharing documents and screen sharing (DG 3.4). **Analyst managers:** For notifications of modifications (DG 3.2), difference between smartphones and tablets not significant. **Consumer managers:** Significant difference between notebooks and tablets for all associated characteristics (3.1: p<0.01; 3.2: p<0.1; 3.3: p<0.01; 3.4: p<0.01).
								3.2	Receive notification that there are new modifications of a shared document.	3.58	1.62	3.83	1.47	**4.17**	1.34	3.25	1.36	3.83	0.94	**4.33**	0.65	
								3.3	See details of modifications.	2.42	1.31	3.75	1.42	**4.00**	1.28	2.17	1.11	3.08	1.08	**4.33**	0.65	
								3.4	Enable screen sharing.	**1.58**	0.67	3.50	1.45	3.92	1.24	**1.42**	1.16	3.25	1.54	**4.33**	1.15	
B. Communication																						
4	MSS should enable annotations.	**4.36**	0.58	2.26	1.05	2.10	<0.01	4.1	Enable textual annotations on KPIs.	2.50	1.38	**4.08**	0.90	**4.50**	0.67	2.08	1.16	**4.25**	0.75	**4.92**	0.29	**Consumer managers:** Textual annotations (DG 4.1) on notebooks most important collaboration technology - significantly more important than for analyst manager (p<0.1). Significant difference between notebook and tablet for all annotation features (DG 4.1: p<0.05; 4.2: p<0.05; 4.3: p<0.05). **Analyst managers:** Significantly prefer notebooks to tablets only for synchronous work on shared documents (DG 4.3, p<0.05).
								4.2	Enable drawings on documents.	**1.92**	1.16	3.83	1.03	**4.00**	1.28	**1.50**	0.90	3.17	1.34	3.83	1.27	
								4.3	Enable synchronous (parallel) work on shared documents.	**1.92**	0.90	3.17	1.34	3.92	1.44	**1.33**	0.89	2.42	1.24	3.25	1.66	
5	MSS should offer direct messages to colleagues.	**4.32**	0.75	2.16	0.96	2.16	<0.01	5.1	Enable direct emails including screenshots out of the MSS.	**4.17**	1.19	**4.50**	0.67	**4.67**	0.65	3.08	1.51	**4.42**	0.79	**4.75**	0.45	**Both analyst and consumer managers:** Direct emails (DG 5.1) and drag-and-drop icons (DG 5.2) appealing on tablets and notebooks. **Analyst managers:** Direct emails are the only collaboration technology with a mean larger than 4 for all devices (4.17; 4.50; 4.67). **Consumer managers:** Only somewhat convinced from direct emailing and drag-and-drop icons on smartphones (significant difference to analyst manager: DG 5.1: p<0.1, DG 5.2: p<0.1).
								5.2	Use drag-and-drop icons of relevant colleagues to a specific KPI to generate an on-topic message to them.	3.58	1.08	**4.25**	0.75	**4.33**	0.65	2.60	1.35	**4.27**	0.79	**4.55**	0.69	
6	MSS should provide video conferencing.	3.83	1.40	2.95	1.63	0.88	ns	6.1	Enable video conferencing in a mobile context.	2.83	1.19	3.83	1.34	**4.00**	1.28	**1.73**	1.01	3.36	1.50	3.36	1.50	**Both analyst and consumer managers:** Videoconferencing is considered important, but high disagreement among managers (σ>1). The as-is/to-be gap is not significant. **Analyst managers:** Videoconferencing is also important in a mobile context (DG 6.1), especially on notebooks. **Consumer managers:** Smartphones supporting videoconferencing in mobile context more than one Likert point lower than tablets (p<0.01) and notebooks (p<0.01).
7	Real-time communication should be integrated into MSS.	3.33	1.35	3.23	1.34	0.10	ns	7.1	Enable instant messaging for rapid and brief alignment.	2.58	1.68	3.33	1.44	3.25	1.36	2.55	1.37	3.45	1.51	3.64	1.57	**Both analyst and consumer managers:** Undecided and varied as to whether real-time communication should be integrated into MSS (DG 7.1). The gap indicates that current implementation is sufficient. No significant differences between tablets and notebooks (ns).
C. Cooperation																						
8	MSS should offer syndication (via RSS).	3.09	1.08	2.14	1.06	0.94	<0.01	8.1	Receive RSS of external and internal content in the MSS.	3.09	1.45	3.55	1.37	3.73	1.27	2.50	1.51	2.89	1.69	2.33	1.41	**Both analyst and consumer managers:** Significant gap due to poor RSS implementation (DG 8.1). Difference between analyst and consumer significant for notebooks (DG 8.1: p<0.05; DG 8.2: p<0.05). **Analyst managers:** Above three Likert points for all devices, but both characteristics are less important on smartphones. **Consumer managers:** Below three Likert points for all devices.
								8.2	Receive other aggregated information of subscribed external and internal content in the MSS.	3.00	1.28	3.67	1.23	3.83	1.27	2.08	1.08	2.82	1.40	2.64	1.29	
9	MSS should offer a search function.	**4.37**	0.83	2.15	0.99	2.22	<0.01	9.1	Content: Enable search for information.	3.27	1.27	**4.36**	0.67	**4.45**	0.69	2.73	1.42	3.27	1.35	3.82	1.40	**Both analyst and consumer managers:** Most important design guideline and largest implementation gap for information search (DG 9.1). Device evaluation of analyst and consumer manager differs in regard to tablets (DG 9.1: p<0.05; DG 9.2: p<0.1). **Analyst managers:** Search for experts (DG 9.2) important on tablets and notebooks. **Consumer managers:** Undecided about search for experts (DG 9.2) on all devices.
								9.2	Enable search for experts internally or externally such as in social networks.	2.82	1.25	3.82	1.17	3.82	1.17	2.80	1.40	2.82	1.25	3.18	1.47	

Table 3. Results of Managers' Business Perspective on Collaboration Technology

5 Discussion

On the one hand, there are requirements such as video conferencing (DG 6) which are already fulfilled in office software—therefore, integration into MSS would not offer additional value in general. On the other hand, there are collaboration capabilities such as annotations of which managers have only just become aware. However, to be accepted by managers they must be available in an easy-to-handle "at the push of a button." Based on our quantitative results and managers' qualitative insights given in the interviews, we propose four initial (paramount) design guidelines that should facilitate their collaboration and therefore are suitable to be incorporated into MSS.

5.1 Coordination: In order to strengthen managerial team work, MSS should indicate the availability of other users, send read confirmations, and provide document sharing

Improving managerial team work, MSS should provide information about other MSS users' current availability (DG 1) revealing their current IS mode (off-/online) (DG 1.1) and—especially for analyst managers—we propose showing colleagues' names and pictures (DG 1.2). Both affordances were known to managers from WhatsApp and are in line with Majchrzak et al. (2013) argumentation who evaluated them as engaging conversation. However, using the calendar function of their email system, managers can see colleagues' basic activities (DG 2.2). Thus, an in-parallel integration of managers' calendars in MSS is not necessary. Justifying this requirement, managers went on in our interviews that it is even more important to know that the recipient actually received their comments. With this qualitative comment, we propose additional "read confirmations" for important comments.

According to the managers we interviewed, the most important coordination feature is document sharing in MSS (DG 3). Sharing files such as screenshots or MSS reports is important for them (DG 3.1). We propose displaying changes in documents in a central MSS "communication center" and receiving automatic notifications when changes are made (DG 3.2)—embracing the self-service philosophy, the selection of relevant documents should be performed by the managers themselves. Working with shared documents, managers wish to see both which changes were made and by whom (DG 3.3). Complementary screen sharing offers analyst and consumer managers the option of getting instant feedback from colleagues by letting them access their screen to see what they are currently working on (DG 3.4). This feature is currently not on managers' list as a "must have" collaboration feature.

5.2 Communication: MSS should enable on-topic annotations and sending them to other users "at the push of a button"

The interviewed managers expressed a preference for textual annotations "directly on KPIs" (DG 4.1). They can enable on-topic discussions—eliminating a forerunning need for explanation and, thus, can complement their current communication beyond mere emailing. Both analyst and consumer managers ask for such annotations on both devices tablets and notebooks.

Although emails lack synchronicity, the interviewed managers evaluate emails as their most appropriate information media. We propose direct emails with an *"at the push of a button"* integration into MSS including screenshots (DG 5.1) as an important next step in improving manager communication. The option of generating on-topic messages to colleagues by a drag-and-drop feature (e.g., dragging a manager picture on a KPI to start a discussion, DG 5.2) was a MSS capability with which most of the interviewed managers were unfamiliar, but which was at the same time greeted with enthusiasm. Integrated videoconferencing in MSS (DG 6) was exposed as well. Its benefits are uncontested and our results show that analyst managers expect additional implementation for mobile MSS use (DG 6.1). We expect that direct messages from the MSS will replace more and more email communication. Real-time instant messaging (DG 7), in turn, is currently not on managers' agenda.

5.3 Cooperation: To accelerate information access, MSS should provide a comprehensive managerial self-service search function

While syndication (DG 8) was expected to be on managers' agenda, our results indicate that this is in fact not the case. Managers are aware of this implementation gap, but are undecided about its importance. In turn, they evaluated self-service IS access as most important. We propose to support this need with a search function to address the increasing challenges arising from large data bases from different source systems (DG 9.1). However, this feature is more appreciated by analyst managers as it matches their preferred way of accessing information. This result is in line with Bughin et al. (2010), who specify the business benefits from the third wave of collaboration technology as increasing the speed of access to knowledge, reducing communication costs, and increasing the speed of access to internal experts. In our examination, the latter benefit was only requested by analyst managers (DG 9.2).

5.4 Devices: For shared documents and textual annotations tablets have become managers most wanted smart device type

Focusing on the fast and simple mobile IS access of analyst managers, there is a significant ($p<0.05$) difference between notebooks and tablets only in one case: enabling annotations ("synchronous work on shared documents," DG 4.3). Consumer managers, in turn, still revealed a significant difference between notebook and tablet use—except for syndication, always in favor of the notebook. That the borders between tablets and notebooks blur has therefore only become evident to analyst managers. Anticipating future developments, checking MSS report updates in a taxi may remain more convenient on tablets, whereas notebooks with tactile keyboards continue to be used for detailed analyses.

Examining the use of smartphones, they have evidently been growing constantly in size and computing power and their prevalence has considerably increased. However, performing collaboration technology, they are ranked extremely low in four cases for analyst managers and seven for consumer managers. Based on qualitative feedback, we attribute this result to the differing screen sizes and especially the lack of tactile keyboards, which inhibits efficient interactive work. We conclude that the time is not yet ripe for MSS to incorporate most collaboration technology on smartphones.

6 Summary and Avenues for Future Research

The objective of this article was to examine collaboration technology suitable for incorporation into MSS. We derived nine design guidelines from our literature review and validated our arguments with face-to-face manager interviews. We end up with four initial (paramount) design guidelines. For *practice*, our results constitute directly usable recommendations for both a checklist to improve existing collaboration technology for managers or to design future MSS with incorporated collaboration technology. In doing so, our findings consider working styles of consumer and analyst managers and different devices. For *research purposes*, compiled from findings of a literature review and validated in manager interviews, the initial design guidelines provide a rigorous starting point for future investigations on collaboration technology per se and for MSS designs specifically. Furthermore, the paper yields initial insights into how determinants such as manager working styles and device selection can influence managers' choice of applying new IT-enabler.

Regarding future research, managers' gender, level of expertise, IS experience, and past device usage patterns might be more important, along with cultural factors which should be relevant especially in international companies. Our sample size of 25 managers lacks generalizability. Thus, a next design cycle should cover a broader empirical analysis and a multi-case study to eradicate this current shortcoming. Furthermore, this paper does not include a subsequent design of MSS. Finally, we expect that technical progress will continue unabated. Software capabilities will improve and additional smart devices such as Google glass may create new use cases for investigation.

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