A Self-Service MSS Design from a New-Generation Manager Perspective

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Abstract. More and more digital natives are populating the management levels of organizations. As such managers have higher expectations toward information systems (IS) accommodating their user self-service preferences, a more business-driven requirements analysis for management support systems (MSS) plays an increasingly dominant role. The objective of this paper is to develop both a set of MSS requirements that is more business-driven than the state of the art and—applying this approach—initial design guidelines for a new self-service MSS design. We demonstrate utility with a single-case study, evaluate our approach against the state of the art, and propose avenues for future research. The findings should lead to a better MSS design and be applicable to other IS domains as well.

Keywords: New-generation managers, management support systems (MSS), management reporting, information systems (IS) analysis and design, self-service IS, requirements analysis, principle of economic efficiency.

1 Design Problem

Management support systems (MSS) are information systems (IS) which are intended to support managerial work [1]. As an umbrella term, MSS covers management information systems (MIS), decision support systems (DSS), executive information systems (EIS), and—more recently—knowledge management systems (KMS) and business intelligence (BI) systems for managers [2]. Besides planning and preparing financial statements [3], the most important MSS function is (management) reporting [4].

Accommodating *user preferences* is particularly important for MSS design because the higher managers are positioned within an organization, the more likely they have multifaceted work experience that nurtures a highly individual attitude toward IS [5]. User preferences in IS research describe differences in the ways individuals want to use IS and have been a research topic since the 1970s. Mayer et al. [6] outline that, as

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early as 1979, Zmud [7] asserts that "individual differences do exert a major force in determining IS success," for example, the technology acceptance model [8] and the IS success model [9] prove that user preferences play a predominant role in IS success.

Redesigning MSS is currently an interesting subject for two reasons: Firstly, digital natives increasingly populate organizations along with digital immigrants, who learned to engage with IS as adults and developed into mobile IS users over the years [10]. These new-generation managers make decisions faster than they have in the past [11] and want *self-service MSS* to support them to do so [11, 12]. Secondly, thanks to technical progress such as multi-touch, direct-manipulation user interfaces in recent years, even senior managers should be able to operate IS themselves [13]. Under these considerations, we state our research questions as follows:

- What is a *set of requirements* that is more business-driven than the state of the art?
- Applying this approach, what are *initial design guidelines* for a new self-service MSS design?

In our context, business-driven means that we derive requirements from new generation managers which are not only conceptually or technically possible but also economically feasible.

We follow design science research (DSR) in IS [14] and apply Peffers et al.'s [15] six-step process model. We motivate our research by identifying gaps in MSS design for new-generation managers and suggest a more business-driven set of requirements to address them (Sect. 1). After that, we reflect the state of the art and derive a future MSS research agenda (Sect. 2). Then, we propose a set of business-driven MSS evaluation criteria (Sect. 3), demonstrate utility of our proposal in a case study (Sect. 4), and—applying this approach—conclude with initial design guidelines for a new self-service MSS design. We evaluate our approach against the state of the art (Sect. 5) and suggest avenues for future research (Sect. 6).

2 Literature Review

2.1 Search Strategy

Following vom Brocke et al.'s four step process for literature research [16], we started with a *journal search*. As Webster and Watson [17] claim that major contributions are in the leading outlets, we chose IS outlets provided by the London School of Economics [18]. The search was based on the three *scholarly databases* AIS Electronic Library, EBSCOhost, ProQuest and we considered title and abstract. In addition, the standard Google search was used to cover recent practitioner contributions. With just six publications, our first *keyword search* focused on MSS and management reporting leads to an inadequate number and content to start our research (marked with "*" in the appendix "publications researched in the literature review").

Thus, we did both expanding our journal base with six ranked accounting journals[1] and complementing our search string. Based on prior research [19] our new keyword search (Table 1) within the new journal base yielded a total of 759 hits. After qualifying their titles, we end up with 60 hits. We scanned their abstracts and ended with 46 publications in total. A final *back and forward search* revealed 63 relevant publications (see appendix).

Table 1. Keyword search string

		OR					
AND		Management support system	Executive information System	Management accounting system	(Group) Decision support system	Management information systems	Business intelligence
	OR	Schedule	Stakeholder	Recipients	Management board	Board of directors	
		Management accounting	Requirements	Reporting	Report	Management	

2.2 Framework for Classification

We structured the publications we examined in terms of the elements of IS design they employ and the meta categories of research in which they can be located.

A. Elements of IS design [20]: (1) *User requirements* are prerequisites, conditions or capabilities needed by managers using IS to solve a problem or achieve an objective [21]. They can be considered from both a functional and non-function perspective [22]. Functional requirements address "what" IS are supposed to or must do (purpose). Non-functional requirements, in contrast, reflect "how well" IS performs within its environment fulfilling its function [23]. (2) *Design guidelines* go beyond requirements to serve as predefined actions specifying how MSS are brought to life [24]. They cover the span from a generic type [14] to a more in-depth IS specification we propose in this paper. Models outline IS features or combinations of these [25]. Complementary methods describe the process of designing MSS [26]. (3) A more *business-driven IS design* should cover a user analysis segmenting user groups and different user group characteristics that influence managers' MSS use. The effects of use occurring to managers while using IS, complement our framework for literature research for a better MSS design proposal [27, 28].

B. Meta categories of research: Publications can be classified by their basic research approach and scientific domain. (4) The *research approach* covers twofold. Publications with a behavioral focus explain phenomena from practice and rely on observations as well as empirical methods. Design approaches involve ideas and frameworks for IS recommendations to create a better world [14, 20]. (5) Another relevant classification in our work is the *research domain* in which the researched publications are released. Since MSS levitate between the domains of management literature and IS we chose these domains as our categories. Figure 1 depicts our results.

[1] Accounting Review, Contemporary Accounting Research, Journal of Accounting Research, Management Accounting Research, Review of Accounting Studies, and Journal of Management Accounting Research.

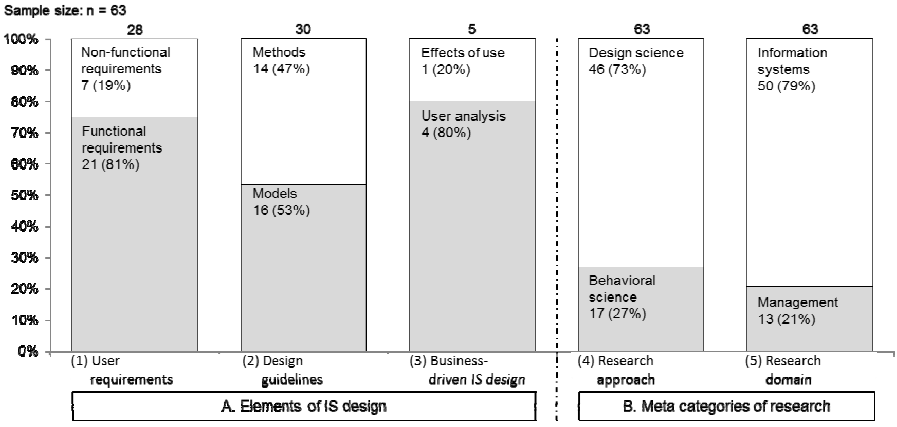

Fig. 1. Classification of the publications within our framework

2.3 Results: Current Shortcomings and Future Research Agenda

Our researched state of the art is shown in Figure 1 and we discuss the shortcomings as follows: (1) *Lack of MSS user requirements focusing on management reporting:* 21 of 63 publications focus on functional MSS requirements and seven of 63 on non-functional MSS requirements. However, there are various requirements for individual MSS aspects which do not focus on management reporting. For example, Tricker [29] describes manager information needs without stating specific reporting requirements. Both, Aders et al. [30] and Cheung and Babin [31] focus on individual aspects for decision-making, such as the right selection of data sources and KPIs, but they do not integrate these into the holistic concept of MSS.

The researched publications focus on the graphical design of MSS [32] and the ability to guide users within MSS. Furthermore, the researched list approaches lack a rigorous framework for requirements development and are most often incomplete. Existing studies [33] fail to provide an applicable set of MSS requirements with a rigorous basis. Finally, the researched requirements lists are most often outdated [34, 35] and do not cover the requirements of new-generation managers [36]. Thus, more current studies are needed.

(2) Lack of MSS design guidelines for management reporting applying new IT-enabler: 14 out of 63 publications cover methods which describe how to build MSS. 16 out of 63 publication focus on models. For example, Mayer [11] describes which areas should be reported and what they cover contentwise. Other publications emphasize the use of individual methods like environmental scanning [37], exception reporting [38] or real-time technologies [39] in the context of MSS. No publications provide comprehensive guidelines which serve as a suitable starting point for building a modern self-service MSS with a focus on management reporting. Marx et al. [36] is the only publication which build a rigorous criteria list and derived multiple principles for MSS design. However, they did not consider new-generation managers and new IT-enablers.

(3) Business-driven IS design is comprehensive: With only five publications, there is a lack of business-driven IS design guidelines for MSS. A configuration model which accommodates the growing range of managerial working styles was proposed by Mayer et al. [6]. Further Armstrong et al. [40] analyzed managers' cognitive styles and propose improvements regarding MSS design, such as modes of information presentation and the flexibility of interfaces for individual working styles.

(4) Research approach could be more differentiated: In three out of four publications, we found DSR in IS applied. Thus, more research should be conducted with a behavioral approach, in order to obtain more differentiated results. In DSR in IS, we propose that artifacts should be evaluated more often by means of a multi-case study.

(5) MSS with a focus on management reporting is covered neither in the IS nor the management literature: We only researched 13 publications in management literature on this topic. When reporting is examined, the focus often lies on external reporting to the capital market and investors [41]. Publications covering internal management reporting generally consider what should be reported [42, 43] and to whom [29], but fail to describe how this should be done. This outlines a lack of MSS literature focusing on management reporting regarding requirements and guidelines.

Summarizing our findings, there is a lack of a rigorous, ready-to-use set of business-driven user requirements from a new-generation manager business perspective with a distinct selection of criteria. Furthermore, initial guidelines for self-service MSS with focus on management reporting are also conspicuously absent.

3 Alternative Method

3.1 Principle of Economic Efficiency

The principle of economic efficiency is a well-known paradigm in business research which addresses the ratio between benefit and cost [44]. Thus, we propose business-driven evaluation criteria for MSS in contradiction to list approaches, structured equation models (SEM), TAM and IS success models. They should be oriented towards what is economically feasible (benefit-cost ratio) and not what is conceptually or technically possible. The following section is based on our prior research [19, 45].

Even if the IS costs can be identified by nature and amount, the ability to quantify IS value is limited [46]. Applying the "black-box method" [47] we differentiate between the basic criteria of IS output and input (Fig. 1). *System capabilities* (IS output) refer to the relevance of MSS to support managers' information needs.

Resource requirements (IS input), in turn, refer to the input needed to generate the IS output, such as primary information and manpower in terms of cost and time.

3.2 First Level of Specification: Design Criteria

We specify IS output by four design criteria following the St.Gallen Business Engineering approach [48] and Mayer et al.'s instantiation for MSS design [11, 19, 49].

The first layer of our design criteria, *strategic positioning* ("what" question) describes what purpose MSS fulfills accommodating different user requirements. In the

conceptual design layer ("how" question) we describe MSS reports threefold regarding their content, visualization ("look & feel"), and process. The layer of *business/IT alignment* focuses on the flexibility of the underlying IT accommodating changing requirements within the layers above. In our context this layer covers the capability to handle changing information requirements and working styles in a timely manner [50]. *IT components* focus on the contribution of new IT-enablers for MSS design. By doing so, this fourth and final layer answers the "what with" question. IS standard components such as data warehouses are not examined, since they should not differ in detail and thus this aspect should be less interesting for research.

IS input specifies the required resources and therefore the effort to design MSS.

3.3 Second Level of Specification: Evaluation Criteria

While the design criteria remain at a more general level, we specify MSS evaluation criteria (EC) for all design criteria. They are derived from our literature review (Sect. 3), complemented by findings from both an expert focus group consisting of heads of management accounting or group business intelligence of large international companies from the competence center "corporate management systems" at the University of St.Gallen [51], and from our single-case study (Sect. 4).

The *MSS purpose* (EC 1) can be specified in terms of its recipient in the company. Besides management, we researched supervisory boards and parties responsible for external communication (e.g., investor relations) as complementary stakeholders of MSS design [29, 52, 53]. This criterion is rated by the scope of the report recipients, consistency, and synergetic efficiency.

The reporting content can be specified by four evaluation criteria. Firstly, the selection of *key performance indicators* (KPIs, EC 2) is evaluated in terms of its completeness in several information categories: profit and loss statement, balance sheet, cash flow statement, value-based management (including a value driver tree for traceability), as well as the current use of non-financial indicators [11, 30, 54]. Secondly, we take into account the extent to which the *information clusters* of financial accounting, management accounting, cash flow and liquidity management, compliance management and program management are covered [11, 55]. Furthermore, the KPIs are analyzed regarding their *dimensions of analysis* (e.g., divisional or regional) and temporal reference (i.e. actual or forecast, EC 3). The criterion is rated by the completeness of coverage of the mentioned information clusters, adequate information breakdowns, as well as a solid mixture of actual, planned and forecast values. The last criterion in this category, *advanced performance management* (EC 4), covers the use of ancillary reporting concepts like compliance/risk management, environmental scanning systems, and exception reporting [37, 38, 56]. The level of completeness of the aforementioned concepts is used for the rating.

To assess the visualization capabilities, we evaluate the *graphic design and data visualization* of MSS (EC 5) in terms of layout and the use of different types of information media like mobile devices and static documents [13], the existence of different types of dialog control [32], the use of different graphic types with or without interaction [32, 57], as well as self-service user guidance.

The MSS *reporting process* (EC 6) is evaluated by means of the reporting schedule which covers when recipients receive which report version, such as flashes (a shorter or preliminary report) or final reports [58]. The earlier the management receives the MSS information, the more time it has for decision-making.

Business/IT-alignment is appraised by the customization capabilities and we propose specifying IS flexibility. EC7 explores the question of how *flexible* MSS can accommodate individual information requirements [57] and working styles [6].

IT components evaluate the use of new IT-enablers in MSS design. This includes *mobile (MSS) use scenarios* (EC 8) focusing on the management reporting [59, 60]. Different *information media* (e.g., paper, PDF, website) are also evaluated (EC 9) [61]. Furthermore, *collaboration/commenting* (EC 10) features are rated by their capability to cover commenting and newer technologies such as RSS feeds or instant messaging [62, 63]. The final criteria in this layer evaluate the coverage of *real-time management* leveraging in-memory technologies (EC 11) [39, 64], as well as *predictive analytics on big data* (EC 12) [33, 65] in terms of their completeness and benefits.

Finally the *effort* (EC 13) consists of cost (i.e. budget spent on the MSS conceptual design, implementation, and maintenance of the IS) and time, i.e. time spent generating the most important MSS reports [66, 67].

Table 2. Evaluation criteria for MSS design

Principle of economic efficiency	**Design criteria**		**Evaluation criteria**			**Description**
Solution capabilities (IS output)	Strategic positioning (WHAT)	Purpose	EC	1	Stakeholder and complementary reports for additional recipients [29, 52, 53]	• Who are the recipients of the report? • What is the coverage and volume of the reports?
	Conceptual design (HOW)	Content	EC	2	Key performance indicators (KPIs) [11, 30, 54]	• What KPIs are primarily used? • Are they traceable by a value-driver-tree?
			EC	3	Dimensions of analysis [11]	• Which information clusters are covered? • How are the performance indicators split up? • What is their temporal reference?
			EC	4	Advanced performance management [37, 38, 56]	• Which ancillary concepts are applied in the management reports? Compliance/Risk management, environmental scanning? • Exception reporting: Is it possible to define exceptions?
		Visualization	EC	5	Graphical design and data visualization [32, 57, 68]	• How is the first "look&feel" and is the basic screen design consistent? • Which types of (interactive) graphics are used? • Are drill-functionalities, filter, and sorting mechanisms supported?
		Process	EC	6	Reporting process [58]	• When are which reports provided to recipients? • When do the recipients discuss the reports?
	Business/IT-alignment	Flexibility	EC	7	Flexibility [6, 57]	• How flexible is the MSS for accommodating individual information requirements and working styles?

Table 2. (*Continued.*)

	IT components (WHAT WITH)	New IT-enabler	EC	8	Mobile use scenarios [59, 60]	• How comfortable is it to adapt stationary desktop design to smart devices (e.g., report transformation for smart devices)?
			EC	9	Information media [61]	• Are there different information media (Paper, PDF, web, app) available to the recipients?
			EC	10	Collaboration/ commenting [62, 63]	• Is it possible to add comments to support collaboration across the company?
			EC	11	Real-time management [39, 64]	• Is in-memory technology used to foster new kind of insights or faster processes?
			EC	12	Predictive analytics on big data [33, 65]	• Are techniques from statistics, modeling, machine learning and data mining integrated into big data?
Resource requirements (IS input)	Effort	Adequacy	EC	13	Cost and time adequacy [66, 67]	• What is the budget and time allocation for MSS design and implementation? • What is the budget and time allocation for on MSS operation and maintenance?

4 Demonstrate

We demonstrate the utility of our findings by means of a *single-case study* and—applying our approach—conclude with some initial design guidelines for a new MSS design. We chose a case study approach, because it examines real-life situations and, thus tests the utility of artefacts for "creating a better world" [20]. A single-case study examines a subject in-depth and is therefore useful when a phenomenon is broad and complex. However, a case study approach is prone to bias as a result of subjectivity, which has been addressed by the authors accordingly, as described below.

We applied our set of requirements (Sect. 5) to a large raw materials and technology company (2012, revenue: USD 40 bn.; employees: 156,000). This company was selected, because its MSS capabilities have recently been reworked and should thus be a representative state of the art from practice.

The objective of the project was to evaluate the MSS status with a focus on management reporting and to investigate the benefit of new IT-enablers such as mobile or predictive analysis. We used a five-point Likert scale [69] to evaluate the company's MSS EC by EC (Table 1). The first point on the Likert scale indicates that the EC is not fulfilled at all, while a "five point" rating shows that it is achieved completely.

A team of three researchers (authors of this paper) and three company representatives—the heads of management accounting, planning, and risk, as well as the head of group reporting—were present at all times to reduce *misunderstandings*, *subjectivity*, and ensure a *comprehensive documentation* (i.e. transcript of audio recording) of all relevant information. We chose the following approach for our data collection: (1) Basic presentation of the MSS by the company's representatives and joint "Q&A" with the researchers to provide a general understanding, (2) analysis of the (monthly) top management report

and the associated executive summary ("front page"), (3) a semi-structured detailed interview using our criteria list, explaining each EC, and letting the company representatives respond, followed by two feedback rounds to discuss certain topics in-depth, (4) presenting our findings to the representatives and giving them the opportunity to discuss the outcome, (5) final (minor) adjustments by the researchers. The findings lead to the following design guidelines for a new MSS design:

(1) *Value-driver trees are losing relevance (EC2)—an EBIT decomposition is gaining importance.* Detailed value-driver trees (with regard to value-based management) are no longer in the focus of new-generation managers, instead, EBIT (earnings before interest and taxes) decomposition is becoming more significant. A visual decomposition into the components could help managers to understand the individual impact factors on the final KPI.

(2) *Exception reporting currently uses separate information media (EC4)—therefore MSS should be able to send proactive "push" information when a certain threshold is crossed.* In order to use MSS as a single "point of truth," we propose an integration of exception reporting. The manager could set different thresholds for performance indicators and is notified if the threshold is exceeded. He or she is then able to perform an instant analysis and reply with edits or comments, without leaving the app.

(3) *"Modern" graphics are lacking (EC5)—a table-centric reporting can be enriched by (micro)charts.* Microcharts offer, within a small space (especially relevant for mobile MSS devices), a good overview of recent developments and contextual information. In addition, they can reveal even more details on demand, by showing tooltips.

(4) *There is a lack of leveraging for the new IT-enabler (EC8-12)—"mobile" is on the list for 2014 as most important.* The company neither uses mobile devices to support their managers, nor any kind of in-memory technology to accelerate its reporting process or enable new insight analyses. An implementation of mobile use with tablets is planned, so as to facilitate self-service use of the MSS.

(5) *Commenting/collaboration functions are lacking (EC10)—different media and commenting/collaboration features should be integrated into MSS.* A basic commenting function for every KPI would be a first step, especially with regard to the growing self-service use of MSS. The managers can use the functions to check back with the accountants, and for discussions with other managers or annotations for upcoming meetings (e.g., monthly regional meeting).

Evaluating *time & cost adequacy (EC13)*, the application of our method was limited. The company could no longer quantify their expenses for the MSS in retrospect and —looking forward to a multi-case study—such information is too sensitive to share. We propose that this is not a major issue with respect to the applicability of our method, because the costs of new MSS designs can be calculated and are usable for internal consideration.

As a result, the researched company is taking our findings for further MSS development. Especially in aspects where the current MSS performed subnormally, changes are required. Therefore, these findings can be used as a set of requirements for the evaluation of MSS frontend applications for mobile and stationary usage.

Principle of economic efficiency	Design criteria		Evaluation criteria		Company as-is profile 1 2 3 4 5
Solution capabilities (IS output)	**Strategic positioning (WHAT)**	Purpose	**EC 1**	Stakeholder and complementary reports for additional recipients	
	Conceptual design (HOW)	Content	**EC 2**	Key performance indicators (KPIs)	
			EC 3	Dimensions of analysis	
			EC 4	Advanced performance management	
		Visualization	**EC 5**	Graphical design and data visualization	
		Process	**EC 6**	Reporting process	
	Business/IT-alignment	Flexibility	**EC 7**	Flexibility	
	IT components (WHAT WITH)	New IT-enabler	**EC 8**	Mobile usage scenarios	
			EC 9	Different information media	
			EC 10	Collaboration/ commenting	
			EC 11	Real-time management/ in-memory technology	
			EC 12	Predictive analytics on big data	
Resource requirements (IS input)	**Effort**	Adequacy	**EC 13**	Time & cost adequacy	

Fig. 2. Evaluation of the company's MSS according to our criteria list (case study results)

5 Evaluate

To evaluate our approach on hand, we differentiate between rigor and relevance [70]. *Relevance* is given when the research addresses the problems faced and the opportunities afforded by the interaction of people, organizations, and IT [14]. *Rigor* is achieved through application of scientific theories, methods, experience, and expertise [71]. Comparing our findings and associated lessons learned from the case study with the state of the art (Sect. 2) we can discuss our approach as follows:

The *principle of economic efficiency* enjoys broad acceptance in business management research. Thus, it marks a rigorous (and generally accepted) starting point for requirements analysis structuring the examined requirements criteria [45]. This should be true for developing EC which are based on the findings from a *literature review* and complemented by findings from a manager expert group. This two-sided approach should lead to a relatively complete set of distinct requirements.

This paper confronts organizational changes in management (the upcoming digital natives) and MSS accommodating the rising self-service issues and increasing mobi-

lity of a new-generation managers. Developing a set of MSS requirements from their perspective ensures *relevance* and hopefully direct advice for practice.

Thus, our method on hand should lead to better results than single criteria or list approaches. In comparison to SEM, our approach is more hands-on, however, it still maintains traceable and the results are transparent in terms of intelligibility.

However, there are limitations as well. The expert focus group's suggestions can only approximate the reality. A larger group of managers could have been interviewed on-the-job to get a broader perspective of requirements for the criteria list. Additionally a single-case study prevents a meaningful quantitative evaluation and with just a single case it entails subjectivity.

Summarizing this short evaluation, we believe that our set of evaluation criteria for self-service MSS is a first step to improving MSS design with regard to requirements from a new-generation managers' perspective.

6 Avenues for Future Research

Taking the self-service MSS design for a new-generation managers as an example, this paper developed both a set of requirements that is more business-driven than the state-of-the-art and initial design guidelines for an new IS design.

To improve the utility of our approach, future research is needed. A first avenue is to complete the single-case profile with findings from a *multi-case study*. Furthermore, these as-is profiles should be complemented with a *to-be profile*. It should cover the perspectives from new-generation managers on future MSS design or summarize most important forward-looking findings from an expanded literature review.

Besides the initial guidelines for a new MSS design (software perspective), managers' *end-user device selection* (hardware perspective) should be examined. It should not be difficult to define a company's choice, but how to examine patterns for such a selection is likely to be more challenging [6]. Furthermore, managers' *MSS use situations* should be captured more in detail. Gender, age, temperament, self-efficacy in IS knowledge, expertise, and prior IS experience could be taken into account, as well as cultural factors.

The *functional perspective* on MSS design should be specified as well, especially whether there are changes due to the 2008/2009 economic crisis and the ongoing financial turbulences in Europe [11]. Last, but not least, the approach on hand has been applied to MSS design as an example. However, as another avenue of future research, the findings should be applicable to other IS domains as well.

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Appendix: Publications Researched in the Literature Review

#	Author(s)	Year	Title	Publication	Elements of IS design	Research approach	Domain
1	Aders et al.	2003	Shareholder Value-Konzepte–Umsetzung bei den DAX100-Unternehmen	Finanz Betrieb	Functional requirements	Behavioral Science	Management*
2	Andersson, B., Henningsson, S.	2010	Mobile IS: Managing Additional Aspects	European Conference on Information Systems	Model	Design Science	IS
3	Armstrong et al.	2011	Role of Cognitive Styles in Business and Management: Reviewing 40 Years of Research	International Journal of Management Reviews	User analysis	Design Science	Management
4	Arnott, D., Pervan, G.	2005	A critical analysis of decision support systems research	Journal of information technology	Method	Behavioral Science	IS
5	Axson, D.A.	2007	Best practices in planning and performance management: from data to decisions	Book	Method	Design Science	Management
6	Barua, A., Whinston, A.B.	1998	Decision support for managing organizational design dynamics	Decision Support Systems	Model	Design Science	IS
7	Cavalcanti, E. P.	2005	The Relationship between Business Intelligence and Business Success	Journal of Competitive Intelligence and Management	Functional requirements	Behavioral Science	IS
8	Cheung, W., and Babin, G.	2006	A Metadatabase-Enabled EIS (Part A): A Flexible and Adaptable Architecture	Decision Support Systems	Functional requirements	Design Science	IS
9	Chi, R. T., and Turban E.	1995	Distributed Intelligent Executive Information Systems	Decision Support Systems	Model	Design Science	IS
10	Clark Jr et al.	2007	The Dynamic Structure of Management Support Systems: Theory Development	MIS Quarterly	Model	Design Science	IS
11	DeFond, M.L., Francis, J.R.	2005	Audit research after Sarbanes-Oxley	Auditing: A Journal of Practice & Theory	Functional requirements	Behavioral Science	Management
12	Dekkers et al.	2007	Organising for Business Intelligence: A Framework for Aligning the Use and Development of Information	BLED	Model	Design Science	IS
13	Demirkan, H., Delen, D.	2013	Leveraging the capabilities of service-oriented DSS: Putting analytics and big data in cloud	Decision Support Systems	Functional requirements	Design Science	IS
14	Deng, X., Chi, L.	2013	Understanding Postadoptive Behaviors in IS Use	Journal of Management Information Systems	Functional requirements	Design Science	IS
15	Donlon, B.	2007	Designing Next-Generation Dashboards	DM Review	Non-functional requirements	Design Science	IS
16	Dutta, S., Wierenga, B., Dalebout, A.	1997	Designing Management Support Systems Using an Integrative Perspective	Communications of the ACM	Method	Design Science	IS
17	Eckerson, W.	2010	Performance Dashboards: Measuring, Monitoring, and Managing Your Business	Book	Method	Design Science	IS
18	Fernández-Medina, E. et al.	2006	Access Control for the Multidimensional Modeling of DW	Decision Support Systems	Functional requirements	Design Science	IS
19	Few, S.	2006	Information Dashboard Design	Book	Non-functional requirements	Design Science	IS
20	Galloway, D. L.	2010	Achieving Accurate Metrics Using BSC and Dashboards	Performance Improvement	Functional requirements	Design Science	Management
21	Ghazanfari, M., Jafari, M., Rouhani, S.	2011	A tool to evaluate the business intelligence of enterprise systems	Scientia Iranica	Functional requirements	Design Science	IS
22	Horngren, C.T.	1995	Management accounting: this century and beyond	Management Accounting Research	Functional requirements	Design Science	Management
23	Houdeshel, G. and Watson, H. J	1987	The Management Information and Decision Support (MIDS) System at Lockheed-Georgia	MIS Quarterly	Non-functional requirements	Design Science	IS
24	Houghton, R. et al.	2004	Vigilant Information Systems for Managing Enterprises in Dynamic Supply Chains: Realtime Dashboards At Western Digital	MIS Quarterly Executive	Method	Design Science	IS
25	Hung, S.-Y.	2003	Expert versus novice use of the executive support systems: an empirical study	Information & Management	Model	Behavioral Science	IS

26	Işık, Ö., Jones, M.C., Sidorova, A.	2013	Business intelligence success: The roles of BI capabilities and decision environments	Information & Management	Non-functional requirements	Behavioral Science	IS
27	Lawson, R., Desroches, D., Hatch, T.	2008	Scorecard best practices: design, implementation, and evaluation	Book	Functional requirements	Design Science	Management
28	Leidner, D. E., Elam, J. J.	1994	Executive Information Systems: Their Impact on Executive Decision Making	Journal of Management Information Systems	Model	Behavioral Science	IS
29	Marx, Frederik, Jörg H. Mayer, and Robert Winter	2011	Six principles for redesigning executive information systems—findings of a survey and evaluation of a prototype	ACM Transactions on Management Information Systems	Method	Design Science	IS
30	Mayer, J. H.	2012	Using the Kano Model to Identify Attractive User Interface Software Components	International Conference on IS	Functional requirements	Behavioral Science	IS
31	Mayer, J. H., Quick, R., Hauke, J.	2013	Taking a New-Generation Manager Perspective to Develop Interface Designs	International Conference on IS	Method	Design Science	IS
32	Mayer, J., Steinecke, N., Quick, R.	2011	Improving the Applicability of Environmental Scanning Systems: State of the Art and Future Research	Governance and Sustainability in IS.	Method	Design Science	IS
33	Mayer, J.H.	2013	Current Changes in Executive Work and How to Handle Them by Redesigning EIS	Accounting IS for Decision Making	Model	Design Science	IS
34	Mayer, J.H.	2010	Organisatorische Veränderungen durch die aktuelle Wirtschaftskrise – Bestandsaufnahme und Implikationen für Unternehmenssteuerungssysteme	Deutscher Controlling Congress	Functional requirements	Design Science	Management
35	Mayer, J.H.	2011	Managing the Future—Six Guidelines for Designing Environmental Scanning Systems	Service-Oriented Perspectives in DSR	Method	Design Science	IS
36	Mayer, J.H., Bischoff, S., Winter, R., Weitzel, T.	2012	Extending Traditional EIS Use to Support Mobile Executives Online and Offline	MIS Quarterly Executive	Non-functional requirements	Design Science	IS
37	Mayer, J.H., Winter, R., Mohr, T.	2012	Situational Management Support Systems	Bus Inf Syst Eng	User analysis	Design Science	IS
38	Nemati, H.R., Steiger, D.M., Iyer, L.S., Herschel, R.T.	2002	Knowledge warehouse: an architectural integration of knowledge management, decision support, artificial intelligence and data warehousing	Decision Support Systems	Method	Design Science	IS
39	Nowduri, S.	2011	Management information systems and business decision making: review, analysis, and recommendations	Journal of Management and Marketing Research	Method	Design Science	IS
40	Parr Rud, O.	2009	BI Success Factors: Tools for Aligning Your Business in the Global Economy	Book	Model	Design Science	IS
41	Popovič et al.	2012	Towards business intelligence systems success: Effects of maturity and culture on analytical decision making	Decision Support Systems	Functional requirements	Behavioral Science	IS
42	Powell P. L., and Johnson J. E. V.	1995	Gender and DSS Design: The Research Implications	Decision Support Systems	Effects of use	Behavioral Science	IS
43	Power, D. J., and Sharda, R.	2007	Model-Driven Decision Support Systems: Concepts and Research Directions	Decision Support Systems	Model	Design Science	IS
44	Rainer, R.K., Watson Hugh, J.	1995	What does it take for successful executive information systems	Decision Support Systems	Method	Design Science	IS
45	Reimann, B.C., Waren, A.D.	1985	User-oriented criteria for the selection of DSS software	Communications of the ACM	Functional requirements	Design Science	IS
46	Rockart, J. F. and Treacy, M. E.	1989	The CEO goes on-line	End-user computing: Concepts, issues, and applications	Non-functional requirements	Design Science	Management
47	Salmeron, J. L.	2002	EIS Data: Findings From An Evolutionary Study	The Journal of IS and Software	Functional requirements	Design Science	IS
48	Sankar, C. S., Ford, N., and Bauer, M.	1995	A DSS User Interface Model to Provide Consistency and Adaptability	Decision Support Systems	Model	Design Science	IS
49	Schober, F., Gebauer, J.	2011	How Much to Spend on Flexibility? Determining the Value of IS Flexibility	Decision Support Systems	Model	Behavioral Science	IS
50	Sharma, A.K., Kumar, S.	2010	Economic value added (EVA)-literature review and relevant issues	International Journal of Economics and Finance	Functional requirements	Behavioral Science	Management
51	Shim, J. P. et al.	2002	Past, Present, and Future of Decision Support Technology	Decision Support Systems	Method	Design Science	IS
52	Singh, S. K., Watson, H. J., Watson, R. T.	2002	EIS support for the strategic management process	Decision Support Systems	Model	Design Science	IS
53	Starovic, D.	2002	Performance Reporting to Boards: A Guide to Good Practice	Chartered Institute of Management Accountants	Functional requirements	Design Science	Management*
54	Taipaleenmäki, J., Ikäheimo, S.	2011	On the convergence of management accounting and financial accounting – the role of information technology in accounting change	Journal of Accounting Information Systems	Functional requirements	Design Science	Management
55	Tricker, B.	1997	Editorial: what information do directors really need?	Corporate Governance: An International Review	Functional requirements	Design Science	Management*
56	Vandenbosch, B., Huff, S.L.	1997	Searching and Scanning: How Executives Obtain Information from Executive Information Systems	MIS Quarterly	Model	Behavioral Science	IS
57	Walstrom, Kent A., and Rick L. Wilson	1997	An examination of executive information system (EIS) users	Information & Management	User analysis	Behavioral Science	IS
58	Watson et al.	2006	Real-time Business Intelligence: Best Practices at Continental Airlines	Information Systems Management	Method	Behavioral Science	IS
59	Winter, Robert	2011	Design of Situational Artefacts—Conceptual Foundations and Their Application to IT/Business Alignment	Information Systems Development	User analysis	Behavioral Science	IS
60	Wixom, B., and Watson, H. J.	2010	The BI-Based Organization	International Journal of BI Research	Model	Design Science	IS
61	Wu, J.	2005	Harnessing the Power of Exception Reporting	DM Review	Functional requirements	Design Science	IS
62	Yigitbasioglu, O. M., and Velcu, O.	2012	A Review of Dashboards In Performance Management: Implications for Design and Research	International Journal of Accounting IS	Non-functional requirements	Design Science	IS
63	Young, D., Watson, H.J.	1995	Determinates of EIS acceptance	Information & Management	Model	Behavioral Science	IS