8-6-2011

Accommodating User-Group Characteristics to Improve the Acceptance of Executive Information Systems— State of the Art and User-Interface Components for Up Close and Personalized Configuration

Jörg H. Mayer
University of St.Gallen, joerg.mayer@unisg.ch

Thomas Mohr
University of Darmstadt, thomas.mohr@stud.tu-darmstadt.de

Accommodating User-Group Characteristics to Improve the Acceptance of Executive Information Systems— State of the Art and User-Interface Components for Up Close and Personalized Configuration

Jörg H. Mayer
Institute of Information Management
University of St.Gallen
Mueller-Friedberg-Strasse 8
9000 St.Gallen, Switzerland
joerg.mayer@unisg.ch

Thomas Mohr
Chair of Accounting and Auditing
University of Darmstadt
Hochschulstrasse 1
64289 Darmstadt, Germany
thomas.mohr@stud.tu-darmstadt.de

ABSTRACT

In executive information systems (EIS) design, where idiosyncratic users must often be considered, understanding users and their preferences is important. Since user interfaces are a highly visible EIS component, they are an important lever for their acceptance. To accommodate executives' growing range of user preferences, this article develops building blocks for the user-interface to make "up close and personalized" EIS possible. As this work represents a first step in a larger research project, we conduct a multidisciplinary literature review on how the EIS design process can accommodate user preferences, thus improving EIS acceptance with the "right" user interface. Based on three findings regarding their design, we propose building blocks for user-interface design covering three clusters of components: information presentation, dialog control, and predefined functions. Finally, we incorporate their components in an EIS prototype to start evaluating our proposal's utility.

Keywords

Information systems (IS) analysis and design, human factors in IS design process, executive information systems (EIS), EIS acceptance and user-group preferences, user interfaces, building blocks

INTRODUCTION

IT-based information systems (IS) meant to help C-level managers are known as *executive information systems* (EIS). They are designed to serve as managers' central, hands-on, day-to-day information source. Three characteristics of such IS stand out (Nord and Nord, 1995). Their overall aim is to help an organization carefully monitor its current status and progress toward achieving its corporate goals. They should enable users to navigate through information culled from both internal and external databases. And, even senior executives should be able to operate such IS themselves.

The present moment seems favorable for redesigning EIS. On the one hand, digital natives, who grew up in a world where information and communication technology (ICT) is pervasive and ubiquitous (Vodanovich et al., 2010), increasingly populate organizations' management along with digital immigrants, who learned to engage with IS as adults (Mayer and Stock, 2011). These new-generation executives more naturally accept EIS, while also having higher expectations for how IS should accommodate their individual *user preferences*. On the other hand, technical progress has been made in recent years, so that EIS have evolved from single IS to integrated applications on top of a corporate business intelligence (BI) architecture (Wixom and Watson, 2010).

EIS are often driven by manager's functional roles within the organization (Sommerville, 2010). Such a design disregards executives' user preferences. Furthermore, one-size-fits-all handling for the "typical" EIS user is no longer sufficient. Because of these disconnects, new-generation executives question the relevance of current EIS (Gartner, 2010; Wixom and Watson, 2010) or, even worse, exempt themselves from dictates of IS use (Mayer and Stock 2011). This article responds to these developments by taking a *non-functional perspective* on EIS design. In this context, this article develops *building blocks for user-interface design*. It makes "up close and personalized" EIS possible.

As this work represents a first step in a larger research project, we conduct a literature review on how user-group characteristics can be incorporated into the EIS design process focusing on the "right" user-interface design, thus, to improve EIS acceptance. Such a review helps to motivate big-picture thinking. To do so, we follow vom Brocke et al.'s (2009) five-step model, which is generally based on the Webster and Watson's (2002) approach to literature review. *Define review scope*: We begin this article by discussing current gaps in managers' acceptance of EIS. *Conceptualize the topic*: After revisiting foundations, we derive a framework for categorizing the literature with findings from three IS fields. *Perform literature search and analysis*: We then describe the search process and generally accepted knowledge we incorporate into our proposal. *Synthesize results*: Based on three findings, we propose building blocks for user-interface design and incorporate their components in an EIS prototype. Thus, this article does not substantially evaluate the findings or the subsequent design of EIS itself. These issues need to be addressed with a future *research agenda*.

FOUNDATIONS

According to ISO 9241-110 (2008), interactive EIS are a combination of software and hardware components that receive input from executives and communicate output in order to support them in performing their management task. *User interfaces,* the software perspective of EIS, "[…] are what users see and work with to use a product." (Hackos and Redish, 1998, p. 1). End-user devices, in turn, are defined as the physical part of IS with which the user works (Laudon and Laudon, 2010). We focus on user interfaces because, as highly visible components, they constitute an important lever for EIS acceptance. Designing effective user interfaces requires IS designers to understand people and technology (Hackos and Redish, 1998). Therefore, *user preferences* describe the differences in how individuals use IS. Addressing the non-functional perspective on IS design, they result in requirements concerning how IS should provide functions and services (Sommerville 2010).

As early as 1979, Zmud (1979, p. 975) echoes several authors by claiming that "[…] individual differences do exert a major force in determining EIS success." However, a few years later, Huber (1983) took the wind out of the sails of this line of thought for many years to come. He claimed that accommodating user preferences require IS designers to consider too many characteristics, that better educating users is a preferable solution, and that EIS might be completely configurable by users in the future anyway. The last 20 years invalidate Huber's line of argument. Research on user acceptance—the technology acceptance model (TAM) by Davis (1989) and the IS success models by DeLone and McLean (2003)—prove that user perception plays a *predominant* role in IS success. In this context, EIS are enjoying a renaissance: today, web technology simplifies IS handling, while groupware modules allow e-mailing and other collaboration. Graphical, textual, and tabular representations are most often combined in a concise format ("dashboarding"). Furthermore, EIS should provide alerts, breadcrumbs, drill-downs from aggregated to detailed data, etc., for intuitive exception-driven navigation within the IS.

STRUCTERING REQUIREMENTS AND PRINCIPLES FOR EIS DESIGN

Using the competing values model developed by Quinn and Cameron (1988) and associates, a current single-discipline approach to IS design is presented by Carlsson et al. (2009). We propose that handling user-group characteristics involves more than a single IS discipline. For that reason, we take a *multidisciplinary approach* to structuring our literature research by findings from requirements engineering (RE), enterprise engineering (EE), and human-computer interaction (HCI, Figure 1).

Requirements engineering

RE is concerned with determining the goals, functions, and constraints of hardware and software systems (Laplante, 2009). It is common to distinguish between functional and non-functional requirements (Sommerville, 2010). Functional requirements describe "what" the system should do. They are statements about a "function that a system […] must be able to perform" (IEEE, 1990, p. 35) related to user tasks within the organization. Thus, they are domain-specific. Examples include customer-relationship-management (CRM) systems covering only the sales domain within a company or EIS that support executives' more comprehensive task of managing the company.

Non-functional requirements, in contrast, reflect "how well" the IS performs within the given environment as it fulfills its function. Unlike functional requirements, they cross domains. Examples include performance, usability, flexibility, reliability, or—at a more detailed level—IS response time. More accurate cross-domain CRM systems or more business-driven EIS would be more comprehensive versions of the previously mentioned examples.

Enterprise engineering

EE aims at the purposeful, theory-based design and implementation of enterprises from an engineering perspective (Dietz, 2007). Their goal is to transform users' requirements (black-box model) into design specifications (white-box model).

This objective may seem to closely resemble that of RE. EE, however, is more concerned with the result of the design phase. First, constructional requirements are explicitly exposed, introducing considerations such as transparency, traceability, and modularity to the IS design process. Second, resulting principles go beyond requirements to serve as predefined design actions specifying how EIS are brought to life (Dietz, 2007). Such constructional principles, such as the use of a service-oriented IS architecture or a client-server architecture with thin clients, are not visible to the user, but important for the IS engineer and his/her IS design task.

Human-computer interaction

HCI is "[…] concerned with the ways humans interact with information, technologies, and tasks, […]" (Zhang, Benbasat, Carey, Davis, and Galletta, 2002, p. 335). This discipline is categorized in terms of three major themes. First, HCI concentrates on users. Second, it is an iterative approach, whereas the software development process demands that all design specifications be conformably implemented. Third, the focus is on empirical testing, which enables IS design to benefit from experience gained in practice. The first step of HCI's design process is to understand users' characteristics and the IS context. Therefore, HCI has established several theories about human behavior and cognition that explain responses to computer use beyond RE.

Framework for literature categorization

Following HCI research, we begin our literature categorization with publications about segmenting (A.1) and characterizing user groups (A.2). We continue with EE, which breaks up the IS design process into two stages. The black-box model describes the users' perspective, covering their functional requirements and associated functional principles (B.3). The white-box model, in turn, considers the constraints on IS design from the engineering perspective with constructional requirements (C.1) and constructional principles (C.2). Next, we use RE to detail the functional requirements. In so doing, we distinguish between domain-specific requirements (B.1), which cover the purpose of IS design, and cross-domain requirements (B.2), which are more formal aspects of IS as they fulfill their function. Finally, we add functional principles (B.3).

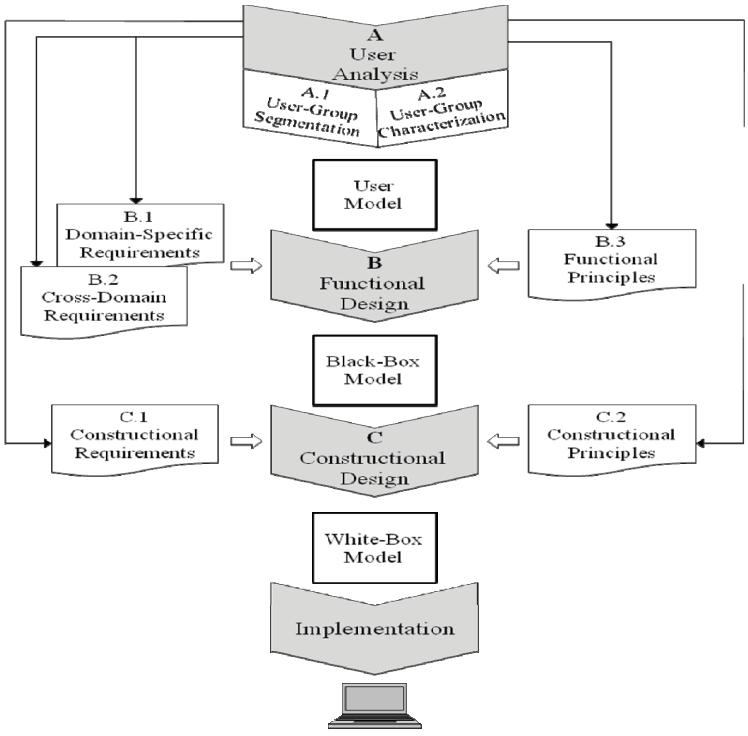

Figure 1. Multidisciplinary framework for literature review on user-group characteristics and EIS design process

LITERATURE ANALYSIS

After introducing our literature search strategy, we synthesize the findings on how user-group characteristics are incorporated into the EIS design process and what gaps exist that must be overcome.

Search strategy

Following vom Brocke et al. (2009), we focus on leading IS research outlets and select ten journals based on the catalog provided by the London School of Economics (Willcocks, Whitley, and Avgerou, 2008). We consider this catalog as appropriate for our purposes, since it incorporates not only mainstream IS journals, but also social studies of IS.[1] Furthermore, we expand our list with proceedings from the two "A"-ranked international conferences: the International and European Conferences on IS (ICIS, ECIS)**.** To expand our journal base towards engineering discipline, we look at publications covering systems and software engineering.[2] Finally, our search also covers HCI journals.[3]

To access the journals, we choose EBSCOhost, Science Direct and ProQuest databases, as they predominantly cover issues of the last 20 years. In a third step, we execute the keyword search on titles and abstracts.[4] The results were 466 hits, of which we found 20 to be relevant (Figure 2, left side). To identify further articles, we do a backward search, which leads to a total of 30 articles (Figure 2, right side) examining user-group characteristics and their implications in EIS research.

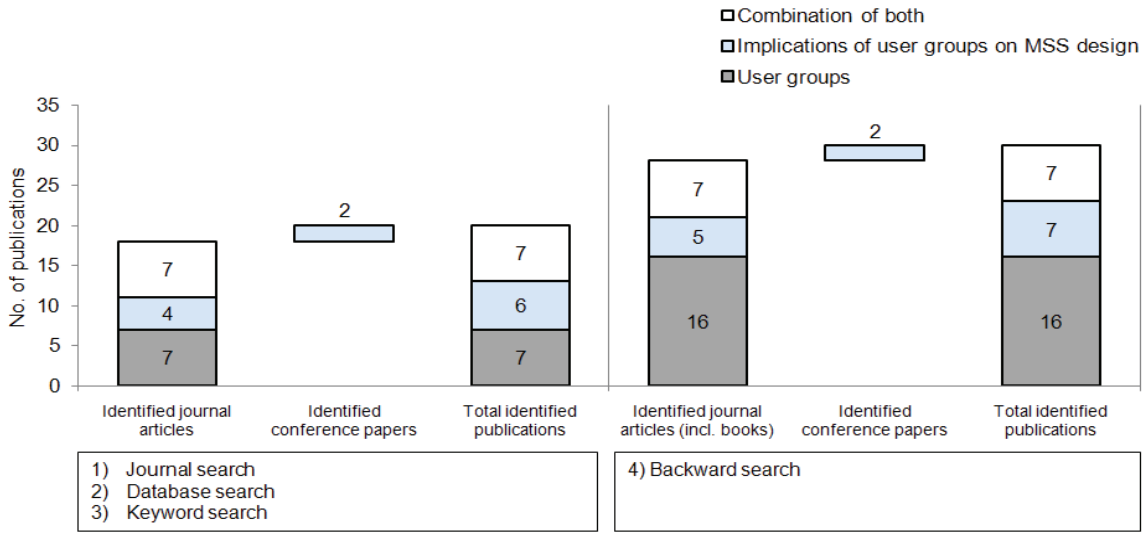

Figure 2. Selection of relevant publications

Results

Figure 3 presents the 30 publications identified as relevant (in detail Table A.I). Studies relating to more than one component of the framework appear more than once. Publications from the journals with the highest impact factors are highlighted in gray and briefly described below to provide a sense of the following seven clusters of publications.

A first group of publications are rooted in psychology and cover *user-group segmentation (A.1)*. They deal with an individual's cognitive style—in other words, the way in which individuals tend to grasp information (e.g., quantitatively vs. qualitatively) and how they apply this information when making decisions (e.g., logical argumentation vs. intuition). One of the most popular and widespread techniques for segmenting user groups is the Myers-Briggs Type Indicator (MBTI, Myers, 1976). Their assessment classifies an individual's personality according to four dichotomies: attitude, perceiving function, judging function, and lifestyle. With respect to IS design, the perceiving and judging functions are of particular interest.

[1] We choose five journals of each set: 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] We used several journal rankings (AIS, 2010; WI, 2008) and choose Information and Software Technology, Communication of the ACM, ACM Computing Surveys, Journal of Systems and Software, and the International Journal of Systems Science.

[3] We found Human-Computer Interaction, International Journal of Human-Computer Interaction, International Journal of Human-Computer Studies, and Computers in Human Behavior in the journal rankings (AIS, 2010; WI, 2008) and added AIS Transaction on Human-Computer Interaction as an upcoming HCI Journal.

[4] Search string: "decision making" OR "executive information system" OR "decision support system" OR "management information system" OR "data warehouse" OR "business intelligence") AND ("use" OR "style" OR "pattern" OR "adoption" OR "acceptance.)"

Persons tend to either trust the data at hand (sensing type) or seek for a broader context in which to understand the data (intuitive type). In summary, a wealth of methods exists for differentiating individuals' cognitive styles (Figure 3) that can be used to define user groups for EIS design purposes. We found no research gap in this area.

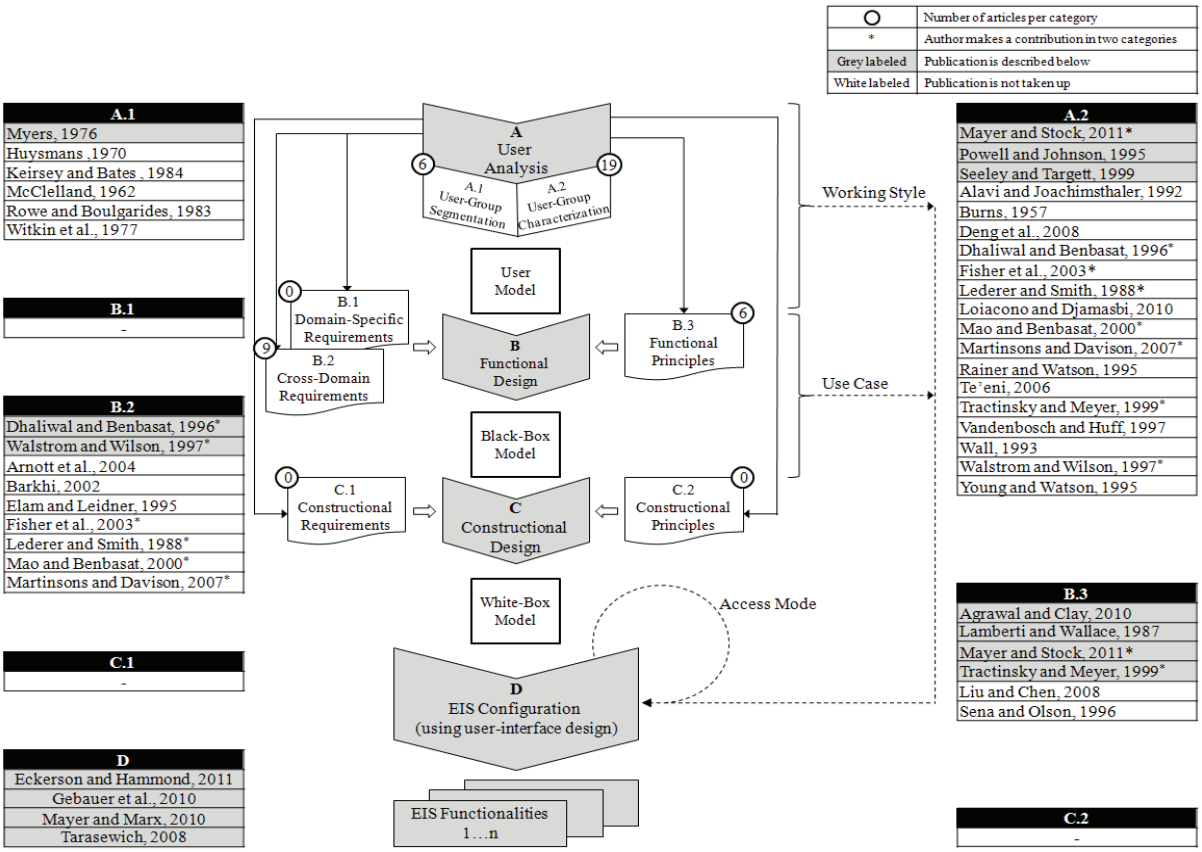

Figure 3. Relevant publications considering user-group characteristics within the EIS design process
Expanded illustration based on Mayer et al. (2011, p. 296)

A second group of publications covers *user group characterization (A.2)*. Either these studies differentiate characteristics that have an impact on EIS (e.g., women vs. men, Powell and Johnson, 1995) or they develop IS profiles for a certain user group. As an example, Seeley and Target (1999) identify four patterns of executive computer use over time: steady-state users, growing users, born-again users, and declining users. Mayer and Stock (2011) identify four working styles among executives. They distinguish between analytical power users (who are growing in number), opportunistic analysts, all-around basic users, and de facto non-users. Summarizing these findings, even more literature exists about characterizing user groups (A.2) and their IS usage than about user-group segmentation (A.1). Once more, no research gap is evident in this area. We synthesize all these individual variables of executives manager' user preferences as their *working style*.

EIS literature provides several methods for determining information needs and reference models for their specification as a starting point for *domain-specific requirements* (B.1). A more recently developed information model is the Balanced Scorecard (BSC, Kaplan and Norton, 1996). But, none of these proposals considers the connections between domain-specific requirements, user preferences, and EIS design. One reason could be that the homo oeconomicus theory has dominated research in recent years, including IS research on the links between humans and IT.

Within the *cross-domain requirements* (B.2), Dhaliwal and Benbasat (1996) examine the type of explanations needed from EIS. They show that novices make greater use of non-case-specific, generalized information, while experts make greater use of case-specific information that explains the outcome of an analysis. Walstrom and Wilson (1997) define typical functionalities used by converts, pacesetters, and analyzers. To sum up the findings, much research is available on the implications of user-group characteristics on cross-domain requirements. However, the fact that they use different user-group characterizations often makes these publications incompatible with one another.

Tractinsky and Meyer (1999) derive *functional principles* (B.3) based on the objectives of EIS users from a presenting perspective. If the reports in the EIS are used to aid decision making, the interface should be restricted to 2D bars and figures so as to not distract from the content. If the reports are used for presentation, the interface should apply 3D bars and figures. Based on their distinction among managers' working styles, Mayer and Stock (2011) define cross-functional principles for designing EIS user interfaces, along with the analysis and corresponding data model for each user type.

Lamberti and Wallace (1987) design user interfaces for the military to identify critical targets in a real-time environment. They develop screen setups with different colors, symbols, graphics, and numeric displays. Agrawal and Clay (2010) examine the effect of the way information is represented on how well individuals with different temperaments perform a decision making task. They suggest that tabular representations will lead to more accurate decisions for individuals with a guardian or artisan temperament, while graphical representations have a similar effect for those with an idealist or rational temperament. Compared to the wealth of articles on functional requirements (B.1, B.2), a far less faceted body of knowledge is available on this topic. To take the various working situations in which executives use EIS into account, we incorporate their *use case* in our forward thinking.

Turning to the field of *constructional requirements* (C.1), Walia and Carver (2009) classify errors that occur during the requirements phase and develop a taxonomy consisting of people errors, documentation errors, and process errors, which include, for instance, management errors or traceability errors. In the field of *constructional principles* (C.2), it is primarily researchers in software engineering who deal with IS architecture, such as a service-oriented architecture (Sommerville, 2010). However, none of these articles consider the implications of user-group characteristics on constructional requirements or constructional principles.

A last group of literature contributes to *EIS configuration (using-user-interface design,* D). Gebauer et al. (2010) focus on the user interface for mobile devices. Rather than examining the user-group characteristics mentioned before, they highlight portability, operations and performance, usability, and network connectivity as determinants for mobile user interfaces. Tarasewich et al. (2008) identify a changing context, limited user attention, users' occupied hands, high mobility, and IS interaction while in motion as future issues for mobile user interfaces. Mayer and Marx (2010) propose a distinction between information presentation, dialog control, as well as predefined functions. Eckerson and Hammond (2011) come up with a list of the most important user interface characteristics. Although this kind of literature does not consider user-group characteristics in detail, we incorporate EIS *access mode* into our model, as doing so serves our purpose of increasing EIS acceptance with better user-interface design.

SYNTHESIS

Six insights emerge from the literature review and suggest ways to accommodate executives' growing range of user preferences. We focus on the three related to user-interface design (for the overall results, Mayer et al., 2011).

First finding: There is a lack of functional principles addressing issues beyond "pure" information presentation. Although cross-domain requirements (B.2) are extensively described in the literature, design principles (B.3) can only be found rarely, and the ones we found are primarily limited to information presentation (Lamberti and Wallace, 1987; Mao and Benbasat, 2000). Thus, we propose expanding functional principles to artifacts beyond user-interface design and their information presentation. For example, additional functional principles can take the form of standardized dialogs or drill-down functionalities. Examples include predefined net sales analysis by product, region, and customers; graphs of cash flow over time; or depictions of how a particular key performance indicator, such as earnings before interest and taxes, is related to others.

Second finding: No commonly accepted model for a basic set of EIS functions is available. Functional requirements (B.1 and B.2) tend to take a granular focus on specific EIS functions, such as generating explanations or providing information on data quality, but they are often not aligned within a commonly accepted overall (research) model for EIS functions, such as the one described by Walstrom and Wilson (1997). Such a model would help to integrate increasingly user-centered functions into EIS design. It should incorporate principles such as basic reporting and planning functions, more experienced shortcut navigation, or flexible analyses. Thus, we propose that the future EIS research agenda should include developing a comprehensive model of EIS functions, even for the growing number of expert users on the C level.

Third finding: Concrete principles for leveraging state-of-the-art user-group characteristics are underrepresented compared to the associated requirements. The last finding is that studies of user-group preferences and their impact on EIS requirements (B.1, B.2) dominate over those on EIS principles (B.3 and C.2). This imbalance could be due to the fact that principles are broader in scope than requirements and therefore more difficult to evaluate. We recommend complementing requirements analysis in future with concrete functional and constructional principles to avoid incoherent solutions for individual problems in favor of generic solutions with adaptation capabilities for different classes of design problems.

USER-INTERFACE FEATURES FOR EIS DESIGN

Following Mayer and Marx (2010), we structure three building blocks of user interface design: information presentation, dialog control, and predefined functions (Figure 4). Specifying their components, we include findings from Eckerson and Hammond (2011) who define a list of the most important user-interface components. They are drillable charts; synchronized charts; the ability to publish to Excel, Word, or PDF; role-based views; embedment in a portal; universal filters, alerts and stoplights; personalization; one-click access to metadata; mouse hovers; sliders to adjust variables; links to related content, navigational breadcrumbs, bookmarks; and Flash/Silverlight animation.

Tractinsky and Meyer (1999) examine 2D vs. 3D bars and figures. Continuing with Mayer and Stock (2011), we add degree of interface flexibility (flexible vs. page-by-page navigation), point of system entry, predefined analysis, ad hoc queries, blending out of unneeded functions and information, and direct links to upstream IS. The authors also call for hierarchical dialog-control trees to simplify navigation, and comments directly on relevant KPIs as predefined functions.

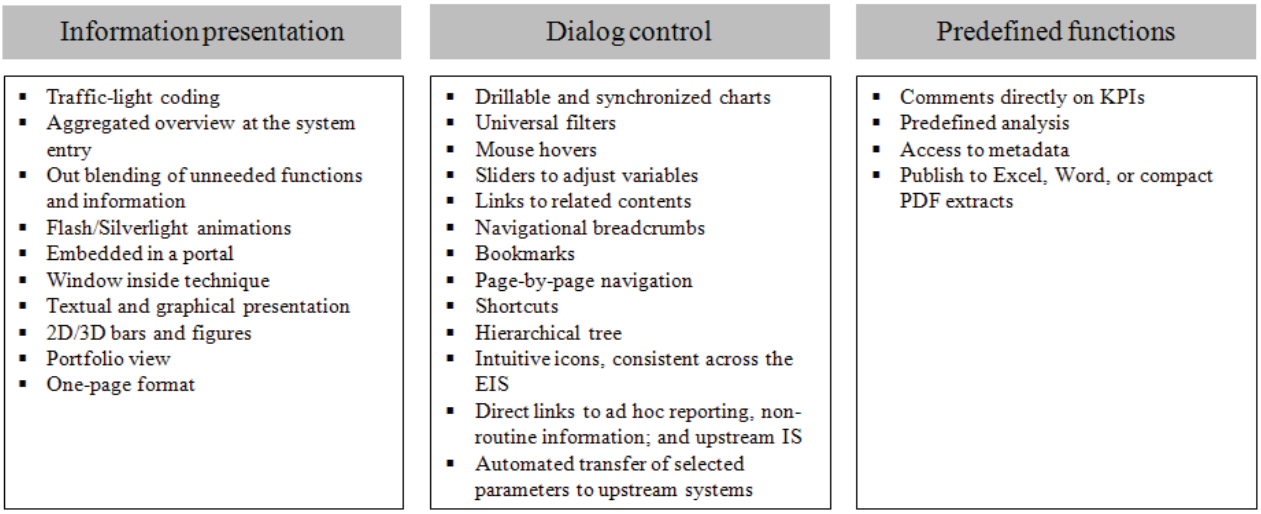

Figure 4 Building blocks of user-interface design

USER INTERFACE FEATURES INCORPORATED IN THE CORPORATE NAVIGATOR

To demonstrate how EIS can accommodate user-group characteristics with the "right" user-interface design, we incorporate our researched components into a prototype. The resulting Corporate Navigator distinguishes between executives of the "analyst" and "consumer" executives. This is in line with Myers (1976) and Mayer and Stock (2011). Analysts seek for causal relationships, prefer quantitative data, and pay attention to detail, whereas consumer are heuristic decision makers, include qualitative factors in their decisions, and pay less attention to detail.

The Corporate Navigator uses an ETL tool to extract data from the various transaction systems and transform and load them into a data warehouse, which stores the data in a central location. Query technologies carry over the IT restrictions based on separate data storages. A business application bundle for planning, consolidation, and strategy management accesses the information and provides management reports to help incorporate it into the executive decision-making process. The data is presented in the uppermost (fourth) layer: the web frontend (Figure 5).

Analysts prefer an aggregated overview at system entry. Therefore, the Corporate Navigator provides a portfolio view, which visualizes the most important key performance indicators (KPIs, Figure 5, top). Thanks to comments provided directly on the KPIs, analysts can go on with self-service analysis or ask for explanations. A one-page reporting includes a comprehensive view of more detailed KPIs in different information categories, such as financial or management accounting (Figure 5, buttom). To focus on revealing changes, the user interface should use traffic-light coding. A flexible periphery for ad hoc requests provides these users the option of deep-dive analyses. Furthermore, analysts can use directs links to upstream IS, which should be available via intuitive icons. To guarantee easy and quick navigation we propose avoiding overlapping windows and pull-down menus in favor of just breadcrumbs, bars, and tabs within a single window. Figure 5 visualizes the resulting user interface design for analysts.

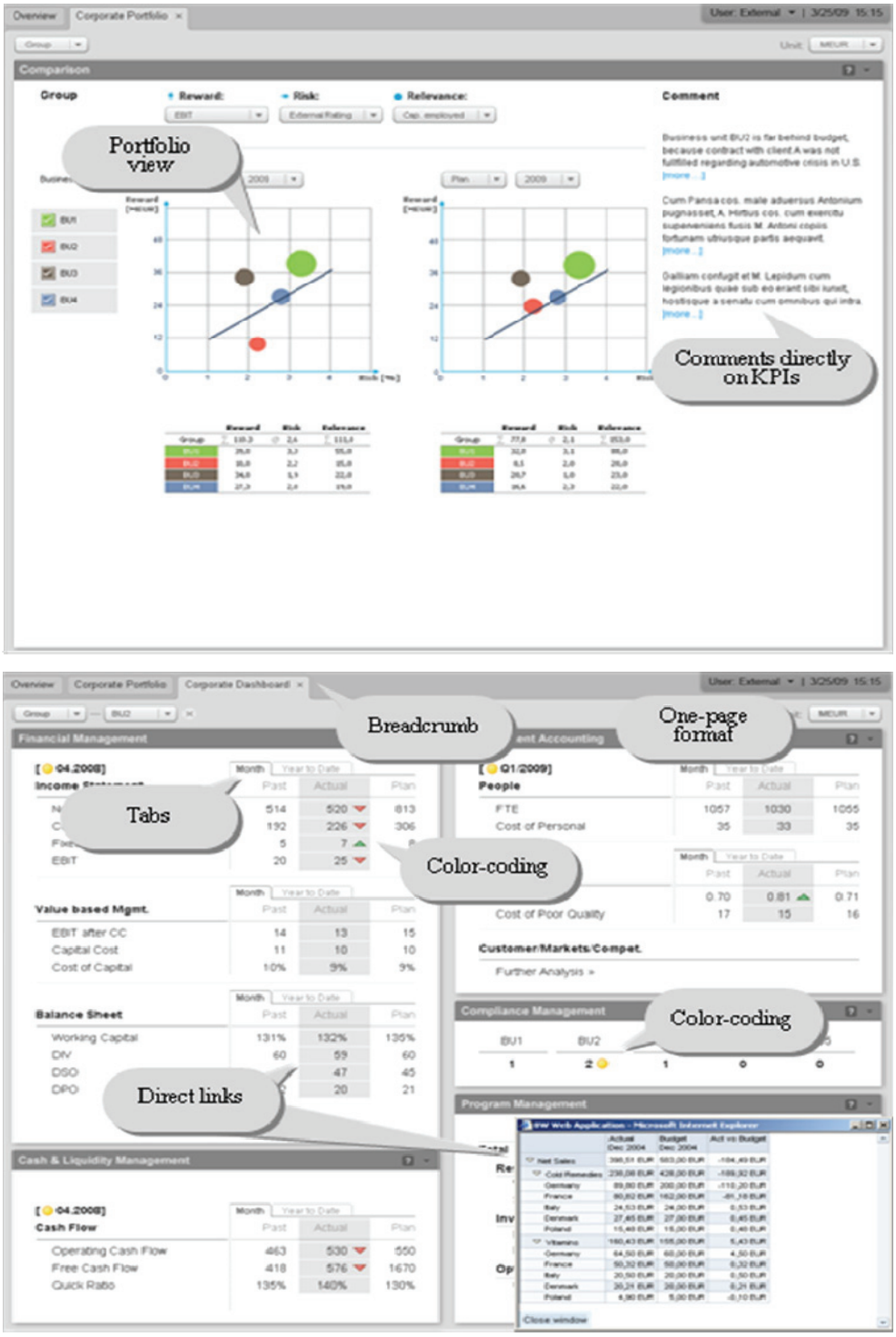

Figure 5: User-interface configuration for analysts (screenshot)

Consumers have a preference for just most important information aligned with easy-to-handle navigation. Functions not on this "main track" should be blended out. Most often, just a few predefined reports and financial management analyses are relevant for these users (Figure 6). Therefore, the entry point should be a compact PDF extract in "e-book" format, with page-by-page navigation instead of flexible navigation. Links allow users to navigate to related content in the PDF extract.

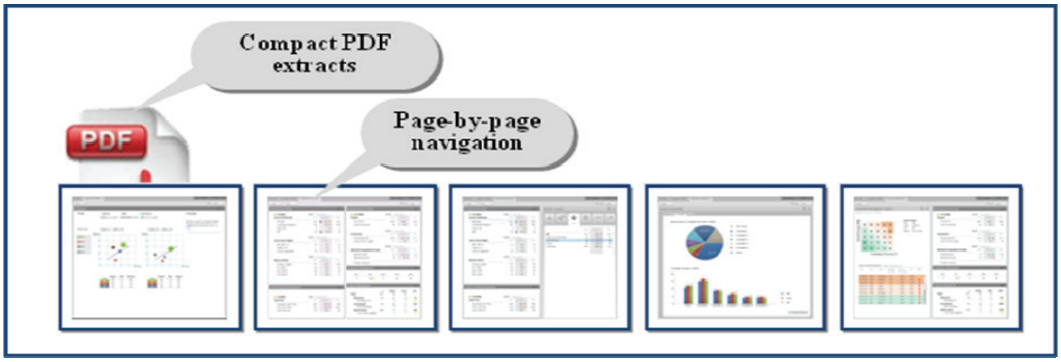

Figure 6: User-interface configuration for consumers (navigation schema with screenshot)

OUTLOOK AND FUTURE RESEARCH

The objective of this article was to develop building blocks for user-interface design to make "up close and personalized" EIS possible. To do so, we reviewed the literature on how EIS design can accommodate user-group characteristics. Three findings that enhance EIS design resulted. Based on these, we proposed three clusters of user interface components: information presentation, dialog control, and predefined functions. Finally, we incorporate these components into an EIS prototype to start evaluating our proposal's utility.

Our research was limited to a restricted number of publications. However, the fact that we covered the leading journals means that major contributions should be included. We will expand our analysis to practitioner publications, but this should be a secondary issue. It is more important to specify the findings presented here with future "build" and "evaluate" activities—driven in case studies or a survey to gain a direct perspective on EIS user-group preferences in a relevant sample. We will go on to develop a configuration tree with executives' various working styles, use cases, and EIS access modes to investigate how their combinations can lead to more situational EIS design.

REFERENCES

1. Agrawal, A. and Clay, P. (2010) Temperament and Cognitive Fit: An Empirical Investigation of Task Performance, in R. Lee, N. Ishii and T. Matsuo (Eds.), *Proceedings of the 31st International Conference on Information Systems (ICIS)*, December 12-15, 2010, Saint Louis, 1-10.
2. AIS (2010) MIS Journal Rankings http://ais.affiniscape.com/displaycommon.cfm?an=1&subarticlenbr=432, accessed November 20, 2010.
3. Carlsson, S.A., Henningsson, S., Hrastinski, S. and Keller, C. (2009) An Approach for Designing Management Support Systems: The Design Science Research Process and its Outcomes, in V. Vaishanvi, R. Baskerville and S. Purao (Eds.), *Proceedings of the Fourth International Design Science Research in Information Systems and Technology (DESRIST)*, June 7-8, 2009, Malvern, PA, USA, 1-10.
4. Davis, F.D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, *MIS Quartely*, 13, 3, 318-340.
5. DeLone, W.H. and McLean, E.R. (2003) The DeLone and McLean Model of Information Systems Success: A Ten-Year Update, *Journal of Management Information Systems*, 19, 4, 9-30.
6. Dhaliwal, J.S. and Benbasat, I. (1996) The Use and Effects of Knowledge-based System Explanations: Theoretical Foundations and a Framework for Empirical Evaluation, *Information Systems Research*, 7, 3, 343-362.
7. Die Sprecher der Wissenschaftlichen Kommission Wirtschaftsinformatik im Verband der Hochschullehrer für Betriebswirtschaft (WKWI) und des Fachbereichs Wirtschaftsinformatik der Gesellschaft für Informatik (GI-FB WI) (2008) WI-Journalliste 2008 sowie WI-Liste der Konferenzen, Wirtschaftsinformatik, 50, 2, 155-163.
8. Dietz, J.L.G. (2007) Architecture. Building Strategy into Design, Academic Service, The Hague.
9. Eckerson, W. and Hammond, M. "Visual Reporting and Analysis," TDWI, Chatsworth.

10. Gartner (2010) Gartner EXP Worldwide Survey of Nearly 1,600 CIOs Shows IT Budgets in 2010 to be at 2005 Levels http://www.gartner.com/it/page.jsp?id=1283413, accessed April 16, 2010.
11. Gebauer, J., Shaw, M.J. and Gribbins, M.L. (2010) Task-Technology fit for Mobile Information Systems, *Journal of Information Technology*, 25, 3, 259-272.
12. Hackos, J.T. and Redish, J.C.R. (1998) User and Task Analysis for Interface Design, John Wiley & Sons, New York.
13. Huber, G.P. (1983) Cognitive Style as a Basis for MIS and DSS design: Much Ado about Nothing?, *Management Science*, 29, 5, 567-579.
14. IEEE (1990) IEEE Standard Glossary of Software Engineering Terminology, IEEE Computer Society, New York.
15. ISO "Ergonomics of human-system interaction—Part 110: Dialogue principles (ISO 9241-110:2006-08)," International Organization for Standardization.
16. Kaplan, R.S. and Norton, D.P. (1996) The Balanced Scorecard: Translating Strategy into Action, Harvard Business School Press, Boston.
17. Lamberti, D. and Wallace, W.A. (1987) Presenting Uncertainty in Expert Systems: An Issue in Information Portrayal, *Information & Management*, 13, 2, 159-169.
18. Laplante, P.A. (2009) Requirements Engineering for Software and Systems, CRC Press, Boca Raton.
19. Laudon, K.C. and Laudon, J.P. (2010) Management Information Systems – Managing the Digital Firm, Pearson, Upper Saddle River.
20. Mao, J.-Y. and Benbasat, I. (2000) The Use of Explanations in Knowledge-Based Systems: Cognitive Perspectives and a Process-Tracing Analysis, *Journal of Management Information Systems*, 17, 2, 153-179.
21. Mayer, J.H. and Marx, F. (2010) Systematic Development of Business-Driven Requirements – Using Next-Generation EIS Design as an Example, in R. Winter, J. Zhao and S. Aier (Eds.), *Proceedings of the Fifth Design Science Research in Information Systems and Technology (DESRIST)*, June 4, 2010, St. Gallen, Springer, 506-521.
22. Mayer, J.H. and Stock, D. (2011) Nutzertypen für die situative FIS-Gestaltung: Ergebnisse einer empirischen Untersuchung, in A. Berstein and G. Schwab (Eds.), *Proceedings of the 10th International Conference on Wirtschaftsinformatik (WI) 2.011*, November 20, 2011, Zurich, 139-149.
23. Mayer, J.H., Winter, R. and Mohr, T. (2011) Utilizing User-Group Characteristics to Improve Acceptance of Management Support Systems—State of the Art and Six Design Guidelines, in H. Jain, A.P. Sinha and P. Vitharana (Eds.), *Proceedings of the Sixth Design Science Research in Information Systems and Technology (DESRIST),* May 5-6, 2011, Milwaukee, Springer, Heidelberg, 291-305.
24. Myers, I.B. "Introduction to Type," Center for Applications of Psychological Type, Gainesville.
25. Nord, J.H. and Nord, G.D. (1995) Executive Information Systems: A Study and Comparative Analysis, *Information & Management*, 29, 2, 95-106.
26. Powell, P.L. and Johnson, J.E.V. (1995) Gender and DSS Design: The Research Implications, *Decision Support Systems*, 14, 1, 27-58.
27. Quinn, R.E. and Cameron, K.S. (1988) Paradox and Transformation: Towards a Theory of Change in Organization and Management, Ballinger, Cambridge.
28. Seeley, M. and Targett, D. (1999) Patterns of Senior Executives' Personal Use of Computers, *Information & Management*, 35, 315-330.
29. Sommerville, I. (2010) Software Engineering, Pearson, München.
30. Tarasewich, P., Gong, J., Fiona, F.-H.N. and David, D. (2008) Mobile Interaction Design: Integrating Individual and Organizational Perspectives, *Information Knowledge Systems Management*, 7, 1, 2, 121-144.
31. Tractinsky, N. and Meyer, J. (1999) Chartjunk or Goldgraph? Effects of Presentation Objectives and Content Desirability on Information Presentation, *MIS Quarterly*, 23, 3, 397-420.

32. Vodanovich, S., Sundaram, D. and Myers, M. (2010) Digital Natives and Ubiquitous Information Systems, *Information Systems Research*, 21, 4, 711-723.

33. vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009) Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process, in S. Newell, E. Whitley, N. Pouloudi, J. Wareham and L. Mathiassen (Eds.), *Proceedings of the 17th European Conference On Information Systems (ECIS)*, June 8, 2009, Verona, 2206-2217.

34. Walia, G.S. and Carver, J.C. (2009) A Systematic Literature Review to Identify and Classify Software Requirement Errors, *Information and Software Technology 51 (2009)* 51, 7, 1087–1109.

35. Walstrom, K.A. and Wilson, R.L. (1997) An Examination of Information Systems (EIS) Users, *Information & Management*, 32, 2, 75-83.

36. Webster, J. and Watson, R.T. (2002) Analyzing the Past to prepare for the Future: Writing a Literature Review, *MIS Quarterly*, 26, 2, 13-23.

37. Willcocks, L.P., Whitley, E.A. and Avgerou, C. (2008) The Ranking of Top IS Journals: A Perspective from the London School of Economics, *European Journal of Information Systems*, 17, 1, 163–168.

38. Wixom, B.H. and Watson, H.J. (2010) The BI-Based Organization, *International Journal of Business Intelligence Research*, 1, 1, 13-28.

39. Zhang, P., Benbasat, I., Carey, J., Davis, F. and Galletta, D. (2002) Human-Computer Interaction Research in the MIS Discipline, *Communications of the Association for Information Systems*, 9, 2, 334-355.

40. Zmud, R.W. (1979) Individual Differences and MIS Success: A Review of the Empirical Literature, *Management Science*, 25, 10, 966-977.

APPENDIX

No.	Author(s)	Title	Year	Source[1]	Discipline
A User Analysis **A.1 User-Group Segmentation**					
1	Myers	Introduction to type	(1976)	Book	Psychology
2	Huysmans	The effectiveness of the cognitive-style constraint in implementing operations research proposals	(1970)	MS	Psychology
3	Keirsey and Bates	Please Understand Me: Character and Temperament Types	(1984)	Book	Psychology
4	McClelland	Business drive and national achievement	(1962)	HBR	Psychology
5	Rowe and Boulgarides	Decision styles - A perspective	(1983)	LODJ	Psychology
6	Witkin et al.	Field-dependent and field-independent cognitive styles and their educational implications	(1977)	RER	Psychology
A.2 User-Group Characterization					
7	Mayer and Stock	Nutzertypen für die situative FIS-Gestaltung: Ergebnisse einer empirischen Untersuchung	(2011)	WI	MIS
8	Powell and Johnson	Gender and DSS design: the research implications	(1995)	DSS	MIS / HCI
9	Seeley and Targett	Patterns of senior executives' personal use of computers	(1999)	I&M	MIS
10	Alavi and Joachimsthaler	Revisiting DSS Implementation Research: A Meta-Analysis of the Literature and Suggestions for Researchers	(1992)	MISQ	MIS / HCI
11	Burns	Management in Action	(1957)	ORS	MIS
12	Deng et al.	A cross-cultural analysis of the end-user computing satisfaction instrument: A multi-group invariance analysis	(2008)	I&M	MIS / HCI
13	Dhaliwal and Benbasat	The use and effects of knowledge-based system explanations: Theoretical foundations and a framework for empirical evaluation	(1996)	ISR	MIS / HCI
14	Fisher et al.	The impact of experience and time on the use of data quality information in decision making	(2003)	ISR	MIS / HCI
15	Lederer and Smith	Individual differences and decision-making using various levels of aggregation of information	(1988)	JMIS	MIS / HCI
16	Loiacono and Djamasbi	Moods and Their Relevance to Systems Usage Models within Organizations: An Extended Framework	(2010)	AIS THCI	HCI

[1] Harvard Business Review (HBR), Journal of Economic Behavior & Organization (JEBO), Leadership & Organizational Development Journal (LODJ), Management Science (MS), Review of Educational Research (RER), Sloan Management Review (SMR), Information & Software Technology (IST), Operational Research Society (ORS), Wirtschaftsinformatik Conference (WI), Information Knowledge Systems Management (IKSM), Journal of Information Technology (JIT), Design Science Research in Information Systems and Technology (DESRIST)

17	Mao and Benbasat	The use of explanations in knowledge-based systems: Cognitive perspective and a process-tracing analysis	(2000)	JMIS	MIS / HCI
18	Martinsons and Davison	Strategic decision making and support systems: Comparing American, Japanese and Chinese management	(2007)	DSS	MIS / HCI
19	Rainer and Watson	What does it take for successful executive information systems?	(1995)	DSS	MIS
20	Te'eni	Design That Fit	(2006)	Book Section	HCI
21	Tractinsky and Meyer	Chartjunk or goldgraph? Effects of presentation objectives and content desirability on information presentation	(1999)	MISQ	MIS / HCI
22	Vandenbosch and Huff	Searching and scanning: How executives obtain information from executive information systems	(1997)	MISQ	MIS
23	Wall	A model of decision making under bound rationality	(1993)	JEBO	MIS / HCI
24	Walstrom and Wilson	An examination of executive information system (EIS) users	(1997)	I&M	MIS
25	Young and Watson	Determinates of EIS acceptance	(1995)	I&M	MIS
B Implications of User Groups on Functional MSS Design					
B.1 Domain-Specific Requirements					
None of the surveyed articles consider implications of user-groups characteristics on domain-specific requirements					
B.2 Cross-Domain Requirements					
see 13	Dhaliwal and Benbasat	The use and effects of knowledge-based system explanations: Theoretical foundations and a framework for empirical evaluation	(1996)	ISR	MIS / HCI
see 24	Walstrom and Wilson	An examination of executive information system (EIS) users	(1997)	I&M	MIS
26	Arnott et al.	Executive information systems development in an emerging economy	(2007)	DSS	MIS
27	Barkhi	Cognitive style may mitigate the impact of communication mode	(2002)	I&M	MIS / HCI
28	Elam and Leidner	EIS adoption, use, and impact: The executive perspective	(1995)	DSS	MIS
see 14	Fisher et al.	The impact of experience and time on the use of data quality information in decision making	(2003)	ISR	MIS / HCI
see 15	Lederer and Smith	Individual differences and decision-making using various levels of aggregation of information	(1988)	JMIS	MIS / HCI
see 17	Mao and Benbasat	The use of explanations in knowledge-based systems: Cognitive perspective and a process-tracing analysis	(2000)	JMIS	MIS / HCI
see 18	Martinsons and Davison	Strategic decision making and support systems: Comparing American, Japanese and Chinese management	(2007)	DSS	MIS / HCI
B.3 Functional Principles					
29	Agrawal and Clay	Temperament and Cognitive Fit: An Empirical Investigation of Task Performance	(2010)	ICIS	HCI
30	Lamberti and Wallace	Presenting uncertainty in expert systems: An issue in information portrayal	(1987)	I&M	MIS / HCI
see 7	Mayer and Stock	Nutzertypen für die situative FIS-Gestaltung: Ergebnisse einer empirischen Untersuchung	(2011)	WI	MIS
see 21	Tractinsky and Meyer	Chartjunk or goldgraph? Effects of presentation objectives and content desirability on information presentation	(1999)	MISQ	MIS / HCI
31	Liu and Chen	The Effect of Individual Differences, Tasks, and Decision Models on User Acceptance of Decision Support Systems	(2008)	AMCIS	MIS
32	Sena and Olson	Decision support for the administrative man: A prototype DSS case	(1996)	EJIS	MIS
C Implications of User Groups on Constructional MSS Design					
C.1 Constructional Requirements					
None of the surveyed articles consider implications of user-groups characteristics on constructional requirements					
C.2 Constructional Principles					
None of the surveyed articles consider implications of user-groups characteristics on constructional principles					
D EIS Configuration (using user -interface design)					
33	Eckerson and Hammond	Visual Reporting and Analysis	(2011)	TDWI	MIS
34	Gebauer et al.	Task-Technology fit for Mobile Information Systems	(2010)	IKSM	MIS
35	Mayer and Marx	Systematic Development of Business-Driven Requirements – Using Next-Generation EIS Design as an Example	(2010)	DESRIST	MIS
36	Tarasewich et al.	Mobile Interaction Design: Integrating Individual and Organizational Perspectives	(2008)	IKSM	MIS

Table A1. Relevant publications considering user-group characteristics within the EIS design process