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MANAGING A PARADOX –
DESIGN PRINCIPLES FOR EXECUTIVES’ IT SUPPORT

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Abstract

How are companies managed today and what part does state-of-the-art IT play? Executive information systems (EIS) should support top managers in managing their companies. But many executives complain that EIS bear little relevance to their management task (functional requirements) and fail even more to accommodate their working style (design requirements). This article focuses on the latter and contributes to new-generation EIS by identifying twelve principles for their design. The first step in doing so is to systematically develop requirements criteria for EIS design. On this point, our research revealed a twofold gap: as the rigor of scientific models (e.g. structural models of IS user satisfaction and technology acceptance) increases, they become less relevant for direct use in practice. At the same time, practitioner journals demonstrate relevance, but do not evidence strong rigor. Linking the requirements criteria with rigor and relevance, this article applies the principle of economic efficiency. In a second step, using that schema, design principles for new-generation EIS are derived. They are based on gaps identified in an empirical study and the findings of four instantiations within the chemicals, logistics, high-tech, and automotive supplier industries.

Keywords: Managing a company, executive information systems, design requirements, principle of economic efficiency, requirements criteria, empirical study, design principles
1 INTRODUCTION

Companies must operate in an increasingly dynamic context. Due to their overall responsibility, executives are particularly affected by this situation. Solutions meant to help top management are known as executive information systems (EIS). While most companies have such information systems (IS) in place, many executives complain that they bear little relevance to managing a company (functional perspective) and fail even more to accommodate their working style (design perspective, Eckerson 2010; Eppler 2004).

When it comes to the latter concern, we identified two issues. First, a misalignment exists regarding EIS requirements criteria. While research contains scientifically sound structural approaches, such as the User Satisfaction or the Technology Acceptance Model, they provide little direct guidance for EIS design (Urbach et al. 2009). Practitioner journals, in turn, focus on relevance, but they are not particularly rigorous.

Second, technical progress has been made in the domain of corporate business intelligence (Wixom and Watson 2010). In particular, frontend interfaces should make system handling easier and make it possible for executives to use IS directly. In the light of this technology “push” it makes sense to rethink existing design research by leveraging these new IS capabilities for a new-generation of EIS.

The objective of this article emerges from these considerations. New-generation EIS requires principles for its design. We aim to develop applicable design principles without sacrificing scientific rigor. To do so, business-driven requirements criteria are identified from the state-of-the-art and structured by the principle of economic efficiency. Using that schema, design principles for new-generation EIS are derived from the findings of our empirical study and first instantiations.

The investigation of EIS design principles is an aspect of design research. This discipline focuses on developing innovative, generic solutions for practical problems, and thus on utility (Hevner et al. 2004; March and Smith 1995). Next to Hevner’s et al. (2004) artefacts—constructs, models, methods, and instantiations—the to-be-developed design principles can be categorized as guidelines (Walls et al. 1992). They contribute to design theories that specify how IS artefacts should be designed based on kernel theories (Kuechler und Vaishnavi 2008, S. 492). But we also reflect on how the method for determining these design principles differs from the state-of-the-art.

Various processes have been proposed for developing artifacts under the design research paradigm (Hevner et al. 2004; March and Smith 1995; Rossi and Sein 2009). The one described by March and Smith (1995), which distinguishes between “build” and “evaluate” activities, is predominant in the literature (Hevner et al. 2004). Our approach maintains the focus on design, but draws on findings about practitioner needs from an empirical study as well.

- Identifying a need (Section 2): After a brief introduction to EIS and their requirements categorization, we reflect on the state-of-the-art to identify requirements criteria for EIS design.
- Research design (Section 3): This section describes the empirical study. We surveyed executives of companies listed in the Financial Times “Europe 500” report. The principle of economic efficiency provides a rigorous framework for structuring the requirements criteria.
- Results (Section 4): At this point, design requirements for new-generation EIS named by the surveyed executives are listed (“to-be” profile). A review of respondents’ existing instruments completes this picture. A to-be and as-is profile comparison helps to structure the design principles to be developed.
- Synthesis (Section 5): Then, the key findings of our four instantiations at large, international companies—in the chemicals logistics, high-tech, and automotive supplier industries—are synthesized into design principles. A substantial evaluation of the requirements criteria based on a sizable sample or the EIS design itself with our design principles is a subject for future research.
- Evaluation (Section 6): Finally, with the feedback from the instantiations, the research design on hand is discussed.
2 DESIGN PRINCIPLES FOR EXECUTIVE INFORMATION SYSTEMS

The literature provides extensive definitions of EIS (early articles were by Ackhoff 1967; Rockart and Treacy 1980; for an overview, Clark et al. 2007). Two characteristics are important: First, their overall aim is “… to help an organization carefully monitor its current status, its progress toward achieving its goals” (Kelly 1988, p. 3). Second, they should enable “… nontechnical senior executives to navigate through strategic information culled from several company databases” (Pappas 1998, pp. 16-17). In detail, EIS are computerized systems with access to internal and external information relevant to executives’ decision making (Nord and Nord 1995, p. 96). This access should be “direct and hands-on,” and the executives themselves should be able to exercise it (Young and Watson 1995, p. 154).

The present moment for EIS design seems fortuitous: today’s executives grew up with IT and should have an increasingly positive attitude toward information and communication technology (ICT, Pijpers et al. 2001). At the same time, they have higher requirements than in the past. On the research side, a more holistic perspective that accommodates diverse types of IS users and places greater emphasis on sociotechnical IS design is gaining importance (Brousseau and Glachant 2008).

Requirements can be defined as prerequisites, conditions, or capabilities needed by users (individuals or systems) to solve a problem or achieve an objective (IEEE 1990). Functional requirements address the content-driven perspective on EIS design. They pertain to what the EIS is supposed to deliver (Dietz 2008, pp. 65-70)—in other words, how they can support executives’ task of managing a company.1 A focus on strategy execution and tracking distinguish new-generation EIS from their predecessors. Today, executives place even more emphasis on how EIS should be tailored to their working style. These design requirements reflect how EIS are aligned in a more sociotechnical perspective to executives as their users (Gregor 2006, p. 629). We will focus on the latter. Beyond this users’ perspective, constructional requirements cover the engineering process of EIS bringing them to life. Compatibility to prior work, transparency in the design, scalability, and artifact adaptivity are requirements of this type. In Section 6, we will evaluate our research design in these terms.

To review the state-of-the-art, we followed a model of literature research described by vom Brocke et al. (2009, pp. 7-12). First, we used the MIS Journal Ranking (AIS 2007) to find the most popular academic journals. We identified Decision Support Systems (DSS), Information & Management (I&M), Communication of the ACM (CACM), Information Systems Research (ISR), Journal of Management Information Systems (JMIS), MIS Quarterly (MISQ), Business & Information Systems Engineering (BISE), and Intelligent Systems in Accounting, Finance & Management (IBIR) as relevant. Beginning with list of AIS journals by Poston and Grabski (2000), we also surveyed accounting journals such as Accounting and Organizations and Society (AOS) that publish IS research to some extent. Furthermore we looked at conference papers from the International, Americas, European, and Pacific Asia Conferences on Information Systems (ICIS, AMCIS ECIS, PACIS). For the practitioner journals we surveyed MIS Quarterly Executive, Harvard Business Review, and journals we were led to by our keyword research. We did not include management or psychology journals; as a result, their findings are comprehensive, but sometimes less than exhaustive. Overall, we identified 45 journals or conference papers examining to IS design principles, about 40 percent of which discuss EIS requirements directly.

Second, we conducted a backward search using keywords to identify determinates and antecedents of EIS success in terms of structural models and requirements lists as well as hand-on recommendations from practitioner journals. In the third and final step, we evaluated the results and synthesized research touchpoints, as follows.

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1 The recent economic crisis, for example, revealed the extent to which EIS must support risk management and the use of early indicators, as well as the importance of cash and liquidity targets. Another implication of the crisis is an expanded role for executives in day-to-day business, EIS have to react on.
2.1 Academic journals

Within the academic journals, we identified two schools of research interested in the prerequisites for successful EIS design: IS user satisfaction (“IS success,” in reference to the D&M-IS success model, DeLone and McLean 2003) and technology acceptance (TAM, Davis 1989; Pijpers et al. 2001; Venkatesh et al. 2003). Later, Wixom and Todd (2005) introduced an integrated model. Each of these schools work with both more complex structural models and “simple” requirements lists.

The structural models provide a rigorous understanding of IS success, but such phenomenal explanations provide little direct guidance for EIS design (Urbach et al. 2009, pp. 369-371; Arnott and Pervan 2008, pp. 660-661). Approaches such as the IS user satisfaction model, TAM, and the integrated model can thus be classified as research methods. The questions at issue here cannot be solved with theory building alone. Several obstacles exist:

• Despite the integrated model, there is a lack of external variables to provide direct guidance on making an IS design successful. Some extensions have tackled this issue, but they are rare for EIS.
• An extensive survey is always needed to demonstrate the proposed relationships between requirements, surrogates, and dependent variables. The external variables provided by TAM, such as perceived usefulness or perceived ease of use, have more to do with attitudes than with concrete requirements for an EIS.
• Overall, EIS cases are limited in number (e.g., for the integrated model). Moreover, these cases focus on organizational impact or identify levers for successful EIS instantiations, such as required business skills.

Despite these obstacles, we believe that the four dimensions of information quality identified —accuracy, completeness, currency, and format (Wixom and Todd 2005, p. 88)—as well as the five dimensions of system quality—accessibility, reliability, response time, flexibility, and integration—can provide an initial specification for the principle of economic efficiency (Section 3.2).

List approaches are dominated by one method: potential requirements for developing EIS are collected based partly on literature research, predominantly on the authors’ own experience (Mayer and Marx 2010). Most of the approaches do not make use of an overall structuring principle. As a result, the EIS requirements criteria selected vary in terms of their number and level of abstraction, but practitioners value them for their information and system antecedents.

For that reason, we add some system characteristics as a starting point for our set of design requirements criteria: Pijpers et al. (2001) named perceived fun/enjoyment as a key antecedent variable of IT used by executives. Vandenbosch and Huff (1997, pp. 91-93) pointed out that the systems characteristics of differentiation, integration, and flexibility are relevant to EIS success. Young and Watson (1995) and Poon and Wagner (2001) provide hands-on variables for EIS design such as ease of use and number of features. As this article wants to outline the design of EIS, we do not consider determinates of IT service support in day-to-day business, project management, sponsorship, project communication within the organization, or executives’ confidence in their IS capabilities.

2.2 Practitioner journals

Given the lack of applicable requirements criteria for EIS, it is not surprising that a number of practitioner approaches have been published. These are founded more on their authors’ own experience than the list-based approaches and even the structural models mentioned above. The approaches they take are as diverse as the requirements for EIS they present. But it should be useful to differentiate between business intelligence (BI) and analytics and “pure” information presentation.

Within BI and analytics, studies of corporate performance management dashboards almost consist of isolated case examples (e.g. Houghton et al. 2004) with comments that fail to demonstrate intersubjective replicability (Cover 2007; Eckerson 2006). The same is true for the results of “scorecarding” (Few 2005; Watson 2005), especially white papers from vendors (SAP 2010). Drillable reports and OLAP reporting, however, are increasingly becoming part of executives’ day-to-day work (Chamoni and Gluchowski 2006; Watson 2009, pp. 495-496).
Within “pure” information presentation, the first gaps are regarding “frontends” for executives (Wixom and Watson 2010, p. 25). A need exists for business metadata (Foshay 2007; March and Smith 2007). In terms of technology, efforts are being made to present the EIS results in web-based applications and mobile user devices (Bhargava et al. 2007). Reports on cockpits for board meetings are becoming popular (Davis et al. 2009) and they are subject of research projects (Microsoft 2010).

Practitioner approaches offer direct recommendations for EIS design, but they lack a rigorous basis (Mayer and Marx 2010). Furthermore, it is usually impossible to prove that the requirements they address are really up-to-date and empirically valid. Nevertheless, some of these ideas could be helpful. A reporting logic for executives should contain three levels of analysis with increasing degrees of detail (Eckerson 2006)—using drillable reports and OLAP reporting. Furthermore, comments, definitions/glossaries, and other business metadata should help to improve the EIS acceptance. Communication functionalities and the mechanism for distributing results should support the integration of EIS into companies’ ICT infrastructure.

3 METHODOLOGY

3.1 Empirical study of Financial Times “Europe 500” companies

A field survey (cross-section analysis) was selected as research method. This approach not only makes it possible to cover various perspectives on EIS, but also ensures that the survey contains findings from multiple companies. Since “managing a company”, especially in large, international ones, has become impossible without IT, this type of organization was defined as the population for our empirical study. As such companies are predominantly share-based, the survey was limited to those listed among the Financial Times “Europe 500” report on April 1, 2008. For cost reasons, the survey was limited to the 250 largest companies on the list.

We conducted the survey using a paper-based questionnaire addressing CEOs and CFOs of the corporate center. The survey consisted of 58 questions, divided into four categories: questions about the company and its organizational structure, the functional requirements of EIS, design requirements (to-be profile), and the instrument currently used by the company (as-is profile). The last two items are relevant for this article. Fifty-one companies responded with a total of 59 questionnaires, a population-based response rate of 23.6 percent. Representativeness by industry and size was proved using the chi-squared test of homogeneity. Frequencies were given for the metrically scaled values. These were analyzed using the arithmetic mean and corresponding standard deviation.

3.2 Set of requirements criteria for new-generation EIS design

In terms of IS design, we propose taking only those principles into account that are aligned with the overall organizational design. In business research, the principle of economic efficiency is a generally accepted paradigm (Samuelson 1983). It addresses the ratio between cost and benefit. In our case, it means the design principles must be oriented toward what is economically feasible in EIS design.

The cost of information (and EIS design) can be identified to some degree. However, the ability to quantify the profitability of delivered information is limited. As a result, a surrogate for IS success is needed. A first step in identifying what it could be is to express economic efficiency in a system of basic criteria. Following mechanical engineering’s “black box” method (Matek et al. 1987), these criteria can be differentiated into solution capabilities (system output), which address the relevance of IS for users, and resources required to generate the output (system input, Figure 1).

In IS user satisfaction models (Section 2.1), system output is determined by information and system characteristics that are relevant for users. We apply them, but the information support process should bring them into a structure which is more distinct (Mayer and Marx 2010). That process consists of three stages: information need analysis, information synthesis, and information presentation.
The information need analysis determines the information demand. Applicable here is the design criterion of *completeness*, which encompasses the scope and structure of the information to be provided to IS users (Nelson et al. 2005). “Scope” refers to the quantitative extent of this information, while “structure” focuses on its qualitative aspects.

Second, the information supply must meet users’ demands in terms of how it is synthesized and presented. The design criterion of *user orientation* applies here. The systems characteristics and users perceived ease of use identified in the state-of-the-art are covered with that requirements criteria and captures the need to adapt IS to users’ working styles.

To allow IS users to work with the information, more formal criteria must be considered as well: executives’ tasks often change, so EIS must be *flexible* enough to adapt to these changes (Vandenbosch and Huff 1997). Even the most carefully presented information is not useful if it is not up to date and delivered on time (*time conformity*). The same is true for its *accuracy* (Jiang et al. 2000). Last but not least, IS design must be verified regarding the *effort* required in terms of costs and time.

Bearing in mind the state-of-the-art, the design criteria are not directly measurable. So, they must be specified with evaluation criteria. Figure 1 shows the result. In terms of “completeness,” the scope of EIS can be detailed of how well they cover objective and subjective information needs (evaluation criteria 1 and 2). Strategic (non-financial) information and information for regulatory compliance can specify the information structure (evaluation criteria 3 and 4).

The “user orientation” criterion relates to executives’ scarce management time and limited ability to absorb the amounts of data needed for managing a company. These concerns are addressed with criteria regarding the aggregation level and verifiability of new-generation EIS (criteria 5 and 6).

Executives still tend to be somehow technology-averse (Jiang et al. 2000) and they mostly have a cognitive working style. As a result, another dimension to specify the users’ system orientation is the quality of its information presentation, user interface design, and dialog control, as well as its functional scope, e.g., analyses and links with upstream systems (evaluation criteria 7 to 9).

Flexibility refers to the ability of IS to respond promptly to changing circumstances (evaluation criteria 10). Timeliness indicates the extent information is delivered on time and in up-to-date form (evaluation criteria 11). Accuracy can be specified in terms of formal and content correctness (evaluation criteria 12 and 13). Finally, the effort needed to design the EIS should be verified in terms of cost and time adequacy (evaluation criteria 14 and 15).

**Profile comparison**

<table>
<thead>
<tr>
<th>Principle of economic efficiency</th>
<th>Design criteria</th>
<th>Evaluation criteria</th>
<th>Design gap</th>
<th>Design areas for new-generation EIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution quality (system output)</strong></td>
<td>Completeness</td>
<td>Coverage of objective information need</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coverage of subjective information need</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coverage of “strategy” (non-financial) information</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coverage of “regulatory compliance” information</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>Flexibility</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time conformity</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Accuracy</td>
<td>Accuracy</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Resources requirements (system input)</td>
<td>Effort</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Figure 1. *As-is/to-be design profile for new-generation EIS*
4 RESULTS

Both the extent to which executives mentioned each EIS requirement (to-be profile) and the existing instrument currently fulfills these criteria (as-is profile) are measured on a five-point ordinal scale (see Figure 1). To better show differentiations, the area between the values “3” (somewhat) and “4” (high) has been extended. The relevance of each issue is measured in terms of the difference between the as-is and to-be profiles (column “design gap”).

Completeness

As their managing a company expands, executives require more comprehensive content. On a scale of 1 (“very low”) to 5 (“very high”), executives rate the coverage of their objective information need at an arithmetic mean of 4.3, with a small standard deviation of 0.76—the third-highest score overall (evaluation criteria 1, see Figure 1). They also pointed out an increasing need for “strategy” information (criteria 3)—in other words, information that is business driven than “pure” financials (arithmetic mean of 3.7). Also the comparison of the as-is and to-be values show that executives need more objective information (gap: 0.6) and “strategy” information (0.5). As a result, providing comprehensive content for managing a company is defined as a first gap for new-generation EIS design.

Aggregation level and verifiability

Furthermore, executives want key insights synthesized in a condensed format (arithmetic mean of criteria 5 “aggregation level”: 3.8), but EIS must also allow to access the underlying details (arithmetic mean of verifiability: 4.0; in addition, correctness in terms of format and content: 4.4 and 4.5). The comparison of the as-is and to-be values of the criterion “verifiability” (0.5) shows that executives consider their current ability to verify the presented information as insufficient. So, a further design gap exists in terms of synthesizing and presenting information in a condensed format.

System handling

The survey suggests that IT support for executives is often not easy for them to use (user orientation criteria 7 to 9). On particular, creating reports is still complex and time-consuming (design gap of functional scope: 0.4). System handling follows IT capabilities rather than business logic (quality of presentation: 0.3) and user-interface design and dialog control does not always match executives’ working style (0.2). As a result, these criteria constitute an ease-to-use system handling as a third development area to improve EIS design.

Flexibility and time conformity

Asking EIS to be flexible (arithmetic mean of criterion 10: 3.8), executives express their need for individual analysis on demand in addition to standard reporting. Such demands—due to regulatory changes or more operative requests from the field—currently require time-consuming adjustments. With an arithmetic mean of 3.0, timeliness of information (criterion 11) had the lowest to-be rating of all requirements criteria in the profile. The fact that this was lower than the as-is score—this occurred only twice in the study—underlines that executives do not see need for improvement in this area.

Accuracy

The weight executives assigned to accuracy reveals the importance they place on trustworthy information. With arithmetic means of 4.4 and 4.5, formal accuracy (criterion 12) and accuracy in terms of content (criterion 13) received the two highest ratings of the survey. Executives currently see a problem with consistency (at 0.8, the largest design gap in the study) and reliability (design gap of 0.4). As a result, a fourth design issue can be defined here.

Effort

Cost and time adequancy served as the final rating criteria. The first was assigned an above-average rating (3.8), while the rating for time adequacy was average (3.5). The design gap of 0.4 for time adequacy suggests that delivering EIS projects on time is a greater issue in practice than keeping to budget; the design “gap” for cost adequacy is actually an inverse one (-0.2).
SYNTHESIS

The gaps of EIS design named by the executives thus create a paradox: on the one hand, they ask for comprehensive content to manage their companies; on the other, they want their EIS to be simple. Using the requirements criteria for EIS design within the chemicals, logistics, high-tech, and automotive supplier industries, our first instantiations led to twelve design principles ("P1-12")—clustered for each of the five design gaps of this paradox (Section 4).

5.1 Completeness: provide comprehensive, consistent, more objective and non-financial reference content for strategic leadership, capital market communication and regulatory compliance

Based on our instantiations, new-generation EIS must fulfill multiple functions: besides supporting strategic leadership—like their predecessors—they have the accessory objective of communicating the results to the capital markets. Regulatory compliance is a strong additional constraint.

P1: New-generation EIS is a multiple design task: besides supporting strategic leadership, communicating the results to the capital markets while ensuring regulatory compliance must be taken into account.

In our empirical study, two-thirds of the executives from financial companies named risk management as one of their current key projects. As the instantiations showed, the ongoing economic crisis means this trend has likely reached the industrial sector as well. In response, risk positions should be more strongly emphasized in EIS and company’s key performance indicators should have a clearer risk-assessment focus, including early-warning capabilities.

P2: Risk management will be an integrative aspect of new-generation EIS. More advanced EIS will supplement risk management with an early-indicator system.

Their growing operational involvement means that executives need more direct access to operational data—in addition to information essential to strategic leadership. A third principle can be phrased.

P3: EIS can be enhanced by drill-through capabilities to operational data.

5.2 Aggregation level and verifiability: information should be synthesized into a condensed standard reporting format with 4+1 information clusters and three layers of analysis

New-generation EIS should embrace more non-financial content than before (see evaluation criteria 3, Figure 1). As a consequence, business departments must be involved to a greater extent in the EIS design process. Information need analyses in particular will gain importance. In our study, executives mentioned financial and management accounting, compliance, and program management as relevant information clusters for comprehensive content. The instantiations through the economic crisis encouraged us to add cash and liquidity management. A fourth design principle can be phrased as.

P4: New-generation EIS should cover 4+1 information clusters: financial and management accounting, compliance and program management—as well as, at least temporarily due to the economic crisis, cash and liquidity management.

Existing reports often offer a flat number-by-number KPI overview. Our instantiations, in contrast, suggest using a hierarchical reporting structure with the most important KPIs at the top. An example from our chemicals case demonstrates such a structure: reporting could consist of a Corporate Portfolio with the most important three KPIs, a Corporate Dashboard with 20 KPIs in a one-page reporting structured in terms of the 4+1 clusters, and more detailed Corporate Analyses on a third level.

P5: Standard reporting within new-generation EIS should start with a graphical overview. A second level should present about 20 KPIs in a one-page report format. Finally, detailed analyses should enable deep dives into the aggregated metrics.
5.3 System handling: information should be presented in an user-friendly frontend interface design that makes accessing information and associated analyses easy

The majority of executives are not sophisticated IT users. As a result, they require a high-end frontend interface to access to the information the EIS provides. This leads to the following design principle.

P6: Executives’ acceptance of new-generation EIS is determined by user-friendly frontend interface design, not by “pure” technology issues such as server performance or storage capacity.

Tensions arise as divisions, used to seeing numbers presented a certain way, vie to retain control over preferred reporting formats. Based on our instantiations, easy-to-use system handling can be specified as a lack of switching among systems within the navigation and providing comments to help executives better understand the information.

P7: New-generation EIS must support executives in managing their companies with an “integrated” approach of IS design—including drill-through analyses, if required.

P8: Comments on the information delivered, definitions/glossaries, and other business metadata should highlight deviations, aid comprehension, and guide users to noteworthy points.

5.4 Flexibility and timeliness: periphery with ad hoc reports, nonroutine information, and direct links to upstream systems should complement the standard reporting

In practice many dashboards offer only a top-line view. In our instantiations, we identified three types for a flexible periphery that should complement standard reporting (Section 5.2): ad hoc reports, nonroutine information, and direct links to upstream systems. EIS that do not support such features will often lead to “in parallel” spreadsheet reporting. A ninth design principle can therefore be phrased as:

P9: New-generation EIS periphery should complement standard reporting with ad hoc reporting, access to nonroutine information, and direct links to upstream systems.

5.5 Accuracy: data should be correct in terms of format and content, with common data definitions and information logistics across the company

One reason for data inconsistency is differences in semantics. The instantiations showed that common data definitions across the company are currently the biggest issue. Information may sometimes be unreliable as well. Therefore, the lack of a continuous “information logistics,” especially missing validations between the various upstream systems, currently hinders EIS. These findings lead to the last two design principles.

P10: New-generation EIS design should contain definitions of the most important KPIs to manage a company—standardized across the organization.

P11: End-to-end data quality should be supported by an overall information logistics effort.

Executives were more interested in seeing EIS projects delivered on time than within budget. Our instantiations showed as follows.

P12: As a starting point for discussions with the client, predefined reports and analysis can help to accelerate the EIS project, especially in terms of information need analysis.

6 EVALUATION

Comparing the findings from our instantiations with the state-of-the-art suggests that the method on hand has the following advantages in terms of the constructional requirements mentioned in Section 2. Advantages over structural models are as follows:

- Handling of the requirements criteria is easier than structural models. Requirements can be used criterion-by-criterion to define a new-generation EIS. The same is true for evaluating existing IS.
Instead of using a significant sample size to define interdependencies between variables and IS success or technology acceptance, we asked just about 10 executives on management levels 1 to 3 in the course of our instantiations to define their needs for EIS design and their current status of IT support. The resulting list should be complete, at least distinct.

We ordered the criteria sequentially by following the structure of an information support process. An optional weighting of the criteria could offer an opportunity for more in-depth differentiation.

In addition, the requirements criteria can structure an as-is/to-be profile to visualize design gaps and focus on the most important ones—specified in terms of each evaluation criterion and traceable for third parties.

Compared with the requirements lists and practitioner approaches, the method at hand offers greater rigor, making a more systematic requirements analysis for executives’ IT support possible. Reflecting Arnott and Pervan (2008) that IS research is losing relevance, the advantages of this approach can be specified as follows:

- The principle of economic efficiency is an accepted design paradigm. It should provide a reliable starting point for EIS design. Deducing basic criteria, design criteria, and evaluation criteria from that principle is scientifically rigorous.
- Using information and IS characteristics from user satisfaction and technology acceptance models ensures that the principles will leverage the state-of-the-art.
- With the empirical study, the executives prioritized the relevant information and IS criteria from their business-driven perspective—thus helping to ensure relevance.
- A review of the existing instruments completed this picture and supports a gap analysis to focus on those issues in EIS design most important for executives.

However, at least one limitation exists in terms of scientific rigor: using ordinal-scaled evaluation criteria causes most of the complex statistical methods to drop out. The scoring model used here can only provide a ranking of the IS pattern to indicate directions for EIS design. Another limitation is that the evaluation entails some subjectivity (the flip side of not using huge samples).

7 OUTLOOK AND FUTURE RESEARCH

Based on the findings of an empirical study and four instantiations, we deduced twelve design principles for new-generation EIS. To link rigor with relevance, this article applied the principle of economic efficiency.

As executives’ task of managing a company expands due to economic crisis, a paradox for EIS design results. On the one hand, executives require more comprehensive content; on the other, they want their EIS to be simple. New-generation EIS must therefore synthesize information hierarchically and present it in a condensed format; easy-to-use system handling will largely determine their acceptance in this regard.

Looking ahead, we expect innovation in terms of design principles will continue. A younger management generation, familiar with state-of-the-art IT and willing to use IS in their day-to-day work, will be particularly interested. EIS could accelerate executives’ decision making by integrating individual desk research, joint problem solving in board meetings, and communication of information to execute decisions—tasks separated until now. For example, in the future, interactive surfaces could turn boardrooms into “management control centers.” Instead of “pure” paper-based reports, key analyses on the wall would create a “flip-chart” atmosphere for joint problem solving that encourages communication.

Our own future research will use an extended population (quantitative research) and additional instantiations (qualitative research) to determine the generalizability of the design principles developed here. Moreover, an empirical study is planned to identify executives’ working profiles in order to develop a situational approach to designing EIS to better meet executives’ individual needs.
References


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