Dissertation

Accounting-Based Decision-Making under Information Overload: Consequences and Potential Remedies

Heinrich Heine University Düsseldorf

Faculty of Business Administration and Economics

Maren Hartmann

2020

Table of Contents

A Research Framework

1. Background and Motivation

During the last few years, the amount of data to be processed has grown tremendously (e.g., Brown-Liburd, Issa, & Lombardi, 2015). This implies that decision-makers in corporations face ever-increasing amounts of information (e.g., Luft & Shields, 2010) that must be incorporated in strategic and operational decision-making. The terms "data" or "information" can generally refer to both relevant and redundant or irrelevant information; in a more specific context, information is often referred to as "data" when the information cues are irrelevant to the decision (e.g., Iselin, 1993). Data have become an important production factor, allowing for the creation of new business models or the improvement of corporate performance through a better understanding of markets and customers, as well as optimized business processes (Henke et al., 2016). Corporate performance management is increasingly based on integrating data from operative functions and financial information. In addition, businesses not only rely on internal data, but also integrate external data from various sources (Simons & Masamvu, 2014). Meanwhile, the business environment is undergoing major technological changes, for example with new technologies shaping the (management) accounting landscape. These changes range from increased data storage capacities and advances in business intelligence systems to a growing number of opportunities for increased automation of decision-making, for example, by making use of big data and artificial intelligence (e.g., Kelton & Murthy, 2016; Rikhardsson & Yigitbasioglu, 2018). All of these developments mean that accounting-based decision-making is currently undergoing major changes (e.g., Richins, Stapleton, Stratopoulos, & Wong, 2017).

These developments have implications for the accounting profession. A model proposed by Frey and Osborne (2017) rates the occupation "Accountants and Auditors" as automatable with a probability of 94%. However, Richins et al. (2017) argue that accounting professionals' skills will stay relevant if complemented by new analytical methods and supported by the necessary tools and environment to transform their role. Even though human decision-makers will not become obsolete in all fields in the short to medium term, human decision-makers will most likely need to interact more with the output of algorithms as opposed to calculating and structuring information themselves in the future (e.g., Richins et al., 2017). Nevertheless, it can be assumed that the way human information processing works and the continued relevance of the underlying factors influencing decision-making performance are relatively stable. Findings on how human decision-makers process accounting information will therefore continue to be relevant, even though the findings will need to be applied to the potentially different settings that (management) accountants and managers find themselves in.

In addition to the need to manage increasing amounts of data, decisions must be made faster to react to a constantly changing environment, leading to a bottleneck: while the requirements of processing information on an absolute and a relative level (in a given period of time) are increasing, human

information processing capacity is not. This makes the well-known phenomenon of "information overload" even more salient today than it has ever been since its first appearance in psychological literature more than sixty years ago (Miller, 1956). While the potential for putting the available data to productive use is undisputed, decision-makers also fear the potential negative impacts of information overload on decision quality (Economist Intelligence Unit, 2013).

While a detailed analysis of the causes and consequences of information load is subject of the papers of this dissertation, a short definition is helpful: In essence, information overload is best described as the negative consequences resulting from the input of an amount of information that exceeds the information processing capacity of the decision-maker. This topic has long been of interest to accounting researchers, one reason being that (management) accountants play a vital role as information providers in ensuring that decisions can be made as effectively and efficiently as possible. Accounting data present a key input factor for managerial decisions and decision-making by further stakeholders inside and outside the corporation (e.g., investors). The abundance of information cues available underlines the pivotal role of management accountants as decision facilitators (Sprinkle, 2003; referring to Demski & Feltham, 1976). Choosing the right quantity as well as the most relevant information cues is key to fostering decision-making quality.

The overall research question of this dissertation addresses the challenges formulated above: how can accounting-based decision-making be improved in an environment characterized by an ever-increasing amount of information?

The phenomenon of information overload has been researched from several perspectives: early conceptual papers focused on the psychological underpinnings of the phenomenon (e.g., Schroder, Driver, & Streufert, 1967), and empirical research has been conducted across a number of disciplines as summarized by Eppler and Mengis (2004), including consumer research (review articles by Malhotra, 1982; Meyer, 1998; Owen, 1992); Management Information Systems (MIS) research (review articles by Edmunds & Morris, 2000; Grisé & Gallupe, 1999; Nelson, 1994); organization science (Galbraith, 1974; Tushman & Nadler, 1978); and accounting (e.g., Schick, Gordon, & Haka, 1990). Within the accounting domain, most research on information overload can be clustered into the following research streams: early conceptual papers that analyzed the potential effects of changes in external accounting (e.g., Fertakis, 1969; Miller, 1972; Revsine, 1970; Wilson, 1973); empirical research dealing with the effects of aggregated versus disaggregated data on managerial decision quality (e.g., Barefield, 1972) and the effects of increases in information load on the quality of bankruptcy predictions (e.g., Casey, 1980; Chewning & Harrell, 1990; Iselin, 1993). Further articles have focused on a variety of management accounting topics, such as capital budgeting (Swain & Haka, 2000) and performance report analysis (Shields, 1980, 1983).

Despite the long history of information overload research in accounting, there are still a number of aspects where research is scarce. This dissertation concentrates on three of these aspects in particular. Firstly, from a conceptual perspective, to date there is no consistent framework that allows the effective categorization of the various variables and mechanisms relevant for information overload research in accounting (frameworks that are not specific to accounting but encompass several fields exist; e.g., Roetzel, 2019). Secondly, from an empirical angle, although information overload has been shown to negatively affect decision performance in a variety of settings, little empirical evidence is available as to how the negative effects can be mitigated by apt countermeasures. Thirdly, most empirical research has focused on input-output relationships, while neglecting the underlying information and decision-making processes that occur inside the decision-maker; however, a better understanding of these processes might contribute to improved decision-making.

2. Overview of Papers

This dissertation advances research in these three areas from a conceptual and empirical perspective. Paper 1 provides a framework and an overview of the most important variables and relationships by reviewing relevant literature on information overload research in the accounting domain. Papers 2 and 3 use an experimental approach to provide empirical evidence for selected aspects of the information overload problem. Sprinkle (2003) summarizes the benefits of experimental research: archival data or field data on individuals' decision-making processes within organizations are rarely easily available. Furthermore, these data risk providing a noisy measurement of the variables under investigation. Experiments are therefore the method of choice to investigate behavioral decision-making. Most importantly, experiments can shed light on cause-and effect relationships by manipulating and measuring the variables of interest in a controlled environment.

More specifically, the three papers contribute to the research question formulated above as follows:

Paper 1, "Information Overload Research in Accounting – A Systematic Review of the Literature," reflects the state of the accounting literature with regards to causes of, effects of, and countermeasures for information overload. A framework is presented that allows organizing extant research and can help to identify recurring themes, discuss conflicting results, and further a common understanding of terminology and variable measurement. The framework is largely based on Eppler and Mengis (2004) and complemented by variables relevant for human information processing, based on Libby and Lewis (1977). Clustered into "input" (e.g., the information set), "process" (e.g., decision-maker characteristics), and "output" (e.g., accuracy or consensus), these variables can be used to further detail and analyze the effects and relationships encountered in the articles reviewed. Literature directly or indirectly addressing the effects of increases of information load in the accounting domain from 1969–2016 serves as the basis for the review. To evaluate the strength of the relationships between variables, stylized facts are derived (e.g., Loos et al., 2011). The main findings are the following: most articles

have focused on external accounting, with financial distress prediction being the theme most frequently investigated. The effects observed were highly dependent on both the information input (relevant, irrelevant or redundant information), as well as the task that was employed (e.g., structured vs. unstructured) and the environment (e.g., influence of incentives). Furthermore, decision-maker characteristics seem to play a subordinate role, and self-insight into information use and decision accuracy seems rather limited. Opportunities for future research are derived, as well as implications for practice. These opportunities for future research refer to both the topics and the variables explored. While there has been a focus on external accounting and bankruptcy predictions, few research papers have explored the management accounting domain. The variables researched have focused largely on the causes and effects of increases in information load, while countermeasures have received less attention. In addition, research on process variables (e.g., applied decision rules), as opposed to input (e.g., number of information cues) and output (e.g., decision accuracy) variables, is relatively scarce. Papers 2 and 3, both set in the management accounting domain, aim to further address these research gaps: Paper 2 focuses on the effectiveness of countermeasures, and Paper 3 explores cue usage during the decision-making process.

More specifically, Paper 2, "Decision-Making in the Capital Budgeting Context – Effects of Type of Decision Aid and Increases in Information Load" experimentally investigated how modifications of the task via provision of different types of decision aids interacted with increases in data load in a structured capital budgeting task. The experimental task employed a 2x2 between-subjects design referring to differing decision aids ("capital budgeting manual" vs. "general principles") and data load ("low" vs. "high"). Subjects assumed the role of management accountants reviewing investment proposals. The experiment was conducted with 136 master's degree students participating in a course on management control systems at a German university in 2013. The experiment contributed to the learning objectives of the course and was not incentivized. While one group received a detailed, rules-based capital budgeting manual that provided clear cut-off rates as a decision aid, the other group was told to rely on generally accepted criteria for investment decision-making, namely net present value (NPV), payback period, and risk. The "data load" manipulation related to the amount of information in the investment proposals. The "low data load" manipulation only included relevant and very few irrelevant information cues, whereas the "high data load" investment proposals contained the same information cues plus a high number of irrelevant information cues. The main dependent variables were perceived task complexity, decision accuracy, and decision confidence. It was found that perceived task complexity increased with increases in data load. While there was only limited evidence of changes in decision accuracy attributable to the experimental manipulations, subjects who received the detailed capital budgeting manual were significantly more confident with their decisions. Based on these results, practical implications on how to provide decision-makers with decision aids for making capital budgeting decisions are derived.

Paper 3, "Information Overload Effects in Sequential Information Acquisition for Investment Decision-Making," also experimentally investigated structured decision-making, shedding light on the underlying information acquisition processes in an investment decision task when information was provided sequentially to the decision-maker. A computer-based experiment employing a process tracing methodology to record information acquisition was run at an experimental lab at a German university. The experiment employed a mixed design: information was provided at two points in time as the within-subject factor, and the amount of initial information was the between-subject factor ("high initial information load" and "low initial information load"). The experiment was conducted in 2015 and involved 66 economics and business students. They received a show-up fee of €4 and a performance-based bonus of up to €10. The experimental task, based on Hirsch and Volnhals (2012) and Volnhals (2010), asked subjects to rank six investment alternatives in the context of acquiring another company. Information was provided at two points in time and subjects ranked alternatives after each step. The "low initial information load" group received four attributes (i.e., performance indicators) per investment alternative (i.e., potential target company) in the first step and information for six additional attributes in the second step; the "high initial information load" group received 14 attributes in the first step of the decision and six additional performance indicators in the second step. Using an open-source computerized process-tracing methodology, "MouselabWeb" (www.mouselabweb.org, for an overview, see Willemsen & Johnson, 2011), the six additional attributes provided in the second step of the decision could only be seen when moving the mouse cursor over the respective fields. These actions were recorded in a database and allowed for tracking of the information acquisition process. The main dependent variables of interest were decision accuracy, decision confidence, and variables measuring the information acquisition process. The amount of information provided significantly impacted decision accuracy and decision confidence, which were lower for the "high initial information load" group. In addition, subjects who received a high number of information cues in the first step devoted less attention to the additional information cues presented in the second step. There was no indication of confirmatory search behavior, such as subjects paying more attention to information cues confirming their initial rankings. The findings contribute to an understanding of how the amount of information and timing of information provision influence decision quality and decision confidence. The following table summarizes the main characteristics of the papers described above.

Table 1: Overview of Papers

Paper	Title	Authors	Scenario	Research method	Research questions	Contribution
1	Information Overload Research in Accounting – A Systematic Review of the Literature	Maren Hartmann	Various judgment and decision-making scenarios in the accounting domain	Literature Review	Which are the main decision-making contexts and variables researched and how are they operationalized? Which stylized facts can be formulated from information overload research in accounting?	Provides a framework for information overload research in accounting Summarizes findings as stylized facts and evaluates strength of links between framework variables Derives implications for practice and future research
2	Decision-Making in the Capital Budgeting Context – Effects of Type of Decision Aid and Increases in Information Load	Maren Hartmann Barbara E. Weißenberger	Capital budgeting decision-making (review of investment proposals)	Classroom experiment 2x2 between-subjects design	How does an increase in data load impact decision-making in a structured task? Which type of decision aid is preferable and can decision aid design mitigate harmful effects of increases in data load?	Furthers understanding of how irrelevant information cues impact decision quality Provides insights into which type of decision aid is preferable

Paper	Title	Authors	Scenario	Research method	Research questions	Contribution
3	Information Overload Effects in Sequential Information Acquisition for Investment Decision-Making	Maren Hartmann Barbara E. Weißenberger	Investment decision-making (acquisition of another company)	Laboratory experiment Mixed design Computerized process tracing	How does an increase in information load impact decision accuracy, decision confidence and information acquisition when information is provided sequentially?	Provides insight into how the amount of information provided in the first step influences information use, decision accuracy, and decision confidence in the second step of a decision

3. Contribution

Returning to the original research question of how to improve accounting-based decision-making in an environment characterized by increasing information load, the contributions made within the three papers can be summarized from the following perspectives: What can be retained for practice? What are the contributions to theory? What are the implications for research methodology?

With regards to practice, the findings largely confirm the negative effect of increased information load on decision accuracy. However, it is important to note that outcomes are highly dependent on the type of task (especially with regards to task structure – Paper 1) and the type of information (e.g., relevant vs. irrelevant information cues, Paper 1). Decision aids help complete a given task with a higher level of decision confidence. Furthermore, decision aids reduce perceived task complexity (Paper 2), which can be considered a factor on the step to a decrease in decision accuracy. Paper 3 sheds light on the effects of increased information load in sequential decision-making, a subject that has not, to the authors' knowledge, been previously explored. Results suggest that the level of information load presented in a first decision stage influences information acquisition in the second stage. This implies that management accountants should consider not only the information in the current decision stage, but also information that may have been provided to a decision-maker in an earlier stage. With the exception of experience, previous research (see literature review, Paper 1) has provided little evidence of differences between individuals being a differentiating factor when it comes to information overload effects. This is supported by analyses in Papers 2 and 3, which did not (with some exceptions) find personality factors to have a significant influence on decision-making performance.

Overall, self-insight into the quality of one's decision is rather limited (see literature review in Paper 1). Therefore, information providers, such as (management) accountants, should exercise special care and reduce the information load to the necessary minimum – even adding irrelevant information can have negative impacts (Paper 2). This underlines the role of management accountants in assuring management rationality (Schäffer & Weber, 1999).

When it comes to theory, the framework allows the integration of findings from previous research into a holistic view (Paper 1). Application of the methodology of stylized facts (e.g., Loos et al., 2011) helps validate the theoretical links between causes of information overload, their consequences for process and output measures, and potential countermeasures to counteract these effects. Aside from special cases where increases in information load were modeled by data disaggregation, the positive link between increases in information load and decision time has been validated consistently through Paper 1. As expected, there also seems to be a rather negative link between increases in information load and decision accuracy, consensus, consistency, and calibration, as well as a rather positive link to the feeling of overload experienced by the decision-maker. Surprisingly, the link to a decrease in

decision confidence was often insignificant. While experience has a rather positive effect on decision accuracy, its effect on decision time is ambiguous.

With regards to research methodology, the literature reviewed in Paper 1 reveals a need to define the variables of interest (e.g., relevant vs. irrelevant information) and the task (e.g., structured vs. unstructured decision-making) clearly and narrowly and integrate findings from past empirical research. While experiments have always played a major role in researching individual decision-making (see Paper 1 for references), complementing experiments with process tracing methodology have, with the exception of Shields (1980, 1983) and Swain and Haka (2000), received little attention, despite being promising. Paper 3 contributes to further exploring this methodology for information overload research in accounting.

4. Limitations and Opportunities for Future Research

While findings enhance our understanding of information overload effects, there is still ample room for future research linked to the limitations of the papers cited above.

Firstly, student subjects were recruited for the two experiments. While often criticized, we argue that students, especially the business and economics students who were the subjects of our experiments, have the knowledge to successfully solve the problems at hand (e.g., Ashton & Kramer, 1980; Liyanarachchi, 2007). However, for different experimental settings that require specialist knowledge, this may not be the case, and non-student participants might make a better subject pool.

Secondly, while individual decision-making (as explored in the experiments of Papers 2 and 3) plays an important role in organizations (Bonner, 1999), our experiments fail to capture organizational factors that might influence decision outcomes or decision dynamics that might appear in groups. Therefore, further analyzing settings in a group or organizational context, for example through qualitative research methodologies such as case studies, would help shed light on mechanisms beyond the individual decision-maker.

Thirdly, the experiments explored structured decision-making, that is, problems with a clear right or wrong answer as described by Iselin (1989). These experimental tasks provided the advantage of allowing a direct measurement of decision accuracy as a dependent variable. However, complex problems in organizations are more likely to require unstructured decision-making. While unstructured decisions have been explored in a number of papers, they focused mostly on bankruptcy prediction tasks (e.g., Gadenne & Iselin, 2000; Rakoto, 2005)

Finally, major technological changes are currently occurring, and research on interaction with human decision-makers and resulting information use is still scarce (see e.g., Rikhardsson & Yigitbasioglu, 2018). While beyond the scope of this dissertation, exploring how organizations and individual decision-makers interact with new technology might offer a fruitful field for research.

References

Ashton, R. H., & Kramer, S. S. (1980). Students as surrogates in behavioral accounting research: some evidence. *Journal of Accounting Research*, *18*(1), 1–15.

Barefield, R. M. (1972). The effect of aggregation on decision making success: A laboratory study. *Journal of Accounting Research*, *10*(2), 229–242.

Bonner, S. E. (1999). Judgment and decision-making research in accounting. *Accounting Horizons*, *13*(4), 385–398.

Brown-Liburd, H., Issa, H., & Lombardi, D. (2015). Behavioral implications of big data's impact on audit judgment and decision making and future research directions. *Accounting Horizons*, *29*(2), 451–468.

Casey, C. J. (1980). Variation in accounting information load: The effect on loan officers' predictions of bankruptcy. *The Accounting Review*, *55*(1), 36–49.

Chewning, E. G., & Harrell, A. M. (1990). The effect of information load on decision makers' cue utilization levels and decision quality in a financial distress decision task. *Accounting, Organizations and Society*, *15*(6), 527–542.

Demski, J., & Feltham, G. (1976). *Cost determination: a conceptual approach*. Ames, Iowa: Iowa State University Press.

Economist Intelligence Unit. (2013). *The data directive: How data is driving corporate strategy - and what still lies ahead: An economist Intelligence Unit report.* Retrieved from https://eiuperspectives.economist.com/technology-innovation/data-directive/white-paper/data-directive

Edmunds, A., & Morris, A. (2000). The problem of information overload in business organisations: a review of the literature. *International Journal of Information Management*, *20*(1), 17–28.

Eppler, M. J., & Mengis, J. (2004). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines. *The Information Society*, *20*(5), 325–344.

Fertakis, J. P. (1969). On communication, understanding, and relevance in accounting reporting. *The Accounting Review*, *44*(4), 680–691.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, *114*, 254–280.

Gadenne, D., & Iselin, E. R. (2000). Properties of accounting and finance information and their effects on the performance of bankers and models in predicting company failure. *Journal of Business Finance & Accounting*, *27*(1–2), 155–193.

Galbraith, J. R. (1974). Organization design: An information processing view. *Interfaces*, *4*(3), 28–36.

Grisé, M.-L., & Gallupe, R. B. (1999). Information overload: Addressing the productivity paradox in face-to-face electronic meetings. *Journal of Management Information Systems*, *16*(3), 157–185.

Henke, N., Bughin, J., Chui, M., Manyka, J., Saleh, T., Wiseman, B., & Sethupathy, G. (2016). *The age of analytics: competing in a data-driven world.* Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20Sector/Our%20Insights/The%20age%20of%20analytics%20Competing%20in%20a%20data%20driven%20world/MGI-The-Age-of-Analytics-Full-report.pdf

Hirsch, B., & Volnhals, M. (2012). Information Overload im betrieblichen Berichtswesen: ein unterschätztes Phänomen. *Die Betriebswirtschaft*, *72*(1), 23–55.

Iselin, E. R. (1989). The impact of information diversity on information overload effects in unstructured managerial decision making. *Journal of Information Science*, *15*(3), 163–173.

Iselin, E. R. (1993). The effects of the information and data properties of financial ratios and statements on managerial decision quality. *Journal of Business Finance & Accounting*, *20*(2), 249–266.

Kelton, A. S., & Murthy, U. S. (2016). The effects of information disaggregation and financial statement interactivity on judgments and decisions of nonprofessional investors. *Journal of Information Systems*, *30*(3), 99–118.

Libby, R., & Lewis, B. L. (1977). Human information processing research in accounting: The state of the art. *Accounting, Organizations and Society*, *2*(3), 245–268.

Liyanarachchi, G. A. (2007). Feasibility of using student subjects in accounting experiments: a review. *Pacific Accounting Review*, *19*(1), 47–67.

Loos, P., Fettke, P., Weißenberger, B. E., Zelewski, S., Heinzl, A., Frank, U., & Iivari, J. (2011). What in fact is the role of stylized facts in fundamental research of business and information systems engineering? *Business & Information Systems Engineering*, *3*(2), 107–125.

Luft, J., & Shields, M. D. (2010). Psychology models of management accounting. *Foundations and Trends in Accounting*, *4*(3–4), 199–345.

Malhotra, N. K. (1982). Information load and consumer decision making. *Journal of Consumer Research*, *8*(4), 419–430.

Meyer, J. (1998). Information overload in marketing management. *Marketing Intelligence & Planning*, *16*(3), 200–209.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81–97.

Miller, H. (1972). Environmental complexity and financial reports. *The Accounting Review*, *47*(1), 31–37.

Nelson, M. R. (1994). We have the information you want, but getting it will cost you! *Crossroads*, *1*(1), 11–15.

Owen, R. S. (1992). Clarifying the simple assumption of the information load paradigm. *Advances in Consumer Research*, *19*, 770–776.

Rakoto, P. (2005). Caractéristiques de l'information, surcharge d'information et qualité de la prédiction. *Comptabilité - Contrôle - Audit*, *11*(1), 23–38.

Revsine, L. (1970). Data expansion and conceptual structure. *The Accounting Review*, *45*(4), 704–711.

Richins, G., Stapleton, A., Stratopoulos, T. C., & Wong, C. (2017). Big data analytics: Opportunity or threat for the accounting profession? *Journal of Information Systems*, *31*(3), 63–79.

Rikhardsson, P., & Yigitbasioglu, O. (2018). Business intelligence & analytics in management accounting research: Status and future focus. *International Journal of Accounting Information Systems*, *29*, 37–58.

Roetzel, P. G. (2019). Information overload in the information age: a review of the literature from business administration, business psychology, and related disciplines with a bibliometric approach and framework development. *Business Research*, *12*(2), 479–522.

Schäffer, U., & Weber, J. (1999). Sicherstellung der Rationalität von Führung als Aufgabe des Controlling? *Die Betriebswirtschaft*. *59*(6), 731–747.

Schick, A. G., Gordon, L. A., & Haka, S. (1990). Information overload: A temporal approach. *Accounting, Organizations and Society*, *15*(3), 199–220.

Schroder, H., Driver, M., & Streufert, S. (1967). *Human Information Processing*. New York, NY: Holt, Rinehard & Winston.

Shields, M. D. (1980). Some effects on information load on search patterns used to analyze performance reports. *Accounting, Organizations and Society*, *5*(4), 429–442.

Shields, M. D. (1983). Effects of information supply and demand on judgment accuracy: Evidence from corporate managers. *The Accounting Review*, *58*(2), 284–303.

Simons, P., & Masamvu, T. (2014). *Big data: Readying business for the big data revolution* (CGMA Briefing Paper). Retrieved from https://competency.aicpa.org/media_resources/206475-big-data-readying-business-for-the-big-data-revolu/detail

Sprinkle, G. B. (2003). Perspectives on experimental research in managerial accounting. *Accounting, Organizations and Society*, *28*(2–3), 287–318.

Swain, M. R., & Haka, S. F. (2000). Effects of information load on capital budgeting decisions. *Behavioral Research in Accounting*, *12*, 171–198.

Tushman, M. L., & Nadler, D. A. (1978). Information processing as an integrating concept in organizational design. *Academy of Management Review*, *3*(3), 613–624.

Volnhals, M. (2010). *Information Overload und Controlling: Analyse kognitiver Restriktionen bei der Wahrnehmung von Berichtsinformationen*. Hamburg, Germany: Kovač.

Willemsen, M. C., & Johnson, E. J. (2011). Visiting the decision factory: observing cognition with MouselabWEB and other information acquisition methods. In M. Schulte–Mecklenbeck, A. Kühberger, & R. Ranyard, *A* (Eds.), *A handbook of process tracing methods for decision research: A critical review and user's guide* (pp. 19–42). New York, NY: Psychology Press.

Wilson, D. A. (1973). A note on "environmental complexity and financial reports". *The Accounting Review*, *48*(3), 586–588.

B Information Overload Research in Accounting – A Systematic Review of the Literature

Author:

Maren Hartmann

Heinrich Heine University Düsseldorf

Information Overload Research in Accounting – A Systematic Review of the Literature

ABSTRACT

This paper reviews literature in the domain of information overload in accounting. The underlying psychological concepts of information load (as applied in accounting research) are summarized, and a framework to discuss findings in a structured way is proposed. This framework serves to make causes, consequences, and countermeasures transparent. Variables are further clustered into major categories from information processing research: input, process, and output. The main variables investigated are the characteristics of the information set, especially the number of information cues as an input variable; the experience of the decision-maker, the decision time, decision rule, and cue usage as process variables; and measures related to decision quality (i.e., accuracy, consensus, consistency) and related to self-insight (calibration, confidence, feeling of overload) as output variables.

The contexts of the respective research papers are described, and the operationalization of variables detailed and compared. I employ the method of stylized facts to evaluate the strength of the links between variables (number of links, direction and significance of relationship). The findings can be summarized as follows: most articles focus on individual decision-making in the domain of external accounting, with financial distress predictions constituting a large part of these. Most papers focus on input and output variables with the underlying information processing receiving less attention. The effects observed are dependent on the type of information input and the task employed. Decision accuracy is likely to decrease once information load passes a certain threshold, while decision time and a feeling of overload increase with increasing information load. While experience increases decision accuracy, the results on decision time are conflicting. Most articles have not established a significant link between changes in information load and changes in decision confidence. Relative cue usage, consensus, consistency, and calibration decline with increasing information load. Based on these findings, implications for practice and future research are derived.

Keywords: information overload, literature review, accounting, decision-making, information processing

JEL Classification: M41; D83; D91

1. Introduction

Information overload is a widely accepted phenomenon that has been researched across a number of disciplines. This article aims to conduct an in-depth review of information overload research in accounting. Eppler and Mengis (2004) and Roetzel (2019) have conducted comprehensive literature reviews in the field of management science. In addition, several research articles include extensive literature reviews, for example Schick, Gordon, and Haka (1990) and Hirsch and Volnhals (2012), which focus primarily on accounting-related topics. Nevertheless, a review of the current state of research into information overload in the accounting field seems warranted for the following reasons: this literature review focuses on accounting-related literature only. It thus takes a narrower stance on the literature to be included and goes into greater detail with regards to the causes and effects of information overload. This review aims to expand and detail the work done by Eppler and Mengis (2004) on accounting by including accounting-related literature that has been published since 2003 and accounting-related literature that was not included in their review. Inclusion of literature published later is beneficial as several changes have taken place. New technologies have shaped the accounting landscape (e.g., web-based reporting; Kelton & Murthy, 2016). Over the last few years, the amount of data to be processed has increased (e.g., Brown-Liburd, Issa, & Lombardi, 2015). As used here, the term "data" refers to both relevant and irrelevant information; sometimes irrelevant information cues are named "data," (Iselin, 1993). The problem of information overload is therefore also likely to have increased. On the other hand, new methods for dealing with increases in information load may have developed. Furthermore, new research methodologies have shed new light on some of the research questions. An updated view on the literature in the field of accounting thus seems warranted. Reviewing the literature, it is apparent that concepts and variables are not always operationalized in a harmonized way, for example with regards to what "information" means. A framework that clusters and defines the relevant variables and their interactions as presented in this paper – building primarily on Eppler and Mengis (2004) and Libby and Lewis (1977) – is therefore beneficial for future research in the field of information overload. The narrower focus and the more detailed framework allow the derivation of more specific implications for practice and implications for future research than it was the case in previous review articles. In addition, by employing the methodology of stylized facts (e.g., Weißenberger & Löhr, 2008), based on the number of papers finding significant relationships for the variables investigated, this review highlights the potential strength of the links proposed in the framework and further allows the identification of gaps and ambiguous relationships.

The first section describes the main concepts of information overload referred to in accounting literature. The main research topics in accounting and the methodology employed to identify the articles included in this review are outlined in the subsequent sections. Then, the conceptual framework is described. The findings from the analysis of the literature are then matched to the

respective parts of the framework, which serves as the basis for deriving implications for practice and directions for future research.

2. The Concepts of Information Overload in Accounting Research

This section gives an overview of the general concepts of information overload applied by accounting researchers, and provides a summary of the most relevant underlying models from cognitive psychology. The relevant parameters, especially concerning the definition of what constitutes information, are further detailed in the analysis section (6).

As summarized by Bonner (1999), important judgments and decisions are made based on accounting information. This happens in a system where producing, using, and auditing (including its evaluation) of accounting information are closely linked and where changes in one factor influence the behavior and decision outcomes of other actors, for example the outlooks given by financial analysts (Bonner, 1999). Furthermore, accounting information "constructs reality" – accounting for revenues or evaluating assets "constructs" their values (e.g., Hines, 1988). Therefore, accounting information and judgment and decisions based on that information play an important role in the functioning of organizations and the economy. However, judgments based on accounting information are often flawed, sometimes leading to a systematic deviation from optimal decisions, such as an overly optimistic forecast of financial earnings (Bonner, 1999; Schipper, 1991). As will be described in detail later, information overload can lead to decreases in decision-making effectiveness and efficiency, for example if the amount of information makes decision-makers process information in a sub-optimal way (e.g., Schroder, Driver, & Streufert, 1967). Thus, information overload can be one of the reasons why individuals make sub-optimal judgments or decisions.

To highlight the commonalities between the different concepts, information overload can be summarized as the (negative) consequences on either the process of information use and subsequent integration, and/or the objective or subjective judgment/decision/prediction quality, caused by a supply of too many information or data cues and/or limited time available. Data cues refer here to cues that are irrelevant to the decision at hand. When using the term "information load" or "information overload" in a general sense in this article, it is meant to encompass consequences that are caused by information or data cues, independent of their characteristics as relevant, irrelevant, or redundant for the decision problem at hand, as this is also the case in most research articles. For clarification, the terms and their implicit meanings are further discussed when describing the causes, particularly the information set (see 6.1.1).

In accounting research, two related concepts are applied to make predictions regarding the effects of increases in information load. The first concept primarily relates to individuals' processing capacity (e.g., Schroder et al., 1967), while the second highlights the time available for the information processing task (Schick et al., 1990). The two concepts are closely related: Tuttle and Burton (1999)

highlight the importance of the time dimension, noting that Schroder et al. (1967) also emphasize that information processing must be considered with reference to the time available. Schick et al. (1990) describe information overload as strictly related to the time at hand, occurring when "the demands on an entity for information processing time exceed its supply of time" (Schick et al., 1990, p. 215). Information load is thus measured as the time needed to process the information, while information processing capacity refers to the time available. In addition, the definition of information load is broadened by not only referring to information cues but also to all other input that individuals receive. Schick et al. (1990) split the necessary capacity to process such input into "processing demands on an individual's actual time to interact with others and perform internal calculations" (Schick et al., 1990, p. 204).

As summarized by Tuttle and Burton (1999), the most prominent model is that of Schroder et al. (1967), which describes the influence of increases in environmental complexity on information processing. In short, the model describes how information processing reaches an optimal state at a certain point of environmental complexity and then declines when environmental complexity increases beyond that point. This leads to the famous inverted U-curve, or bell-shaped curve, for the level of information integration, exemplified in Figure 1.

According to Schroder et al. (1967), levels of information processing refer to the abilities of groups or individuals to integrate the information cues at hand, where information processing is clustered into low integration structures (termed "concrete conceptual levels") or high integration structures (termed "abstract conceptual levels"). High integration structures can deal with complex patterns by differentiating, combining, and comparing information dimensions and adapting and developing new structures of information processing. Environmental complexity relates to properties of the environment, namely, considering the complexity of the information set, "information load, information diversity, and rate of information change" as so-called "primary properties" (Schroder et al., 1967, p. 31) or "secondary properties" such as rewards ("eucity") or threats ("noxity") associated with the task (Schroder et al., 1967, p. 32).

Focusing on the question of whether optimal information load differs between groups as suggested by Miller (1972), Wilson (1973) highlights the findings from Streufert and Schroder (1965). Figure 1 is based on Wilson (1973) and Streufert and Schroder (1965); it shows the levels of information integration for concrete and abstract conceptual levels for changing levels of information load. In Streufert and Schroder (1965)'s experiment, groups were formed of individuals who had achieved either very low or very high scores on tests to identify levels of conceptual abstractness. These groups were tasked with playing a tactical game (making decisions in relation to invasion of an island), receiving differing numbers of information cues. The graph depicts the number of integrations in task performance on the y-axis, depending on the information load (x-axis) for groups of people with concrete (lower curve), as well as abstract (higher curve) conceptual structures (Streufert & Schroder,

1965). Information integration is described as the number of decisions that are based upon each other: "For example, a decision to destroy enemy defensive positions through an air attack followed later by a landing at that point would be scored as an integration" (Streufert & Schroder, 1965, p. 135). While groups or individuals with concrete conceptual levels only reach lower levels of information integration, both curves reach an optimum at the same level of information load (Streufert & Schroder, 1965; Wilson, 1973). Schroder et al. (1967, p. 153) summarize the finding (also illustrated in Figure 1, below) as follows:

> In all experiments . . . the differential peaking hypothesis has not been upheld. In all cases, the curves appear to peak at the same point. That is, for concrete and abstract structures, the optimal environment . . . is the same.

Therefore, although individuals have different levels of conceptual abstractness, the level of environmental complexity that leads to the specific maximum level of information integration seems to be the same (Schroder et al., 1967; Streufert & Schroder, 1965; Wilson, 1973).

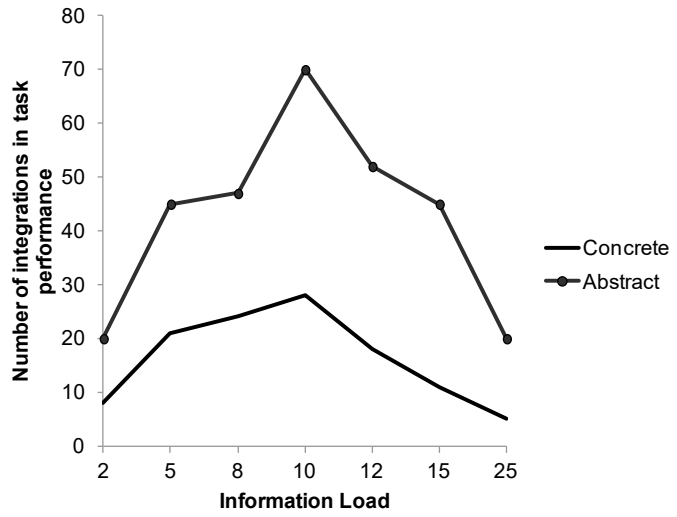


Figure 1: Number of Integrations Under Different Information Load Conditions

Note. Reprinted from "Conceptual structure, environmental complexity and task performance" by Streufert, S., & Schroder, H. M., 1965, *Journal of Experimental Research in Personality*, *1*(2), p. 135.

It is important to highlight that, without further knowledge of the characteristics of the information to be integrated, there is no definite link between the level of information integration and decision quality. The model suggests that individuals become better at creating more links and incorporating more information with increasing environmental complexity. However, if environmental complexity increases and the predictive value of the information stays the same, then individuals' information processing might be at a higher level, but without further benefit to decision effectiveness – even with the highest level of information integration, irrelevant or redundant information added cannot increase

decision quality. Vice versa, decision quality is not necessarily low when the number of information cues is low, if one considers the maximum possible decision quality that can be reached with the information at hand (see also Iselin, 1996). To illustrate the link between increases in the number of information cues and decision quality, Iselin (1996) depicts the link for three different information characteristics: the impact of relevant information cues on uncertainty reduction, relevant information cues (not yet considering their impact in reducing uncertainty for the problem at hand), and irrelevant information. Considering the effect of relevant information cues on reducing uncertainty for a given decision, decision quality should increase gradually, at some point reaching a plateau as additional cues only contribute incrementally to increased decision quality (Figure 2).

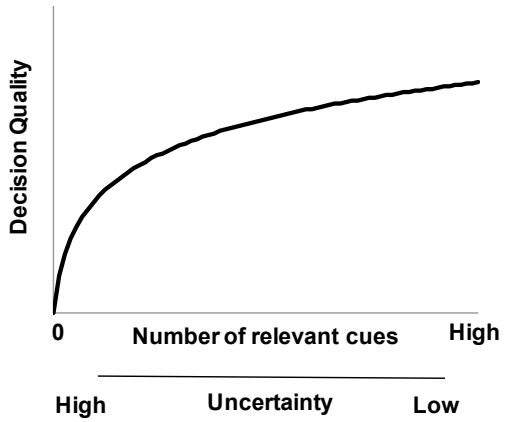


Figure 2: Effects of changes in the number of relevant cues decreasing uncertainty on decision quality

Note. Reprinted from "Accounting information and the quality of financial managerial decisions," by Iselin, E. R., 1996, *Journal of Information Science, 22*(4), p. 149.

Only considering relevant information cues without their effect on uncertainty reduction, decision quality declines after a certain point when the maximum information processing capacity is reached (Figure 3).

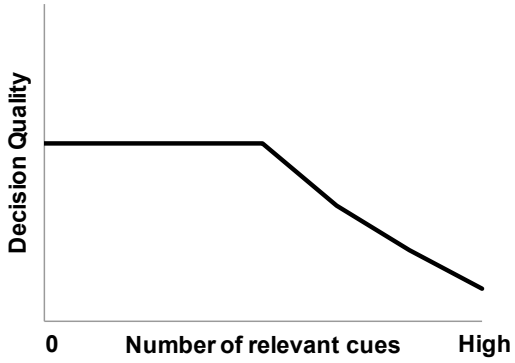


Figure 3: Effects of changes in the number of relevant cues on decision quality

Note. Adapted from "Accounting information and the quality of financial managerial decisions," by Iselin, E. R., 1996, *Journal of Information Science, 22*(4), p. 150.

Increases in the number of irrelevant information cues leads to a decline in decision quality from the first irrelevant information cue, as irrelevant information must be filtered out by the decision-maker, which requires additional processing capacity (see Figure 4). Iselin (1996) summarizes the trade-off as follows: while decision-makers should not be given irrelevant information, provision of relevant information cues needs to consider the trade-off between the associated increase in decision quality attributable to uncertainty reduction and the negative impact on decision quality due to the increasing number of information cues that need to be integrated in the decision.

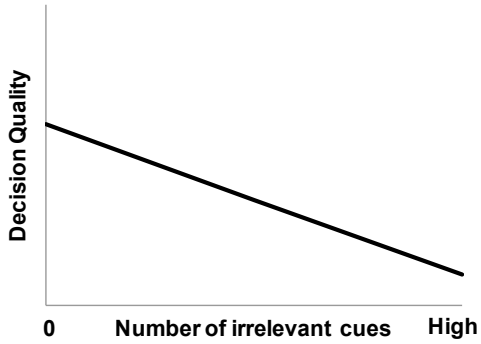


Figure 4: Effects of changes in the number of irrelevant cues on decision quality

Note. Reprinted from "Accounting information and the quality of financial managerial decisions," by Iselin, E. R., 1996, *Journal of Information Science, 22*(4), p. 151.

The model by Schroder et al. (1967) therefore is the basis for claiming that decision performance will decline beyond a certain point of environmental complexity. However, this model does not say that decision performance will necessarily be lower if environmental complexity is below a certain point (not considering the value of the information at hand). To summarize, even the most elaborate information processing structures are of no use for increasing decision quality if the input to be processed is irrelevant or additional information is redundant with regards to the information cues

already at hand. The distinction between relevant, irrelevant, and redundant information is further described in Section 6.1.1. A potential missing link between information integration and decision quality is similarly addressed by Snowball (1979), who refers to a potentially missing link between the "level of processing" and the "effectiveness of processing" (Snowball, 1979, p. 26) – outlining that accounting researchers should primarily investigate the impact of increases in information load on decision effectiveness.

Based on Schroder et al. (1967), Miller and Gordon (1975) argue that individuals can adapt their conceptual level and that higher environmental complexity can have a training effect in the long term. As such, while in the short term a decision-maker moves along a given curve, in the long term a decision-maker might move to a more abstract curve (i.e., the top curve in Figure 1). Miller and Gordon (1975), referring to Harvey, Hunt, and Schroder (1961) and Schroder et al. (1967) state that "the key long-run training variables which influence conceptual level are the diversity (complexity) and conflict induced over extended periods in the learning situation" (Miller & Gordon, 1975, p. 262). In addition, Miller and Gordon (1975) highlight that more abstract conceptual levels are not superior to more concrete conceptual levels as there are decision problems for which less abstract conceptual levels are better suited.

Models that address humans' limited information processing capacity make similar predictions with regards to information processing performance declining beyond a certain point of input, for example as highlighted by Tuttle and Burton (1999); Newell and Simon (1972); and the landmark article, "The magical number seven, plus or minus two," by Miller (1956). Such predictions are also made by models that assume a certain medium level of stress or arousal to be necessary to reach optimal performance (e.g., Eysenck, 1982; Berlyne, 1960). The latter models posit that when stress is too low, performance might suffer (Iselin, 1988). Citing Berlyne (1960), Iselin (1988) calls the reduced performance when performing simple tasks the "boredom effect" (Iselin, 1988, p. 151). Relating to the optimal amount of stress, both remaining below the optimal level and surpassing the optimal level can harm performance (e.g., Baumeister, 1984). In the field of behavioral economics, Ariely, Gneezy, Loewenstein, and Mazar (2009) demonstrate how high performance-based incentives can lead to decreases in performance. The other models named above (Miller, 1956; Newell & Simon, 1972; Schroder et al., 1967) do not explicitly state that a lack of stress in itself leads to inferior performance.

The concepts of information overload are closely related to models of task complexity (e.g., Wood, 1986) or cognitive load (e.g., Sweller, 1988). This is particularly relevant when interaction with further variables is investigated, for example in decision aid research (e.g., Rose & Wolfe, 2000; Rose, 2005). Task complexity is further described in the section describing the framework for analysis (6.1.2).

3. Main Topics and Literature Considered in this Review

While detailed elements of the articles reviewed are described later, the goal of this section is to give a broad overview of the general topics investigated. Information overload research in the accounting domain was first triggered by the question of how reporting of more (detailed) information in external reporting would affect users of this information; this was partially triggered by early initiatives to expand the information reported in external financial reports (e.g., as summarized by Snowball, 1979). The first conceptual papers were therefore concerned with applying research in psychology (notably the model by Schroder et al., 1967) to the accounting domain and describing how changes in information load might affect the readers of external reports (Fertakis, 1969; Miller, 1972; Revsine, 1970; Wilson, 1973). Researchers then continued to broaden the conceptual research to managerial decision-making (e.g., Ashton, 1974; Miller & Gordon, 1975).

The first empirical papers addressed the influence of aggregated vs. disaggregated data in the analysis of cost variances (Barefield, 1972), financial distress prediction (Abdel-Khalik, 1973), and operational management (Chervany & Dickson, 1974). Most empirical papers have addressed so-called "bankruptcy prediction tasks" or "financial distress prediction tasks" (see Table 1 for an overview), in which subjects are tasked with assessing a firm's financial health by analyzing financial ratios, statements, or further financial information (e.g., footnotes).

A number of papers have investigated the information search process by applying methodologies to track subjects' information acquisition processes, either in the analysis of performance reports (Shields, 1980, 1983) or in the capital budgeting domain (Swain & Haka, 2000). More recently, new technological developments have triggered additional research questions, notably addressing how new interactive presentation formats affect decision-making (Kelton & Murthy, 2016) or how "big data" influences decision-making in auditing (Brown-Liburd et al., 2015).

Table 1 provides an overview of the research included in this literature review in chronological order, stating the context analyzed in each paper and whether it is a conceptual or empirical article (similar to Schick et al., 1990). As indicated by Schick et al. (1990), some articles have investigated changes in information load indirectly, for example, not explicitly naming "information overload" as the research topic but manipulating information load by disaggregating data or by manipulating a related variable, such as uncertainty (Iselin, 1990). These articles are marked with an asterisk in the "method" column.

Papers can be organized into the categories below. The examples describe a typical research setting from the respective categories as an illustration, while not aiming to account for all specifics of the papers included in the respective category – the literature cited represents an example and does not aim for completeness:

1) The first category represents research that is concerned with how changes in external financial reporting affect users of financial statements ("external financial reporting"). A number of

papers address external financial reporting in general; these are largely conceptual papers that analyze the extent to which more detailed external reporting might influence financial statement users' decision-making. Others have more specifically investigated the following topics:

- Snowball (1980) investigated the quality of cash flow predictions dependent on varying information load in the footnotes of annual reports.
- Tuttle and Burton (1999) investigated stock price predictions based on a varying number of information cues.
- Chan (2001) investigated the effectiveness of graphs in mitigating the effects of increases in information load when predicting future operating margins based on historical data.
- Agnew and Szykman (2005) investigated (among other variables) the effects of changes in the number of available options in a retirement contribution plan on choice behavior.

2) The second category comprises research that has investigated how changes in information load affect financial distress or bankruptcy predictions ("financial distress prediction"). Papers in this section typically investigated subjects' judgment quality in making predictions on bankruptcy or financial distress for a number of firms, manipulating the number of financial indicators the subjects received to make their predictions.
3) The third category comprises research in the field of management accounting ("management accounting"). This covers several areas, including managerial decision-making:
    - Miller and Gordon (1975), conceptually analyzing the role and possible evolution of decision-makers' conceptual levels.
    - Swain and Haka (2000) investigated the effect of increases in information load on search patterns with KPIs used for capital budgeting decisions.
    - Shields investigated the influence of increases in information load on search patterns (Shields, 1980) or information supply and demand on judgment accuracy (Shields, 1983) by varying the number of KPIs and responsibility units in a performance report.
    - Barefield (1972) investigated whether aggregating performance measures, thus reducing the number of information cues in cost reports, influenced subjects' accuracy in judging whether labor was efficiently used.
    - Ding and Beaulieu (2011) investigated the effect of financial incentives on a mood congruency bias under two different levels of information load, operationalized as changes in the number of balanced scorecard measures as input for performance evaluation.

- Iselin (1989) investigated the effect of increasing information diversity by providing one group with additional information in an unstructured decision-making task in a market simulation.

4) The fourth category comprises research addressing how auditing is affected ("auditing"). Arnold, Collier, Leech, and Sutton (2000) investigated whether experience can mitigate bias under high information load in a going concern and an insolvency setting. Brown-Liburd et al. (2015) conceptually analyzed how big data, including potential information overload effects, could impact auditing.

As can be seen in Table 1 (column "Decision-Maker"), most research has addressed individual decision-making. Unsurprisingly, the most common research methodology is experimental research, experiments being the most powerful tool in investigating cause and effect relationships (e.g., summary in Sprinkle, 2003). The underlying psychological literature is not included in the table below.

Table 1: Overview of Papers Included in this Literature Review

ID	Paper	Context	Method	Decision-Maker
1	Fertakis (1969)	External financial reporting	Conceptual	Individual, (group)
2	Revsine (1970)	External financial reporting	Conceptual	Individual, (group)
3	Barefield (1972)	Management accounting: Analysis of cost variances	Empirical (experiment)*	Individual
4	Miller (1972)	External financial reporting	Conceptual	Individual, (group)
5	Abdel-Khalik (1973)	Financial distress prediction	Empirical (experiment)*	Individual
6	Wilson (1973)	External financial reporting	Conceptual	Individual, (group)
7	Ashton (1974)	External financial reporting and management accounting	Conceptual	Individual and organizational level
8	Chervany and Dickson (1974)	Management accounting: Operational decision-making	Empirical (experiment)*	Individual
9	Miller and Gordon (1975)	Management accounting: Managerial decision-making	Conceptual	Individual, (group)
10	Dickson, Senn, and Chervany (1977)[1]	Several experiments	Empirical (experiment)*	Individual
11	Benbasat and Dexter (1979)	Management accounting: Operational decision-making	Empirical (experiment)*	Individual
12	Snowball (1979)	External financial reporting and management accounting	Conceptual	Individual and organizational level
13	Casey (1980)	Financial distress prediction	Empirical (experiment)	Individual
14	Shields (1980)	Management accounting: Performance report analysis	Empirical (experiment)	Individual
15	Snowball (1980)	External financial reporting: Cash flow prediction	Empirical (experiment)	Individual

[1] The article summarizes findings from several experiments. Chervany and Dickson (1974) is part of the summary provided and is further analyzed for this review.

ID	Paper	Context	Method	Decision-Maker
16	Shields (1983)	Management accounting: Performance report analysis	Empirical (experiment)	Individual
17	Belkaoui (1984)	Financial distress prediction	Empirical (experiment)	Individual
18	Iselin (1988)	Management accounting: Capital budgeting (NPV calculation)	Empirical (experiment)	Individual
19	Iselin (1989)	Management accounting: Operational decision-making	Empirical (experiment)	Individual
20	Chewning and Harrell (1990)	Financial distress prediction	Empirical (experiment)	Individual
21	Iselin (1990)	Management accounting: Operational decision-making	Empirical (experiment)*	Individual
22	Schick et al. (1990)	General	Conceptual	Individual and organizational level
23	Iselin (1993)	Financial distress prediction	Empirical (experiment)	Individual
24	Stocks and Harrell (1995)	Financial distress prediction	Empirical (experiment)	Individual and group level
25	Iselin (1996)	General	Conceptual	Individual
26	Simnett (1996)	Financial distress prediction (auditing)	Empirical (experiment)	Individual
27	Stocks and Tuttle (1998)	Financial distress prediction	Empirical (experiment)	Individual
28	Tuttle and Burton (1999)	External financial reporting: Estimation of stock prices	Empirical (experiment)	Individual
29	Hwang and Lin (1999)[2]	Financial distress prediction	Empirical (meta review)	Individual
30	Arnold et al. (2000)	Auditing	Empirical (experiment)	Individual
31	Gadenne and Iselin (2000)	Financial distress prediction	Empirical (experiment)	Individual
32	Swain and Haka (2000)	Management accounting: Capital budgeting	Empirical (experiment)	Individual

[2] Selected articles included in the meta review are considered in this review, the meta review as such is not considered in further analysis.

ID	Paper	Context	Method	Decision-Maker
33	Chan (2001)	Management accounting: Prediction of operating margin	Empirical (experiment)	Individual
34	Rose, Roberts, and Rose (2004)	Recall of financial ratios (investment decisions)	Empirical (experiment)	Individual
35	Agnew and Szykman (2005)	External financial reporting: Investment decisions	Empirical (experiment)	Individual
36	Rakoto (2005)	Financial distress prediction	Empirical (experiment)	Individual
37	Ding and Beaulieu (2011)	Management accounting: Performance Evaluation	Empirical (experiment)	Individual
38	Hirsch and Volnhals (2012)[3]	Management accounting: Capital budgeting	Empirical (experiment)	Individual
39	Brown-Liburd et al. (2015)	Auditing	Conceptual	Individual
40	Kelton and Murthy (2016)	External financial reporting: Investment decisions	Empirical (experiment)*	Individual

4. Methodology of Analysis

To identify research articles that address information overload in accounting, a methodology similar to that applied by Eppler and Mengis (2004), who based their methodology on Webster and Watson (2002), was used. Webster and Watson (2002) propose identifying the relevant literature to be included by starting with a set of relevant papers and looking at references cited as well as forward-citations. In the field of accounting, Eppler and Mengis (2004) and Schick et al. (1990) provide very helpful starting points for the compilation of the landmark articles for the time periods from 1970 to 2003. The articles included in their review of the accounting literature thus serve as the basis. To further advance completeness, similar to Eppler and Mengis (2004), the Business Source Premier database within EBSCO served as a further source for potential papers to be included. As in Eppler and Mengis (2004), an initial broad selection was made by searching for papers that included either "information load," "information overload," "cognitive load," or "cognitive overload" in either title or abstract, restricted to only include peer-reviewed journals.

[3] Throughout this review, I continue to refer to the published article by Hirsch and Volnhals (2012), which is based on Volnhals (2010).

The papers identified were then screened to determine whether information overload was the main topic of the article (similar to Eppler & Mengis, 2004) and then screened for those that were related to accounting topics. "Related to accounting" is for the purpose of this paper defined as research that focuses on any form of interaction with accounting information. This can include papers in the realm of external accounting, management accounting, auditing, tax, individual investment decisions (stock markets), or capital budgeting decisions. The analysis of the papers identified resulted in a number of additional papers that were, if relevant, included as well. This resulted in a total of 40 articles that have been reviewed for this article, excluding those articles that describe underlying psychological mechanisms, such as Schroder et al. (1967), and articles dealing with overarching models of task performance (e.g., Bonner, Hastie, Sprinkle, & Young, 2000; Bonner & Sprinkle, 2002). Table 1 gives an overview of the relevant articles. As suggested by Webster and Watson (2002), this review article neither focuses on a specific region or time period, nor on a pre-specified selection of journals, but rather attempts to attain completeness by including peer-reviewed scientific articles that address the concept of information overload in the accounting domain.

As will be seen later in this review, not all variables have been investigated with similar intensity. While some links have received considerable attention, others have been investigated less frequently. In addition, some links are rather unambiguous with similar cause-effect relationships in the papers reviewed, while for other links, results point in differing directions. What has come to be known as the replication dilemma (e.g., Schooler, 2014) also seems to apply for research in the information overload context. To account for the different levels of empirical validation, the methodology of "stylized facts" was applied. Stylized facts can be considered a common ground based on current empirical knowledge: "Stylized facts are broad, but not necessarily universal generalizations of empirical observations and describe essential characteristics of a phenomenon that call for an explanation" (Heine, Meyer, & Strangfeld, 2007, p. 583).

Loos et al. (2011) summarize the methodology of stylized facts, which was initially coined by Kaldor (1961): the methodology of stylized facts lies between a review and meta-analysis. Unlike a literature review, it includes only empirical findings. Unlike a meta-analysis, it is less restrictive with regards to similarity of content of the studies or empirical methodology employed and therefore allows for a broader consideration of the subject. Based on Weißenberger and Löhr (2008), Schwerin (2001), and Oppenländer (1991), Loos et al. (2011) summarize three requirements for the formulation of stylized facts: stylized facts must be important for the research question at hand; they should hold irrelevant of the underlying theory or research methodology; and they should not only be based on one observation, but should rely on findings that are observable multiple times.

There is no generally agreed threshold for classification of a finding as a stylized fact (Weißenberger & Löhr, 2008). Therefore, there is an element of subjectivity that makes it especially important to make the process of generating the stylized facts transparent (e.g., Heine et al., 2007; Weißenberger & Löhr, 2008). For this review we use the following clusters, only considering effects that have been analyzed by a minimum of two articles:

1) ++: clear positive link: dominance of positive, significant relationships
2) +: rather positive link (e.g., one positive, one insignificant)
3) O: tested, but no significant results
4) ?: contradictory results
5) -: rather negative link (e.g., one negative, one insignificant)
6) --: clear negative link: dominance of negative, significant relationships

5. Framework for Analysis

To effectively analyze the literature and formulate well-structured implications, a framework serves to cluster the variables and their respective interactions encountered in the research reviewed. The framework combines relevant elements from the framework proposed by Eppler and Mengis (2004), research on information processing in accounting (Libby & Lewis, 1977), and the model on task performance by Bonner et al. (2000) and Bonner and Sprinkle (2002). Figure 5 below illustrates the framework that will be used in this review to categorize the findings on information overload effects in accounting-based decision-making.

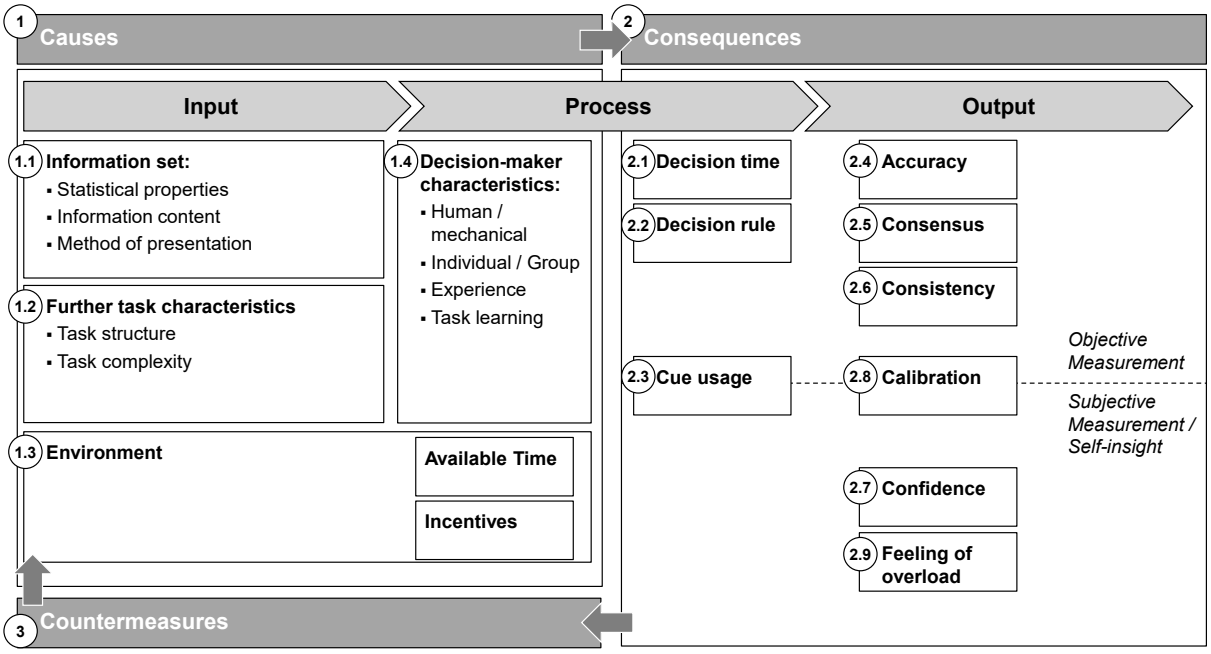


Figure 5: Framework for Analysis of Information Overload

The overarching structure is borrowed from Eppler and Mengis (2004). They focus their synthesis around the three elements "causes," "consequences" (termed "symptoms" by Eppler & Mengis, 2004),

and "countermeasures," highlighting the fact that it is not a one-dimensional or one-directional relationship – changing one of the elements (e.g., applying a countermeasure) might affect other elements in the relationship. Eppler and Mengis (2004)'s approach resembles that of Bonner (1999), as it establishes a framework around causes, consequences (or "deficiencies" in Bonner, 1999), and countermeasures (or "remedies" in Bonner, 1999). Generally speaking, causes are the independent variables investigated, while consequences are the dependent variables investigated. Countermeasures can either be directly researched as independent variables or are implied in the discussion section of the articles. Countermeasures can be effective when addressing the causes of information load, and their analysis is thus structured in the same way as the causes for information overload (Eppler & Mengis, 2004).

Libby and Lewis (1977)'s model is very useful for further structuring the relevant variables that are used to investigate the described causes, consequences, and countermeasures. Libby and Lewis (1977) categorize the parameters of their model into input, process, and output parameters, where input variables of interest consist of the information set that is being used. According to Libby and Lewis (1977), the process describes the characteristics of the "judge", differentiating between judge characteristics and characteristics of the decision rule. The judge refers to the person or "mechanical" judge making the decision. The concept of a mechanical judge is only relevant for few papers reviewed here (Gadenne & Iselin, 2000; Simnett, 1996) but is of potential interest for future considerations of the automation of decision-making. Instead of "judge," the term "decision-maker" will be used here. The output variables in Libby and Lewis (1977) refer to "judgment – prediction – decision," whereby the variables of interest are "qualities of the judgment" and "self-insight."

Input parameters appear as "causes" in the framework and are clustered into characteristics of the information set, further task characteristics, and environmental variables. Process parameters are relevant to both the "causes" and the "consequences" section. Decision-maker characteristics, such as experience, are considered to be potential causes, whereas decision time, cue usage, and the decision rule applied are considered consequences of increases in information load for the purposes of this review. In her commentary on judgment and decision-making research in accounting, Bonner (1999) also categorizes the variables of interest referring to input, process, and output variables. The categorization of the respective parameters differs slightly from that of Libby and Lewis (1977), however. One example is the following: while Libby and Lewis (1977) consider person variables, such as the knowledge the decision-maker applies a parameter that refers to the "process," Bonner (1999) considers this to be an input parameter. The categorization employed here, that sees decision-maker characteristics as a cause, aligns with the view that person variables are "input" or independent variables, as described by Bonner (1999).

Consequences of information load can be measured both on an objective and subjective level, for example via self-reports by subjects. Libby and Lewis (1977) term these "self-insight." Self-insight

can also relate to perceptions of the information set. With regards to process variables, in the research reviewed here, decision time and decision rules employed have been measured objectively.[4] Cue usage can be measured on both an objective and a subjective level. Accuracy, consistency, and consensus are measured on an objective level, while decision confidence and the feeling of overload are subjective measures. Calibration is measured by combining objective measures (in general, accuracy) with subjective measures (in general, confidence).

Eppler and Mengis (2004) equally organize causes and countermeasures by "personal factors," "information characteristics" and "task and process parameters." However, they add "organizational design" and "information technology." Information overload research on decision-making in accounting, with few exceptions (see Table 1), mainly addresses individual decision-making, for which an organizational setting would set the frame. I therefore include organizational design under the cluster "environment." Similarly, in the papers reviewed, "information technology" either changes the task or the presentation format and thus is included under these clusters respectively (e.g., Kelton & Murthy, 2016). Eppler and Mengis (2004) categorize consequences of information overload into the following clusters: "limited information search and retrieval strategies," "arbitrary information analysis and organization," and "suboptimal decisions." According to Libby and Lewis (1977), suboptimal decisions are a consequence of the input and process variables. As such, "limited information search and retrieval strategies" and "arbitrary information analysis and organization" would be considered variables that describe the process and then possibly entail suboptimal decisions in the framework described above.

Not every element from the models cited above is depicted in the framework (Figure 5). I concentrate on the main variables that are investigated. The framework serves as a schematic overview covering the main aspects and does not claim completeness, neither of all possible variables, nor of all interactions between variables (which are described in detail in the analysis section).

I also deviate from Libby and Lewis (1977)'s model by assigning decision time to "process," whereas Libby and Lewis (1977) consider decision time an attribute of decision quality. Benbasat and Dexter (1979) note that there is often a trade-off between decision quality and decision time, for example in Chervany and Dickson (1974). For the purpose of investigating information overload, it makes sense to consider decision time as an antecedent to output variables such as accuracy, consistency, and consensus. As explained below, decision time can in turn influence output variables. The placement of the decision rule to be employed also needs some further explanation: while Libby and Lewis (1977) consider the decision rule a personal characteristic, I prefer to describe the decision rule separately:

[4] Theoretically, decision time and decision rules could also be investigated by subjective measures. As this is not the case for the papers reviewed here, the two variables are included in "objective measurement."

although it is clearly related to the person, it does not need to be considered as invariable. Whereas available time is to be considered as a cause, decision time is a consequence.

The variable "feeling of overload" or a similar concept has been investigated in a number of articles (Agnew & Szykman, 2005; Gadenne & Iselin, 2000; Hirsch & Volnhals, 2012; Iselin, 1993; Kelton & Murthy, 2016). It is not addressed by Libby and Lewis (1977) directly, but it can be considered a sub-aspect of self-insight. Libby and Lewis (1977) describe task characteristics as "context" of the information set. As the task at hand plays an important role in the effects of increases in information load, "further task characteristics" are considered a separate category in the framework employed here.

Although the main objective of Bonner et al. (2000) and Bonner and Sprinkle (2002) was to build a conceptual framework to explain how monetary incentives effect task performance, the general parameters in their framework can serve as an addition to the variables already described above and help further classify research on information load.

The following section summarizes the main findings from the papers reviewed, focusing on empirical articles. Each section describes what is understood by the respective variable and its manipulation (independent variable) or measurement (dependent variable). With regards to the main effects investigated in the papers reviewed, the summary includes significant and insignificant results; interaction effects are only described when they are significant.

6. Analysis of the Literature

6.1. Causes

6.1.1. Information Set

Naturally, the most obvious cause of information overload is an increase in the amount of "information." However, what is understood by "information" must be further defined. As will be seen in this review, an increase in the number of "information cues" can lead to a variety of consequences, both at the processing stage and at the output stage, depending on what the characteristics of the information set (among other factors) are.

In the model proposed by Libby and Lewis (1977), the characteristics of the information set are categorized into several clusters. The aspects that are especially relevant for describing the information set in the context of this literature review are summarized below (Figure 6). Some characteristics of the Libby and Lewis (1977) model have not been explicitly investigated in the articles dealing with information load and therefore are not included in Figure 6; these characteristics are "scaling characteristics of individual cues," for example whether a cue's measurement is ordinal or nominal. Rather than being considered within the "information set" section, for this review, the characteristics mentioned for the context of the information set ("physical viewing conditions," "instructions," and

"feedback") are considered in the "environment" section (see 6.1.3) while "task characteristics" are described in the "further task characteristics" section (see 6.1.2).

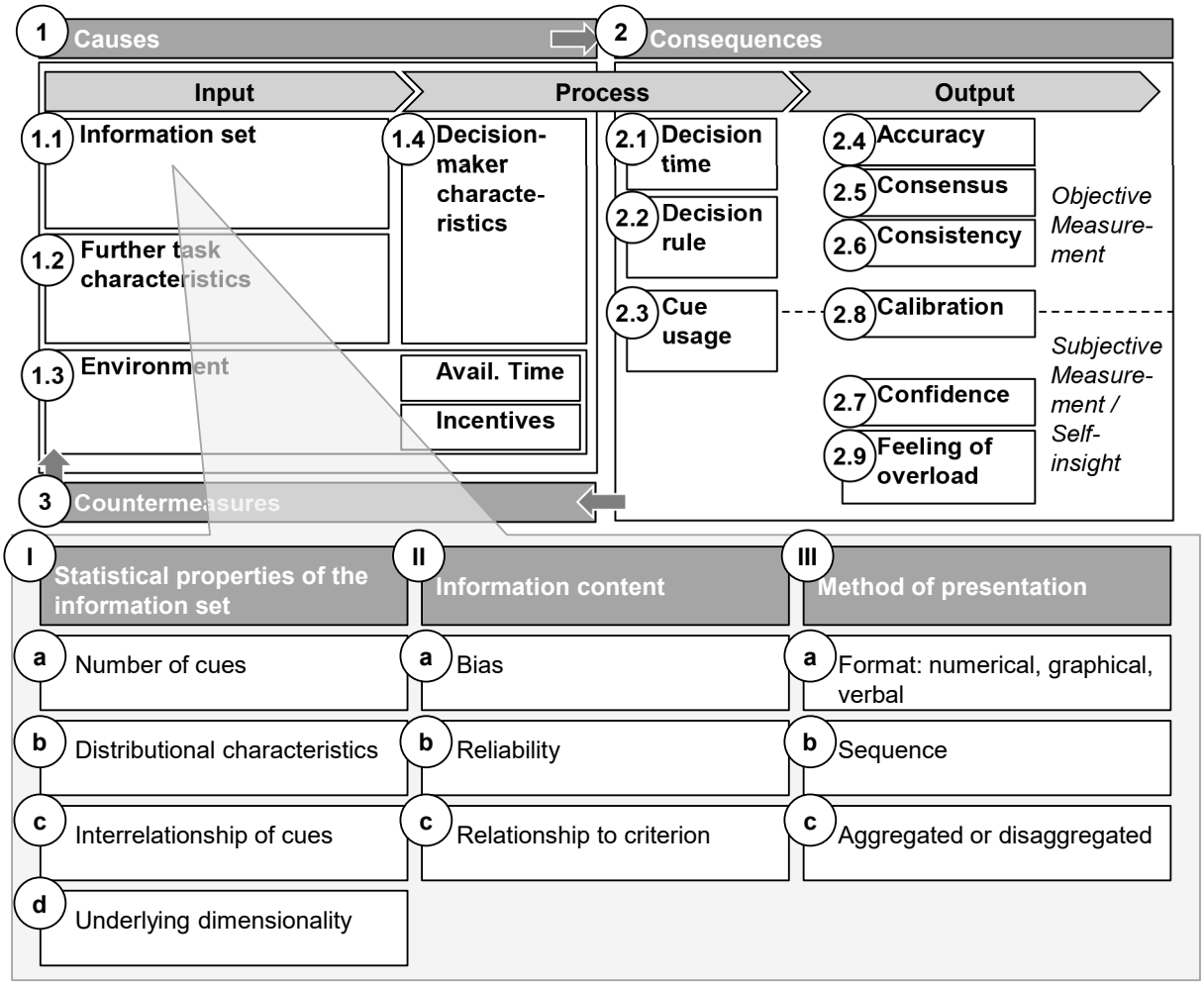


Figure 6: Characteristics of the Information Set

Note. Parts are adapted from "Human information processing in accounting: The state of the art," by Libby, R. & Lewys, B.L., 1977, *Accounting, Organizations and Society, 2*(3), p. 247.

Research into information load has typically investigated a combination of the characteristics (Libby & Lewis, 1977), for example changing the number of cues by presenting either aggregated or disaggregated data, or increasing the number of cues when the cues are uncorrelated with those already present ("relationship to criterion"). Not all studies explicitly describe which elements are changed; in this case, they are inferred from the description in the articles where possible. In addition, manipulating one aspect sometimes affects other aspects as well, for example, data aggregation is likely to affect the information content. This section aims to present the major clusters.

I: Statistical Properties of the Information Set

I.a. Looking at the statistical properties of the information set, the most evident element in information load research is the number of cues. A change in the number of cues is of interest in all research articles dealing with information load. An exception are the articles that imply information overload to be present (e.g., Kelton & Murthy, 2016, or the second experiment in Ding & Beaulieu, 2011) or those that trigger information overload effects by restricting the time (Hirsch & Volnhals, 2012; Snowball, 1980)

I.b. Distributional characteristics are most often termed "uncertainty." Iselin (1990) manipulated uncertainty by changing the variability of the data over time periods. Uncertainty, as best described by variability, is to be differentiated from a cue's potential to reduce environmental uncertainty (see "relationship to criterion" below).

I.c. Interrelationship of cues is referred to by Libby and Lewis (1977) more narrowly as redundancy. In this review, redundancy is described in detail, together with "relationship to criterion" (to explain the link to relevance, see II.c). In a wider sense, similarity can be considered an aspect of interrelationship of cues – Agnew and Szykman (2005) analyzed the effect of similarity of investment options on the feeling of information overload.

I.d. Underlying dimensionality is operationalized in several ways. A similar term used in this context is "information diversity" (e.g., Iselin, 1988, 1989). Studies applying the model by Schroder et al. (1967) to accounting have highlighted that the amount and diversity of information may lead to an increase in environmental complexity (Fertakis, 1969; Revsine, 1970). Iselin (1988, 1989) investigated the effects of increasing information diversity, defining information diversity as the number of different dimensions in an information set. Adding an additional performance indicator (e.g., adding information for earnings before interest and taxes to the information set that might until then consist of net sales and gross profit) is thus defined as adding a new dimension, whereas the value of that performance indicator for another time period (e.g., not only looking at net sales for the years 2000–2005 but for the years 2000–2006) is called a "repeated dimension." Shields (1980, 1983) differentiated between adding organizational units or performance indicators to the information set. Similarly, Swain and Haka (2000) differentiated between adding investment alternatives and adding additional performance indicators, which they term dimensions.

II: Information Content

II.a., II.b.: Two elements of information content, namely bias (systematic error; Libby & Lewis, 1977) and reliability (random error; Libby & Lewis, 1977) in the data set are not of interest in the research of information overload in accounting – there are no research papers that have manipulated these characteristics.

II.c. The most important aspect of the information content cluster is the aspect "relationship to criterion." This refers to the predictive ability of the cue with regards to a specific event. Summaries can be found in Libby and Lewis (1977) and Belkaoui (1984).

Relevance and redundancy are the two key terms when it comes to describing the relationship to criterion within information load research. Relevance refers to the predictive ability of a cue. Cues that have no predictive ability for the respective event are irrelevant. Relevance is typically measured by looking at the significance of coefficients in a regression model (e.g., Gadenne & Iselin, 2000) or based on expert judgments (Casey, 1980).

Redundancy refers to the cue's correlation with other cues in the information set. It therefore describes both a form of interrelationship of cues (Libby & Lewis, 1977) and relationship to criterion. As summarized by Rakoto (2005), redundancy can thus only be determined by considering at least two cues in conjunction. If a cue added to the information set is (highly) correlated with another cue, it is considered redundant. The predictive ability of the information set therefore does not increase when redundant cues are added. Redundancy is typically measured by the correlation coefficients between cues (e.g., Belkaoui, 1984; Rakoto, 2005). It is important to note that the concepts of relevance and redundancy are independent: a cue can be relevant and redundant at the same time (or neither of the two). However, if a cue is redundant with regards to another relevant cue, it is also relevant.

Often, the term "data load" is used to describe irrelevant data (e.g., Iselin, 1993). Gadenne and Iselin (2000) define data load as the total number of cues minus the number of the relevant cues, considering a cue irrelevant that does not have any predictive ability with regards to the event to be predicted. Iselin (1993) considers a cue as data load when the correlation with another cue is larger or equal to 0.85, indicating redundancy. This article focuses on the terms "relevance" and "redundancy" to ensure unambiguous wording.

A term that is related to relevance is the term "uncertainty", meaning the cue's potential to reduce uncertainty with regards to the decision at hand. Only relevant information can objectively reduce uncertainty. Uncertainty is then measured by "one minus the coefficient of environmental predictability" (Iselin, 1993, p. 258). Iselin (1993) and Gadenne and Iselin (2000) explicitly investigated changes in uncertainty. As noted above, uncertainty refers to the uncertainty around predicting an outcome, not to uncertainty in the variability of information cues (see "distributional characteristics" above).

Most studies address an increase in relevant information. This is true for most financial distress prediction studies[5] and for studies that have employed a highly structured decision task requiring the

[5] With the exception of Rakoto (2005), who investigated the effect of both an increase in relevant and redundant data, and Belkaoui (1984), who investigated the effect of adding redundant data.

inclusion of all cues presented to attain the optimal solution (e.g., Iselin, 1988; Tuttle and Burton, 1999; Hirsch & Volnhals, 2012). Effects of increases in redundant data have been explicitly investigated by Barefield (1972), Belkaoui (1984) and Rakoto (2005). Referring to the conceptual model by Schroder et al. (1967), the differentiation between relevant, irrelevant, and redundant data can be considered as creating a link between increased information integration and increased decision quality: Adding redundant or irrelevant cues may increase information integration, but, as the information content does not increase, the decision quality will only increase as much as is warranted by integration of relevant cues already present.

Increases in the amount of irrelevant data have been investigated by Gadenne and Iselin (2000), Iselin (1993), and Rakoto (2005). Some researchers argue that a lack of significant effects of increased information load is due to the addition of redundant data or subjects perceiving the data as redundant or irrelevant (Snowball, 1980).

III: Method of Presentation

III.a. With regards to the "format" of information presented, most studies have used numerical data. However, some financial distress prediction studies have used "top 1/3 of the industry", for example Chewning and Harrell (1990) or Stocks and Tuttle (1998) or use verbal characteristics such as "weak" or "favorable" (Tuttle & Burton, 1999). The paper by Snowball (1980), who adds footnotes (thus including verbal cues) as well as the paper by Chan (2001), who investigates numerical (tables) vs. graphical presentation are further examples of differing methods of presentation.

III.b. "Sequence" has not been explicitly investigated in the articles analyzed for this review.

III.c. Aggregated or disaggregated data are also termed a "precombination of data" by Libby and Lewis (1977). The precombination of data (or the contrary, decomposition of data) was the focus of early conceptual papers (e.g., Fertakis, 1969; Miller & Gordon, 1975; Revsine, 1970) and a number of empirical studies (e.g., Abdel-Khalik, 1973; Barefield, 1972; Chervany & Dickson, 1974; Kelton & Murthy, 2016). It is important to note that the methods of aggregation and disaggregation differ markedly between the papers, for example calculating variances (Barefield, 1972), adding up data (Abdel-Khalik, 1973; Kelton & Murthy, 2016), and calculating statistical measures (mean, variation coefficient, range, maximum value; Chervany & Dickson, 1974). Swain and Haka (2000) aimed to add performance indicators by disaggregating data without changing information content. Different aggregation methods are likely to influence information content; the method of aggregation therefore must be taken into account when interpreting the resulting effects. As will be seen in later sections (6.2), the consequences of varying the number of information cues by aggregating or disaggregating differ notably from simply increasing or reducing the number of information cues.

6.1.2. Further Task Characteristics

One way to investigate the influence of task characteristics is to compare different tasks against each other, making a change in task characteristics the independent variable. An example could be comparing performance in a structured decision-making task with performance in an unstructured decision-making task (more details regarding structured and unstructured decision-making can be found below). While such a setting cannot be found among the articles reviewed here, it can be argued that some aspects of manipulations in an experimental design implicitly lead to changes in task characteristics. Even if task characteristics are not explicitly manipulated in the literature reviewed, it is still important to consider the nature of the task being investigated – task characteristics, especially task complexity, are likely to influence how changes in further variables (e.g., possible reduction of the effect of experience or learning) affect task performance (Bonner et al., 2000; Bonner & Sprinkle, 2002). Thus, considering task characteristics is essential when analyzing and comparing results.

According to Wood (1986), task complexity consists of three components: component complexity, which depends on the amount of information and steps needed to perform a task; coordinative complexity, which describes the relationship between input and output of a task; and dynamic complexity, which is present when the form of the relationship between input and output changes. While the former two dimensions are relevant in the context of information overload research, dynamic complexity is less important – in experiments, the relationship between task input and task output rarely changes (Bonner et al., 2000). Research that considers the effects of aggregation or disaggregation of accounting information and therefore implicitly changes information load (e.g., Barefield, 1972) is likely to result in changes in task complexity.

As Iselin (1988), referring to Mason and Mitroff (1973), highlights, an important aspect is the divide between structured and unstructured decision-making. Gorry and Scott Morton (1971, p. 60; referring to Simon, 1960) describe the difference as follows: "in the unstructured case the human decision-maker must provide judgment and evaluation as well as insights into problem definition. In a structured situation, much if not all of the decision-making process can be automated." Simon (1960, p. 6) explains that the distinction between the two types is not clear-cut, but typical management decisions should be positioned on a "continuum" from highly structured to highly unstructured.[6] As task structure increases, task complexity decreases (e.g., Bonner & Sprinkle, 2002; Wood, 1986). Most research reviewed in this article is concerned with unstructured decision-making, which is a task where "there is no unique correct decision and no algorithmic decision procedure" (Iselin, 1989, p. 164). Iselin (1988) was the first to investigate information overload effects in a structured decision task. Tuttle and Burton (1999) and Hirsch and Volnhals (2012) also investigated structured decision-making. They investigated tasks that, when employing an adequate algorithm, could be solved

[6] Simon (1960, p. 6) uses the terms "programmed decisions" and "nonprogrammed decisions."

unambiguously. Task characteristics also played a role in early conceptual papers. Fertakis (1969) describes tasks or information needs as relating to three broad areas: internal organization of the firm, information regarding the firm's external relationships, and the firm in its social or political role. According to Fertakis (1969), individuals do not have the capacity to select the relevant information for their specific purposes when provided with all information relevant to the above areas, so there must be a fit between information provision and task requirements. Miller and Gordon (1975) introduce the task aspect more explicitly, stating that the optimum conceptual level depends on the task at hand. Less abstract conceptual levels might be beneficial for simpler tasks.

6.1.3. Environment

Environmental characteristics have the potential to influence task outcomes (e.g., Bonner & Sprinkle, 2002). Environmental variables of primary relevance to information load research in accounting are available time and incentives.

Snowball (1980) and Hirsch and Volnhals (2012) operationalized increases in information load (partly) by restricting the time available to perform the task. Similarly, as mentioned above, in their conceptual paper, Schick et al. (1990) explicitly describe the concept of information overload as relating to the time available. Snowball (1980) notes that in the Schroder et al. (1967) model, the time available is explicitly considered. While a certain number of studies tracked (decision) time, for example Abdel-Khalik (1973), Barefield (1972), and Chervany and Dickson (1974), besides the articles mentioned above, no other study has explicitly claimed to have restricted decision time.

Tuttle and Burton (1999) and Ding and Beaulieu (2011) investigated the influence of a performance-based monetary incentive as an independent variable. Even if not explicitly part of the experimental manipulation, whether subjects received some sort of incentive to participate in the study might influence performance (Bonner & Sprinkle, 2002). In the following studies, subjects received (only) a monetary base payment, and/or course credit, and/or opportunity to participate in a draw: Agnew and Szykman (2005), Casey (1980), Chervany and Dickson (1974), Ding and Beaulieu (2011), Rose et al. (2004), Swain and Haka (2000), Stocks and Tuttle (1998), and Tuttle and Burton (1999) – for the groups that were not part of the incentives manipulation described above. In some studies, subjects received a performance-based payment (the following list also includes those that received performance-based incentives in addition to a base payment): Barefield (1972), Benbasat and Dexter (1979), Chervany and Dickson (1974), Rose et al. (2004), and Swain and Haka (2000). Other studies used the opportunity to learn, receive feedback, or the results as an incentive for participation: Casey (1980) and Iselin (1993). The remaining articles reviewed are silent with regards to incentives of any kind.

Further environmental variables include feedback and viewing conditions. Feedback during the task is described by Libby and Lewis (1977) as a context variable. Although not analyzed explicitly as an

independent variable, feedback is likely to impact learning and motivation – see Bonner and Sprinkle (2002) for a summary. Tuttle and Burton (1999) provided feedback to the subjects after each decision. Libby and Lewis (1977) name "physical viewing conditions" as another context variable. In the 1970s, interactive drilldowns (Kelton & Murthy, 2016) or multiscreen presentations (Rose et al., 2004) did not play a role in accounting-based decision-making; nevertheless these variations can be included under further environmental variables.

6.1.4. Decision-Maker

The structure proposed by Libby and Lewis (1977) is useful for describing variables that refer to the decision-maker. Their first characteristic refers to whether decisions were taken by humans or a decision rule. Simnett (1996) and Gadenne and Iselin (2000) investigated human performance compared to that of a mechanical rule; other research reviewed here has exclusively addressed human decision-making. Libby and Lewis (1977)'s second differentiation refers to the number of decision-makers. As described above (see Table 1), except for Stocks and Harrell (1995), most empirical research has addressed individual decision-making as opposed to group decision-making.

Libby and Lewis (1977) further describe personal characteristics and task related characteristics of the decision-maker as relevant clusters. With regards to personal characteristics, early conceptual papers mostly addressed individuals' level of conceptual abstractness – this is a prominent component of the Schroder et al. (1967) model. Personal characteristics were empirically investigated by Abdel-Khalik (1973), who investigated risk preference, and Ding and Beaulieu (2011), who investigated the effects of moods. Benbasat and Dexter (1979) compared the performance of high and low analytic subjects.

Task-related characteristics of the decision-maker have been more frequently investigated than personal characteristics, most often as experience (Abdel-Khalik, 1973; Snowball, 1980; Iselin, 1988 – students vs. practical decision-making experience; Iselin, 1989; Iselin, 1990; Simnett, 1996; Swain & Haka, 2000) or knowledge, based on a test taken by subjects (Agnew & Szykman, 2005). Task learning (Iselin, 1988, 1989, 1990) is another aspect that may be counted within task-related characteristics of the decision-maker. However, because of the way it is operationalized (measuring how performance changes over a number of trials), it is not used to analyze different personal characteristics, but rather to analyze if there is a learning effect in general.

6.2. Consequences

The following section synthesizes the consequences triggered by a change in the variables described above, focusing solely on empirical articles. With the exception of the effects on decision rules and cue usage, where variables are too diverse to be clustered in a tabular format, each section contains a tabular overview of the effects encountered. While the main effects studied that did not yield any significant effects are also included, only significant interaction effects are presented in the tables; the reason being, besides brevity, that the articles' authors most often restrict the discussion to significant

interactions. The tables give an overview, especially conflicting results and the potential underlying reasons are discussed in more detail. Findings are summarized as stylized facts.

6.2.1. Decision Time

Decision time, or the time used to complete the task, is generally considered an (opportunity) cost for decision-making (Abdel-Khalik, 1973; Benbasat & Dexter, 1979; Iselin, 1988). This is similar to using time as a measurement for effort duration, as in models of task performance, for example Bonner and Sprinkle (2002). Time can either be self-reported by subjects (e.g., Abdel-Khalik, 1973), recorded by the experimenter (e.g., Iselin, 1988), or tracked automatically when using computer-based technology (e.g., Chervany & Dickson, 1974; Swain & Haka, 2000). As noted above, time can be explicitly limited to induce information overload and is then considered a characteristic of the environment. This section focuses on decision time as a dependent variable.

Table 2 gives an overview of the factors affecting decision time. As described in section 4, the following classification is used to describe the stylized facts across articles analyzed:

1) ++: clear positive link: dominance of positive, significant relationships
2) +: rather positive link (e.g., one positive, one insignificant)
3) O: tested, but no significant results
4) ?: contradictory results
5) -: rather negative link (e.g., one negative, one insignificant)
6) --: clear negative link: dominance of negative, significant relationships

These elements are shown in brackets in italics after the summary below and integrated as an overview in Figure 7.

More cues (even if they are redundant) tend to increase decision time *(++)*, as does an increase in information diversity and uncertainty. For increases in information load that are due to disaggregating measures, the relationship is less clear. While Benbasat and Dexter (1979) observed an increase in decision time, Chervany and Dickson (1974) found a decrease in decision time for disaggregated data, that is, more information cues *(?)*. A tentative interpretation could be that aggregating measures as statistical measures (as is the case in Chervany and Dickson, 1974) reduces information cues, but makes the task more difficult, leading to increased decision times.

The effect of experience is unclear. While Swain and Haka (2000) found experience to increase decision time, Iselin (1988) and Iselin (1989) found experienced subjects to (sometimes) spend less time on the task, and Iselin (1990) found no significant effect on decision time *(?)*. A reason could be the different tasks employed – while Swain and Haka (2000) used an unstructured task, Iselin (1988) employed a structured decision-making task. However, this does not explain the opposite effects between Swain and Haka (2000) and Iselin (1989), whose experiment also employs an unstructured decision-making task. Task learning seems to decrease decision time *(--)*.

Legend: increase/high = ↑; decrease/low = ↓; significant positive ($p < 0.05$) = "+"; significant negative ($p < 0.05$) = "-"; not significant = "o". +/- refers to the direction of the effect discussed in the article. Only significant interaction effects are reported here.

Table 2: Effects on Decision Time

Main effects:			
ID	**Change in independent variable(s)**	**Effect**	**Article(s)**
1	Information cues ↑ (no further specification)	+	Casey (1980) (partly); Iselin (1988) (diversity and repeated dimensions); Swain and Haka (2000)
		o	Stocks and Tuttle (1998)
2	Information cues ↑ (disaggregation)	+	Benbasat and Dexter (1979)
		-	Chervany and Dickson (1974)
		o	Abdel-Khalik (1973)
3	Information cues ↑ (redundant)	+	Belkaoui (1984)
4	Information diversity ↑ (at an information overload level)	+	Iselin (1989)
5	Uncertainty (variability of cues)↑	+	Iselin (1990)
6	Experience	+	Swain and Haka (2000)
		-	Iselin (1988); Iselin (1989) (partly)
		o	Iselin (1990)
7	Psychological type (high analytic)	-	Benbasat and Dexter (1979)
8	Incentives ↑	+	Tuttle and Burton (1999)
9	Task learning ↑	-	Iselin (1988); Iselin (1989); Iselin (1990)
Significant interaction effects:			
ID	**Description**		**Article(s)**
10	Experience most strongly affects time in the high diversity, low learning condition. Then, the effect of experience on decision time is reduced by learning.		Iselin (1989)
11	Higher learning reduces the effect of uncertainty on decision time.		Iselin (1990)

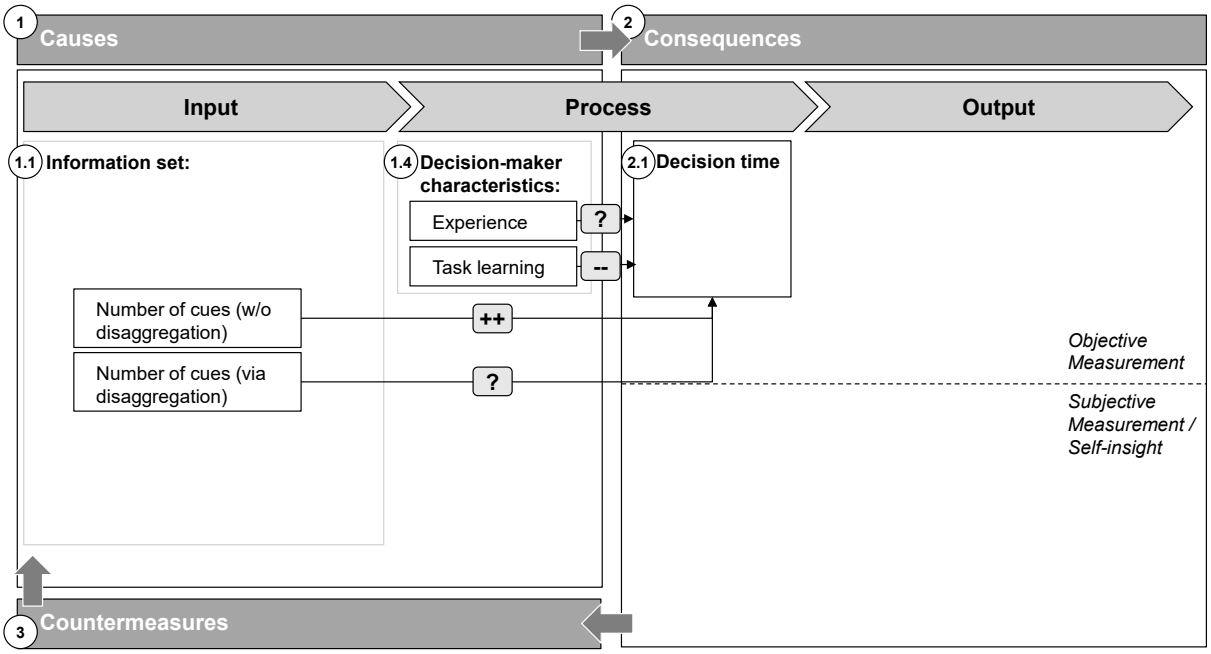


Figure 7: Stylized Facts for Effects on Decision Time

6.2.2. Decision Rule

In the articles reviewed, decision rules used by subjects refer to either the way of weighing alternatives against each other, the use of heuristics, or the tendency for biases when making judgments or decisions. Having subjects choose between alternatives, Shields (1980) and Swain and Haka (2000) investigated cue usage patterns (see following section) to derive assumptions as to which decision rule might have been used by subjects. As will be described also in the "Cue usage" section, Swain and Haka (2000) found that with increasing information load, the relative amount of information searched decreased, the variability of the search process increased, and subjects switched from an intradimensional to interdimensional search strategy – which is interpreted as a switch to a less systematic, more satisficing search strategy. However, the last finding was not robust to different measurements of search strategy employed. Shields (1980) implies that his findings regarding the increased variability of search patterns with increasing information load indicate the use of non-compensatory decision strategies. Unlike compensatory decision strategies, which incorporate all information and require exact weights on the different attributes, non-compensatory strategies are assumed to require less cognitive capacity, for example by identifying the most important attributes and only taking those into account (see Luft & Shields, 2010).

With regards to heuristics, within the context of balanced scorecard-based performance ratings, Ding and Beaulieu (2011) found incentives to be unsuccessful at correcting a mood congruency bias (performance evaluations influenced by either an induced positive or negative mood) when information load was too high. Kelton and Murthy (2016) found that an earnings fixation effect in an information overload setting was reduced by providing interactive drilldown possibilities; this was not the case when using footnotes to present the additional information. Rose et al. (2004) found that

memory reconstruction effects to match an affective state induced (e.g., having a tendency of recalling rather positive performance indicators after a decision when a positive mood was induced) decreased when information load or cognitive load was reduced. Agnew and Szykman (2005) investigated whether increases in information load made subjects choose a default option more frequently, which could be interpreted as using a heuristic decision rule. They found an interaction effect between knowledge and number of options – high knowledge individuals chose the default option more often when the number of options increased, while low knowledge individuals chose the default option less often. Arnold et al. (2000) found that the assumption for experience to mitigate biases proposed by the belief adjustment model did not hold for complex (high information load) environments.

Due to the differing definitions and the limited number of articles investigating decision rules, no tabular overview is presented, and no stylized facts are derived.

6.2.3. Cue Usage

Similar to the previous section, this section addresses how the information set is used. This can be either the search pattern applied or the extent to which the cues are incorporated in the respective judgment. As information demand is the necessary – if not sufficient – condition for information use, this aspect is also considered in this section. As described in the framework (section 5), cue usage can be measured either objectively or subjectively.

Objective measurement is possible via regression (Chewning & Harrell, 1990; Stocks & Harrell, 1995; Stocks & Tuttle, 1998; Tuttle & Burton, 1999) or process tracing (Shields, 1980, 1983; Swain & Haka, 2000). Process tracing allows the tracking of which information cues have been selected or viewed by the decision-maker. It is important to note that selecting a cue does not necessarily equal integration of that cue into the respective decision (e.g., Reisen & Hoffrage, 2008). Subjective measurement refers to self-reports by subjects, sometimes used in addition to objective measurement (e.g., Chewning & Harrell 1990; Stocks & Tuttle, 1998).

Stocks and Tuttle (1998) found increased information load and numerical (vs. categorical) data to negatively impact relative cue usage (measured by significant betas in the regression model). In addition, subjects in the high information load condition reported subjectively integrating significantly more information cues in their judgments, while this perception was not influenced by the type of information presented. Furthermore, the low information load group and the categorical data group showed higher self-insight, measured by the correlation between subjective cue weights and weights objectively determined by the regression model. Tuttle and Burton (1999) also found a decline in relative cue usage with increasing information load.

Shields (1983) found that absolute frequency of information selection increased with increasing information load, while relative frequency declined. Chewning and Harrell (1990) and Stocks and Harrell (1995) measured cue usage utilizing a regression model, with significant beta weights as

indicators for cues used. Chewning and Harrell (1990) split subjects into two groups based on their absolute cue usage. For the group impacted by information overload, cue usage declined significantly from the six- to eight-cue level, while it significantly increased for all information load levels for the group not affected by information overload. However, individuals were not aware of the decline in cue usage. In addition, they observed significant differences between different information load levels (within subjects). Stocks and Harrell (1995) found that groups increased their cue usage with increasing information load levels, while individuals did not incorporate more cues (significant interaction effect).

The effect of increases in information load on the search patterns employed are not clear. Shields (1980) used search patterns as the dependent variable and found that variability increased (per unit) when the number of units to be analyzed increased. There was no significant switch to a more "processing-by-parameter" search (switch to intradimensional search) when the number of units increased. As mentioned in the previous section, Swain and Haka (2000) found the relative amount of information searched to decrease with increasing information load, while the variability of the search increased. Subjects seemed to switch from an intradimensional to interdimensional search strategy. As mentioned above, the switch to interdimensional search was not robust to different ways of measuring search strategy.

As described above, information demand is related to cue usage. Benbasat and Dexter (1979) found that information demand varied with psychological type and information provision. While using an aggregate reporting system, low-analytic-type subjects requested more reports. Under the detailed reporting system, high-analytic types asked for longer time series of historical data than low-analytic types, although there was no significant difference in report demand.

Due to the differing definitions within articles investigating cue usage, there is no tabular overview for this section. A stylized fact that can be derived is a decline in relative information use *(--),* Figure 8, as shown by Shields (1983), Stocks and Tuttle (1998), Swain and Haka (2000), and Tuttle and Burton (1999).

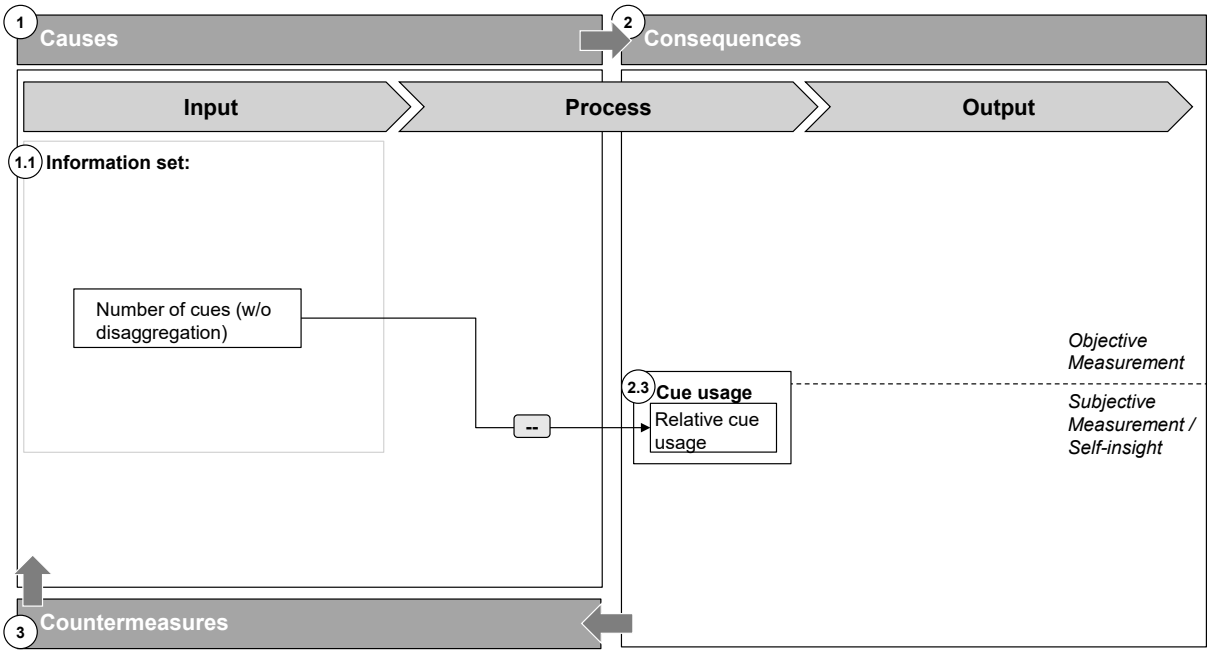


Figure 8: Stylized Facts for Effects on Relative Cue Usage

6.2.4. Accuracy

Measuring decision accuracy requires the task at hand to have a correct solution against which judgment and decision outcomes can be measured. An unambiguous solution can in most cases be found in highly structured tasks, which allows the unambiguous measurement of accuracy (Hirsch & Volnhals, 2012; Iselin, 1993; Tuttle & Burton, 1999). Snowball (1980), among others, indicates that measuring decision accuracy is harder to implement when subjects are supposed to engage in unstructured decision-making. However, researchers have resorted to several approaches to overcome this issue: the most common case when measuring accuracy is to use historical data and then compare judgments and decisions to the real event. In most cases, this is the bankruptcy / no bankruptcy of a firm to be analyzed (see Hwang & Lin, 1999, for an overview). Another option is to compare outcomes with expert judgments (e.g., Shields, 1983) or the results of a statistical model (Rakoto, 2005). Another measure of accuracy is attaining low production costs (Chervany & Dickson, 1974) or higher profit (Iselin, 1989, 1990) in a simulation task.

Difficulty arises when both decision accuracy and cue usage should be measured using a regression model, as cues must be uncorrelated to measure cue usage. It is therefore not possible to use real firm data and the real default event: Chewning and Harrell (1990), for example, describe the trade-off between measuring cue usage and measuring decision accuracy (hypothetical, uncorrelated cues vs. real firms).

Table 3 provides an overview of the effects of increases in information cues on accuracy; stylized facts are summarized in Figure 9. Although some studies have found the predicted decline of decision accuracy when the number of cues surpasses a certain threshold, this is not the case for all research

articles reviewed here. The first studies that investigated data aggregation are among these: Barefield (1972) did not find a significant effect of data aggregation on decision quality (applying the optimal decision criterion); Chervany and Dickson (1974) found provision of aggregated data to be associated with higher decision quality, but the difference was not significant. Iselin (1993) did not study the effect of information load further as there was no significant difference between the subjective measurement for both conditions. Only data load (considered as irrelevant data in the article) was further investigated.

Abdel-Khalik (1973) found that disaggregated data, which technically constituted an increase in the number of information cues, led to higher decision accuracy. However, the reason for this is unclear as users indicated in a questionnaire that they found the same data important (the aggregated measures that were provided to both groups). One possible reason proposed by Abdel-Khalik (1973) was that users of disaggregated data felt more comfortable. Furthermore, he investigated whether experience affected accuracy; the effect was not significant.

Operationalized as predictive accuracy, Casey (1980) found an increase in predictive accuracy when supplementing financial ratios with balance sheet and income statement, but no further increase when adding the notes as well.

The effect of adding redundant cues to the information set is also ambivalent. While Belkaoui (1984) found an increase in decision accuracy, Rakoto (2005) found a decline. A reason for the differing result could be the task employed in the experiment. While Belkaoui (1984) operationalized the increase in information load by adding further financial ratios, Rakoto (2005) added financial statements to increase information load. Furthermore, the number of ratios provided was lower in Belkaoui (1984). Einhorn, Kleinmuntz, and Kleinmuntz (1979) summarize the possible positive (e.g., limited search effort) and negative effects (e.g., attention paid to cues that have little predictive value) of redundant information clues. A tentative interpretation of the different outcomes is that these effects worked differently or with differing strength due to the differences in task design.

To derive stylized facts, papers that found limited effects (Casey, 1980) or where effects were only observable for a sub-set of cases (Abdel-Khalik, 1973) were not included in the analysis. Summarizing the effects, increases in information load (excluding increases caused by disaggregation) above a certain level rather reduce decision accuracy *(-)*. There is little or no effect of increases in information load caused by disaggregating information *(O)*. Experience seems to have a rather positive effect on decision accuracy *(+)* and task learning *(++)*. With regards to interaction effects, increasing cognitive load further harms task performance (Rose et al., 2004). In addition, Benbasat and Dexter (1979) found an interaction between psychological type and format of data provision.

Table 3: Effects on Accuracy

Main effects:			
ID	**Change in independent variable(s)**	**Effect**	**Article(s)**
1	Information cues ↑ (no further specification)	+	Casey (1980) (limited); Stocks and Harrell (1995) (only for groups)
		-	Chan (2001)
		∩	Shields (1983) (inverted U-curve)
2	Information cues ↑ (disaggregation)	+	Abdel-Khalik (1973) (only for selected firms)
		o	Barefield (1972); Benbasat and Dexter (1979); Chervany and Dickson (1974)
3	Information cues ↑ (relevant)	∩	Hirsch and Volnhals (2012) (inverted U-curve)[7]
		-	Iselin (1988)
		o	Iselin (1989); Rakoto (2005); Tuttle and Burton (1999)
4	Information cues ↑ (redundant)	+	Belkaoui (1984)
		-	Rakoto (2005)
5	Information cues ↑ (irrelevant)	-	Iselin (1993)
		o	Rakoto (2005)
6	Experience ↑	+	Iselin (1988) (partial); Iselin (1989) (partial); Iselin (1990) (approaching significance); Simnett (1996) (partial)
		o	Abdel-Khalik (1973)
7	Task learning ↑	+	Iselin (1988) (partial); Iselin (1989); Iselin (1990)
8	Incentives ↑	+	Tuttle and Burton (1999)
9	Group (vs. individual)	+	Stocks and Harrell (1995) (partial)
10	Available time ↑	o	Hirsch and Volnhals (2012)[8]

[7] It must be noted that the task was designed in a way that subjects could not achieve the optimal solution before additional information cues were added.
[8] No additional effect of a reduction in time for the group that already received the highest number of information cues.

Significant interaction effects:		
ID	**Description**	**Article(s)**
11	Combination of psychological type "low analytic" and aggregated/structured data led to worst performance	Benbasat and Dexter (1979)
12	Increases in information load have a more pronounced effect (negative) on the recall of financial information than on affective responses	Rose et al. (2004)

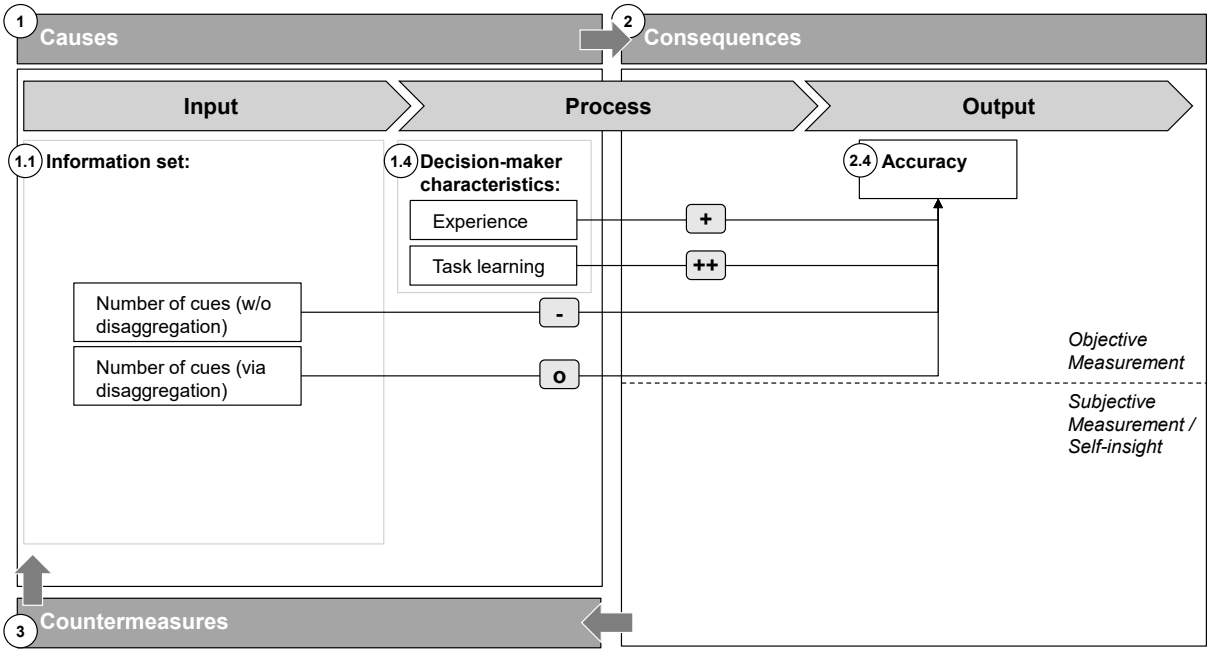


Figure 9: Stylized Facts for Effects on Decision Accuracy

As a measurement of decision accuracy cannot be implemented in all cases (e.g., when there is no "correct" solution to the task), researchers have resorted to measuring further aspects of the outcome that are sometimes also called quality-indicators, such as consensus or consistency. These variables are analyzed in the subsequent sections.

6.2.5. Consensus

In the research papers reviewed, decision consensus typically refers to the distribution of judgments or decisions across several individuals (Abdel-Khalik, 1973; Chewning & Harrell, 1990; Shields, 1983; Snowball, 1980; Stocks & Harrell, 1995) or of several groups of individuals (Stocks & Harrell, 1995). It is measured by comparing variances between experimental groups (Abdel-Khalik, 1973; Snowball, 1980) or the average degree of correlation between individuals' decisions (Chewning & Harrell, 1990; Stocks & Harrell, 1995). Similarly, Shields (1983) used a non-parametric equivalent (coefficient of concordance).

As mentioned above, consensus is often used as proxy for decision quality when decision accuracy cannot be measured (e.g., Ashton, 1985; Stocks & Harrell, 1995; Stocks & Tuttle, 1998; Wright, 1988). Consensus being a major variable of interest, especially in the auditing context, Ashton (1985) found a significant correlation between consensus and decision accuracy in a prediction task. This supports the assumption of consensus being a proxy for decision accuracy.

While Snowball (1980) found experience to negatively affect consensus, the effect of a reduction in processing time only approached significance – an operationalization of information load similar to that defined by Schick et al. (1990). A possible reason mentioned is that the more detailed footnotes may not have added any informational value.

Table 4 gives an overview of the effects on consensus. There is some support for increases in information load to have either no effect (one article) or to negatively affect decision consensus (two articles). As a stylized fact, I summarize this as "-", Figure 10. In addition, Stocks and Harrell (1995) found an interaction effect between increases in the number of cues and the judgments made by individuals vs. groups, with consensus decreasing more for individuals then it did for groups when information load was at the highest level. Further interaction effects were observed between available time and expertise (Snowball, 1980); the level of information load and type of group (affected vs. not affected by information load; Chewning & Harrell, 1990); and changes in information load and data format (numerical vs. categorical; Stocks & Tuttle, 1998).

Table 4: Effects on Consensus

Main effects:			
ID	**Change in independent variable(s)**	**Effect**	**Article(s)**
1	Information cues ↑ (no further specification)	-	Stocks and Harrell (1995); Stocks and Tuttle (1998)
		o	Shields (1983)
2	Information cues ↑ (disaggregation)	-	Abdel-Khalik (1973) (limited)[9]
3	Group (vs. individual)	+	Stocks and Harrell (1995)
4	Categorical (vs. numerical) data	+	Stocks and Tuttle (1998)
5	Available time ↑	o	Snowball (1980)
6	Experience ↑	-	Snowball (1980)
Significant interaction effects:			
ID	**Description**		**Article(s)**
7	At highest (relevant) information load level, most important difference observed in consensus between the group affected by information overload and the group not affected by information overload		Chewning and Harrell (1990)
8	Reduction in time led to greater differences in confidence intervals for subjects with high expertise opposed to smaller differences for subjects with low expertise		Snowball (1980)
9	Individuals' decision consensus declined more strongly with increases in information load than did groups' decision consensus		Stocks and Harrell (1995)
10	Higher increase in consensus with decreasing information load for group that received categorical (vs. numerical) data		Stocks and Tuttle (1998)

[9] Abdel-Khalik (1973) found no significant difference when analyzing differences in variances, but ranking dispersion pointed to more dispersion (less consensus) for disaggregated data.

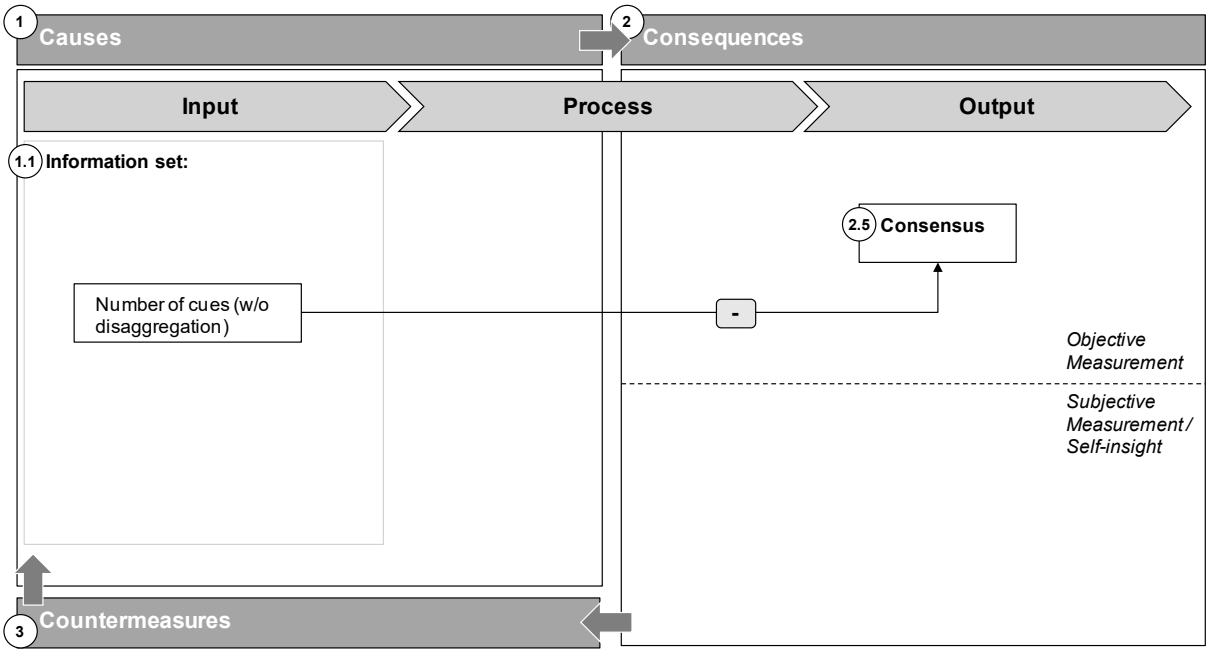


Figure 10: Stylized Facts for Effects on Consensus

6.2.6. Consistency

Consistency refers to the stability of subjects' judgments and decisions, either over a number of judgments in a repeated measure design (e.g., Barefield, 1972), or by comparing different measures of decision outcomes to each other (e.g., lending decision and estimate of default probability; Abdel-Khalik, 1973). The findings for the effects of an increase in the number of information cues on consistency are ambiguous, see Table 5. Again, the studies on data aggregation/disaggregation are an exception to the general tendency, finding increased decision consistency for disaggregated data (Abdel-Khalik, 1973; Barefield, 1972). In contrast, Stocks and Harrell (1995) and Stocks and Tuttle (1998), who did not operationalize increases in information load via disaggregation, found negative effects.

The different findings can most likely be attributed to differences in the task at hand (e.g., a clear decision rule in Tuttle & Burton, 1999; while others have employed unstructured decision tasks) and different measurements for decision consistency: Barefield (1972) defines consistency as the consequent use of the decision model chosen by the subject. Chewning and Harrell (1990), Stocks and Harrell (1995), Stocks and Tuttle (1998), and Tuttle and Burton (1999) used the adjusted R^2 of subjects' regression models. To summarize, increases in information load not caused by disaggregating data seem to affect consistency rather negatively *(-)*, illustrated in Figure 11.

Table 5: Effects on Consistency

Main effects:

ID	Change in independent variable(s)	Effect	Article(s)
1	Information cues ↑ (no further specification)	-	Stocks and Harrell (1995) (for individuals); Stocks and Tuttle (1998)
		o	Tuttle and Burton (1999)
2	Information cues ↑ (disaggregation)	+	Abdel-Khalik (1973) (partly); Barefield (1972)
3	Redundancy[10] ↑	o	Barefield (1972)
4	Group (vs. individual)	+	Stocks and Harrell (1995)
5	Categorical (vs. numerical) data	+	Stocks and Tuttle (1998)

Significant interaction effects:

ID	Description		Article(s)
6	Increase in relevant information cues for the group affected by information overload led to a decline in consistency (only at highest load level)[11]		Chewning and Harrell (1990)
7	Individuals' decision consistency declined more strongly with increases in information load than groups' decision consistency		Stocks and Harrell (1995)

[10] Barefield (1972) analyzed disaggregation and different levels of redundancy between information cues in his experiment.
[11] Chewning and Harrell (1990) did not explicitly test for an interaction effect.

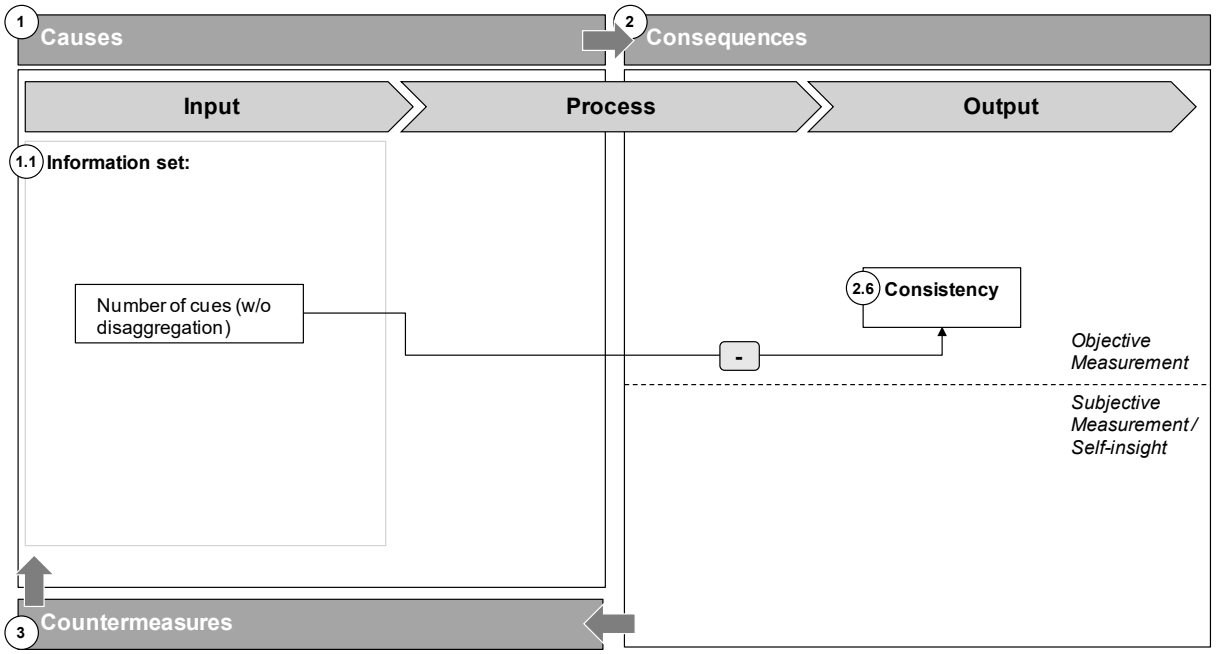


Figure 11: Stylized facts for effects on Consistency

6.2.7. Confidence

Confidence is measured by having subjects indicate their confidence or certainty with the decision or judgment made (Agnew & Szykman, 2005; Chervany & Dickson, 1974; Hirsch & Volnhals, 2012). Agnew and Szykman (2005) measured confidence as an item in an overall satisfaction score. In contrast, in Snowball (1980)'s study, subjects were asked to indicate a confidence interval, in addition to a confidence interval assumed for experts or under complete information provision, which then served as a reference point. Another set of papers had subjects estimate the probability of their answer being correct (Belkaoui, 1984; Simnett, 1996). Belkaoui (1984) measured confidence in reporting under- and overconfidence (among others) but did not report confidence separately; results are therefore not included in Table 6.

The effect of increased information load on decision confidence is not clear – while most studies (except for the second experiment in Agnew & Szykman, 2005) have found no effect, disaggregating data seems to positively affect decision confidence (Chervany & Dickson, 1974). Not considering studies using disaggregation as a means to increase information load, most papers analyzed have not found an impact of increases in information load on decision confidence *(O)*, Figure 12.

Table 6: Effects on Confidence

Main effects:			
ID	**Change in independent variable(s)**	**Effect**	**Article(s)**
1	Information cues ↑ (no further specification)	o	Agnew and Szykman (2005) (first experiment); Simnett (1996); Snowball (1980)
	Information cues ↑ (no further specification)	-	Agnew and Szykman (2005) (second experiment)
2	Information cues ↑ (disaggregation)	+	Chervany and Dickson (1974)
3	Information cues ↑ (relevant)	o	Hirsch and Volnhals (2012)
4	Available time ↑	o	Snowball (1980)
Significant interaction effects:			
ID	**Description**		**Article(s)**
5	Reduction of time leads to a bigger decrease in confidence (measured as compared to experts' confidence intervals) for high expertise subjects than for low expertise subjects		Snowball (1980)

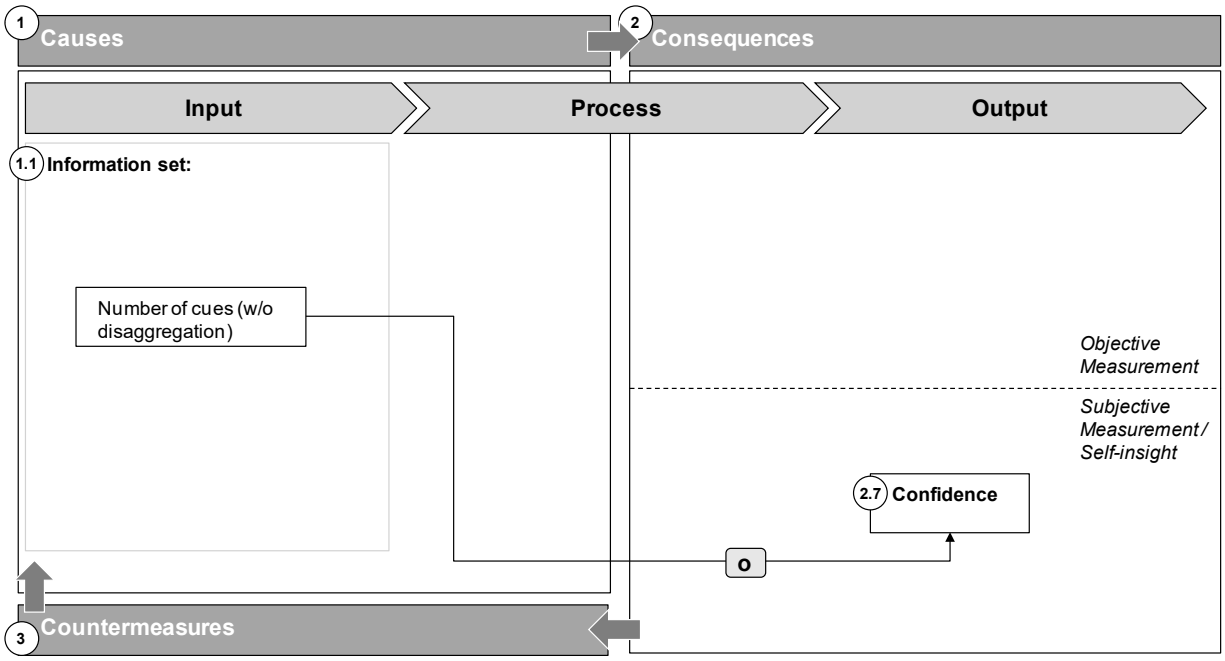


Figure 12: Stylized Facts for Effects on Confidence

6.2.8. Calibration

Calibration refers to "accuracy of confidence" Simnett (1996, p. 700), thus describing the extent to which subjects realistically estimate the quality of their decisions. Calibration is measured by comparing confidence judgments to decision accuracy. Hirsch and Volnhals (2012) did not compare confidence to accuracy but rather compared perceived overload with objective overload. A limited

number of studies have investigated the effects on calibration; the effects of increases in the number of information cues are insignificant or negative *(-)*, see Table 7 and Figure 13 below.

Table 7: Effects on Calibration

Main effects:			
ID	**Change in independent variable(s)**	**Effect**	**Article(s)**
1	Information cues ↑ (no further specification)	o	Simnett (1996)
2	Information cues ↑ (relevant)	-	Hirsch and Volnhals (2012)
3	Information cues ↑ (redundant)	-	Belkaoui (1984) (increased overconfidence)

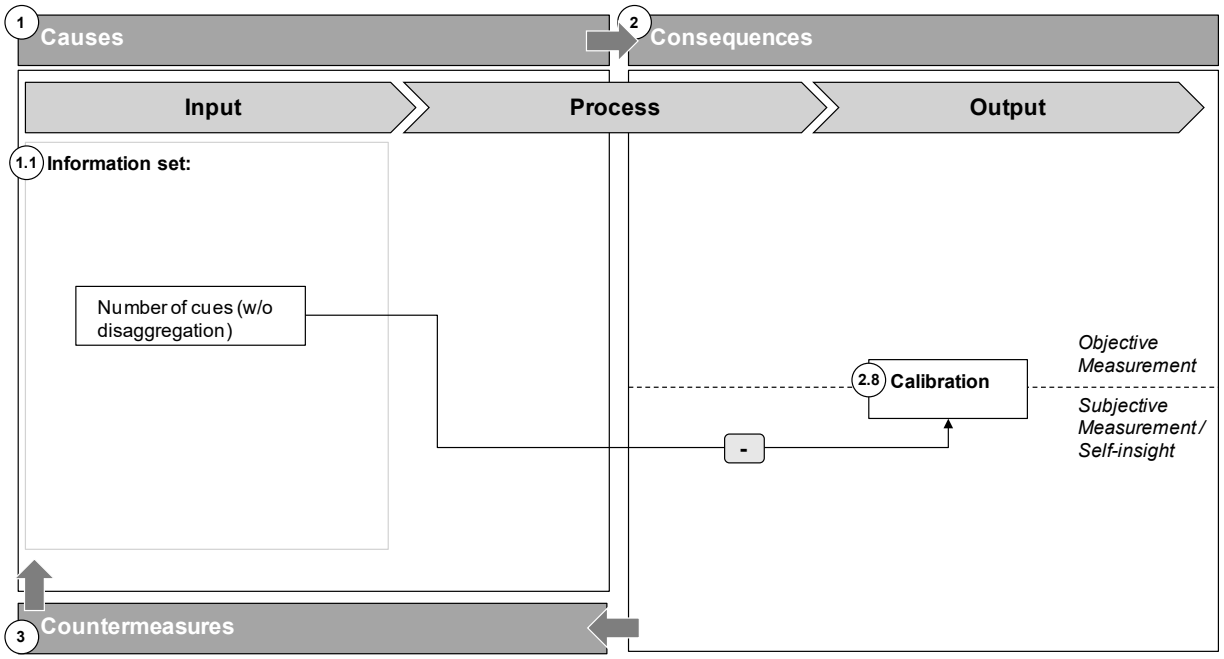


Figure 13: Stylized Facts for Effects on Calibration

6.2.9. Feeling of Overload

A number of research articles have investigated subjects' self-insight with regards to their perception of information load or cognitive load (Agnew & Szykman, 2005; Gadenne & Iselin, 2000; Hirsch & Volnhals, 2012; Iselin, 1993; Kelton & Murthy, 2016). Measurement is typically done via a questionnaire during or after the experimental task. As described above, it is thus a self-reported measure.

While some research articles have focused more on the judgments of subjects regarding effort needed for completion (e.g., Kelton & Murthy, 2016) or make use of a measure containing several items to determine subjective information overload (Agnew & Szykman, 2005), others have asked participants directly for an estimate of information load (Iselin, 1993).

The findings are ambiguous. Iselin (1993) neither found an increase in subjective information load, formulated in the questionnaire as "relevant information," nor in subjective uncertainty, but only subjective data load (worded as "irrelevant data" in the questionnaire). Using a similar set of measures, Gadenne and Iselin (2000) found a significant effect of increases in number of cues on subjective data load and uncertainty reduction, but also not on subjective information load.

Agnew and Szykman (2005) found a significant main effect of an increase in the number of options on perceived overload. They also found an interaction effect between financial knowledge and perceived information load (approaching significance at $p < 0.10$) in their first experiment: Individuals with low scores on financial knowledge had high scores on the perceived overload measure, independent of the level of information load received, while perceived information load was reduced for high financial knowledge subjects in the low information load condition.

Kelton and Murthy (2016) found diverging effects for the use of an interactive drilldown functionality: while the reported cognitive load increased when using a drill-down functionality for subjects in the group for which the utility of disaggregating data was low, it decreased for subjects in the group for which the utility of disaggregating the data was high.

Hirsch and Volnhals (2012) found that subjects' perceptions of feeling overloaded increased from the group with few information cues to the group with an optimal number of information cues. However, it did not significantly increase from "optimal" information load to the "high information load" group.

In summary, although objective increases in information load are not always fully reflected in subjective judgments of information load, there seems to be a slightly positive link between increases in the number of information cues and the subjective information or data load reported *(+)*, Figure 14.

Table 8: Effects on Feeling of Overload

Main effects:

ID	Change in independent variable(s)	Effect	Article(s)
1	Information cues ↑ (relevant)	+	Hirsch and Volnhals (2012) (partly)
2	Information cues ↑ (number of options in choice task)	+	Agnew and Szykman (2005) (experiments 1 and 2)
3	Information cues ↑ (relevant and irrelevant)	o	Measuring subjective amount of relevant information: Gadenne and Iselin (2000); Iselin (1993)
4	Information cues ↑ (relevant and irrelevant)	+	Measuring subjective amount of irrelevant information: Gadenne and Iselin (2000) (partial); Iselin (1993)

Significant interaction effects:

ID	Description	Article(s)
5	Subjects with high financial knowledge had lower measures of perceived overload for the low information load scenario; subjects with low financial knowledge had high overload measures for both settings (low and high information load)	Agnew and Szykman (2005) (experiment 1)
6	Reported cognitive load increased when using a drill-down functionality for subjects in the group for which the utility of disaggregating data was low; it decreased for subjects in the group for which disaggregating the data was high.	Kelton and Murthy (2016)

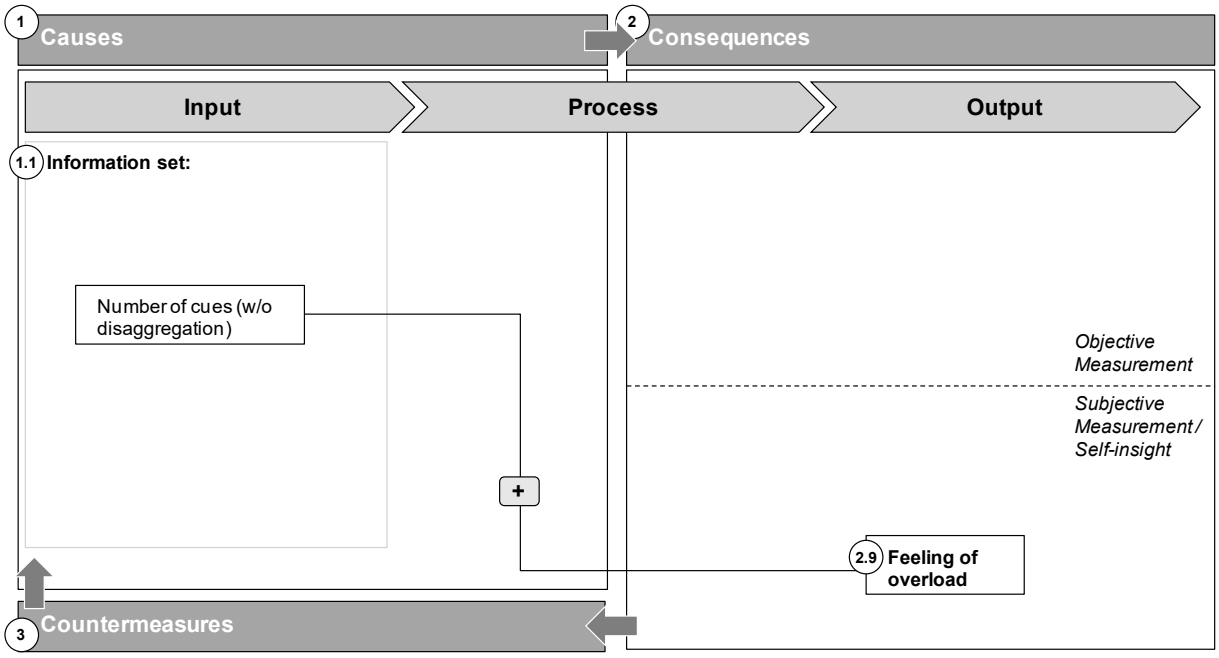


Figure 14: Stylized Facts for Effects on Feeling of Overload

6.3. Countermeasures

Looking at possible countermeasures, it is important to distinguish countermeasures named as potential mitigations for information overload effects in the discussion or conclusion of a paper, and countermeasures that were the direct focus of the paper and have been tested empirically. Furthermore, some possible countermeasures, in addition to those named in the articles reviewed, can be derived by analyzing the causes identified in the previous sections. Investigating possible countermeasures has high relevance for practice, as recommendations can be made regarding possible actions to take to mitigate the negative effects of information overload.

As highlighted in the framework for analysis, countermeasures should try to address the causes for information overload phenomena (see also Eppler & Mengis, 2004). This section therefore clusters possible countermeasures by following the categories in the "causes" section of the framework, also naming countermeasures that have not been effective. An overview of potential countermeasures described in more detail in the following sections is illustrated in Figure 15.

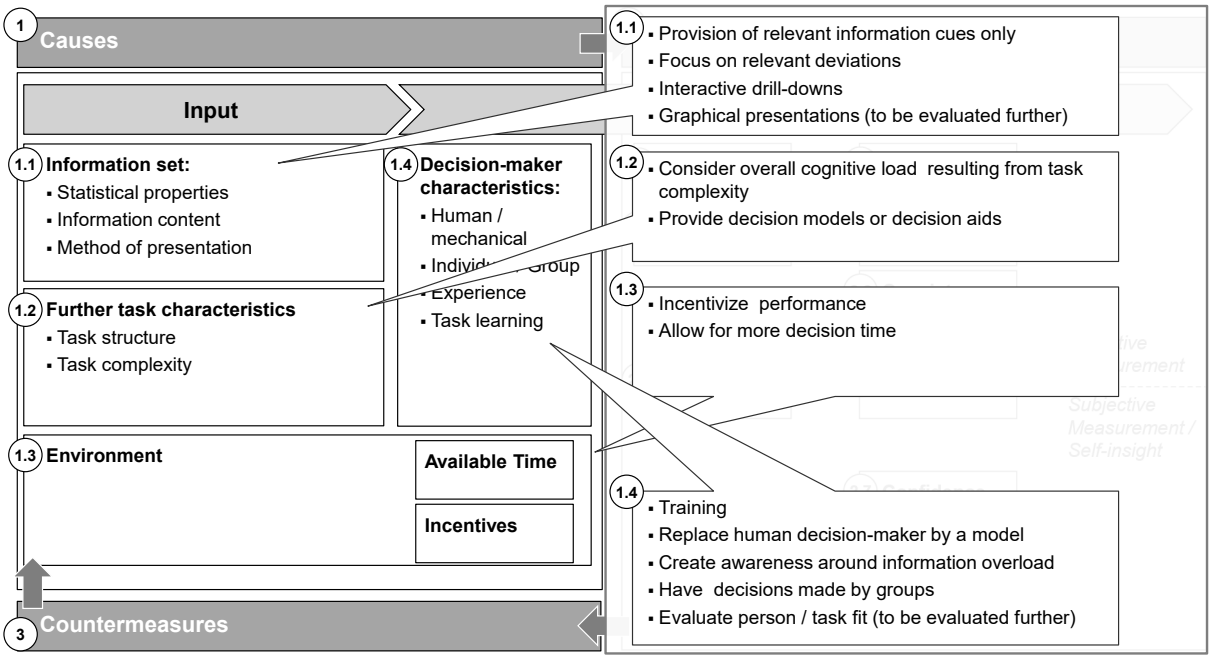


Figure 15: Potential Countermeasures to Mitigate Information Overload

6.3.1. Information Set

The most immediately evident possible countermeasure is changing the characteristics of the information set. One measure is to fit the information set to the task at hand, as discussed in the conceptual paper of Fertakis (1969), supplying only the information cues that are necessary for the decision to be taken. Considering the negative effects that even redundant and irrelevant information cues can have on decision outcomes, the information set should be limited to relevant information cues (e.g., Iselin, 1996; Rakoto, 2005). Given that the decision is taken repeatedly, relevance of information cues can be determined by analyzing the information cues' predictive ability, for example, via regression models as in Gadenne and Iselin (2000). Redundant cues that correlate highly with the relevant information set in use should be excluded. Another possibility, as discussed by Iselin (1989), is "exception reporting," which focuses on reporting relevant deviations only (e.g., Judd, Paddock, & Wetherbe, 1981). With regards to information presentation, Chan (2001) did not find graphical presentation to be effective in mitigating information overload effects. However, generalization beyond the task analyzed should be done with caution. More research is necessary to determine whether graphical representations can help mitigate information overload effects. Interactive drilldowns have been shown by Kelton and Murthy (2016) to reduce perceived cognitive load and an earnings fixation effect for data disaggregation when the utility of the disaggregated data is high. This indicates possibilities for improving decision-making by giving the decision-maker more control over how to approach the information set. Presentation of additional information in footnotes has not been shown to have an effect similar to interactive drilldowns (Kelton & Murthy, 2016).

A question that can be raised is whether personalization of information provision might be beneficial, meaning that personal characteristics are taken into account when selecting the amount and

characteristics of information cues to be provided. While fitting the information set to the decision at hand (and therefore implicitly to a person's role within or outside of the organization, e.g., Fertakis, 1969) is beneficial, the arguments for fitting an information set to personal characteristics are less promising: decision-makers are probably more similar than they are different. Although the number of cues integrated into a decision might differ between decision-makers, the maximum level of integration is reached at a similar degree of environmental complexity (see section 2 for more details), indicating that the optimal number of information cues does not differ between individuals, even if some individuals perform better than others at this optimal level of information load (Schroder et al., 1967; Streufert & Schroder, 1965; Wilson, 1973). Personalization is also difficult to implement, as information users' individual decision models would need to be transparent to the designer of the information system (Revsine, 1970). In addition, learning has been shown to be possible: Wilson (1973) highlights Streufert and Schroder (1965)'s findings, indicating that individuals' conceptual levels are not fixed but can develop. In addition, task learning has been shown to positively affect decision accuracy and reduce decision time (Iselin, 1988, 1989, 1990). Another potential drawback when considering fitting the information set to personal characteristics becomes apparent when considering interaction around accounting numbers in an organization. A certain standardization is necessary in order to facilitate efficient discussions within and across departments. Iselin (1989) discusses aggregation as a possible remedy; however, as described in the section dealing with consequences of increased information load (6.2), the effects of data aggregation on decision performance are ambiguous at best.

As highlighted by Snowball (1979), to be able to provide decision-makers with a pre-selected information set, knowledge on the specific requirements of the decision problem and process at hand is critical. Therefore, asking the decision-makers for their information requirements could solve this issue. However, decision-makers tend to demand more information than is useful for effective decision-making, thus risking information overload and reduced decision quality (e.g., Snowball, 1979). In addition, self-insight with regards to information use and relevance is rather limited (e.g., Stocks & Tuttle, 1998).

6.3.2. Task Characteristics

Task characteristics other than the number of information cues provided can further improve or deteriorate decision performance. Reducing cognitive load associated with the task, supplying decision aids, or changing the task structure are potential remedies to mitigate effects of increases in information load.

Changes in cognitive load resulting from a change in task characteristics imply changes in the total processing capacity needed (e.g., Schick et al., 1990) to accomplish the task at hand. Therefore, these changes are likely to influence individuals' information processing capabilities. Rose et al. (2004)

indicate that variations in information load should be investigated along with increases in cognitive load, as cognitive load is a factor that is influenceable by the way a task is set up. Although Rose et al. (2004)'s experiments were not designed to investigate interaction effects between information load and cognitive load, the findings showed that increases in cognitive load negatively impacted recall and led subjects to rely more heavily on reconstruction matching affects.

Discussing their results, Chewning and Harrell (1990) and Rakoto (2005) indicate that making decision-makers use a decision model might be a solution to the information overload problem when reducing the number of information cues is not an option. However, as Rose et al. (2004) indicate, increases in cognitive load must be taken into account when providing individuals with a decision aid.

Benbasat and Dexter (1979) argue that, depending on the structure of the task, information should be provided structured and aggregated for more structured, programmable tasks, and less so for tasks that require more flexible information use. However, there is no empirical evidence that verifies this assumption. Although not directly investigated by the research reviewed for this article, task complexity (e.g., Wood, 1986) is likely to interact with the information set. Increases in information load might have a stronger effect in more complex (e.g., less structured) tasks than in simpler or more structured tasks. Reducing task complexity (notably coordinative and dynamic complexity, as component complexity is determined by the number of cues – Wood, 1986) is therefore likely to mitigate information overload effects.

6.3.3. Characteristics of the Environment

Characteristics of the decision-making environment (such as time available or incentives) can help or harm information processing. One of the most evident countermeasures is to increase the time available for information processing for an individual decision-maker or within an organization (Schick et al., 1990; Snowball, 1980).

Another option is to incentivize task performance (Ding & Beaulieu, 2011; Tuttle & Burton, 1999). However, as shown by Ding and Beaulieu (2011) and also pointed out by Bonner and Sprinkle (2002), there is a limit to the effect incentives have on task performance. If information load increases beyond a certain level, even incentives cannot mitigate the negative effects on decision performance (as shown by Ding & Beaulieu, 2011).

When deciding which countermeasures to implement, a cost-benefit calculation is advisable as some countermeasures might be costly – either with regards to additional decision time due to longer time needed for individual decision processes or discussion and coordination in teams; or for defining relevant information, decision models, implementing information systems, training, and more.

6.3.4. Decision-Maker Characteristics

Several articles discuss measures that deal broadly with the characteristics of the decision-maker (task-related and person-related). Countermeasures can be categorized into countermeasures that help change certain task-related characteristics and those that relate to a replacement of the decision-maker. The former countermeasures encompass measures such as training. Task learning has been shown to positively affect task performance (Iselin, 1988, 1989, 1990). In these articles, the task was not changed, so it seems reasonable to assume that the learning effects represent an upper limit and should be lower in tasks that are less standardized. In addition, experience has been shown to improve decision-making performance in selected experiments (e.g., Iselin, 1988). However, not all measures improve with experience: Snowball (1980) found less consensus for experienced subjects. Experience has also been associated with longer decision times (Swain & Haka, 2000). The latter countermeasures, in the more radical form, imply replacing the person with a statistical model (one step further than providing a decision aid to the decision-maker).

A further measure (not directly linked to task performance but necessary nonetheless) is to create awareness around the phenomenon of information overload – decision-makers are often unaware they are overloaded (Hirsch & Volnhals, 2012) or that their cue usage deteriorates (Chewning & Harrell, 1990). In some cases, this can lead to overconfidence on the side of the decision-maker (e.g., Abdel-Khalik, 1973) and potentially to harmful decisions. If decision-makers are aware of the potential detrimental effects of information overload on decision-making performance, they might stop requesting too many information cues or know when to ask for help or use a decision model.

Chewning and Harrell (1990) found that certain subjects' cue usage was not affected by increases in information load, leading to the question of whether a person who is not or is less affected by information overload should be the one to make decisions. However, there is a limit to the number of information cues humans can handle. Therefore, as described by Brown-Liburd et al. (2015), employing statistical models and teaching (human) decision-makers how to engage with the output of these decision models seems a more fruitful middle ground when the information set cannot be kept to a level that does not generate information overload effects. Another aspect relates to the person-task fit. Miller and Gordon (1975) argue that people with less abstract conceptual structures are better at simple tasks. Benbasat and Dexter (1979) found that high-analytic-type subjects performed better with a pre-structured, aggregate report, while low-analytic-type subjects performed better with a database inquiry system. The evidence on finding a person-task fit, however, is rather scarce. Group decision-making has also been shown to improve performance (Stocks & Harrell, 1995); having more complex decisions taken by groups might therefore help to improve decision performance.

7. Summary of Findings and Recommendations

Summarizing the main findings is no easy task, as for some variables, there is no consistent picture with regards to the effects on the dependent variables investigated. The stylized facts which have been derived for each of the potential consequences in section 6.2 are summarized in Figure 16 below. In addition, the number of articles analyzing the respective variable have been added to illustrate the focuses of the articles reviewed.

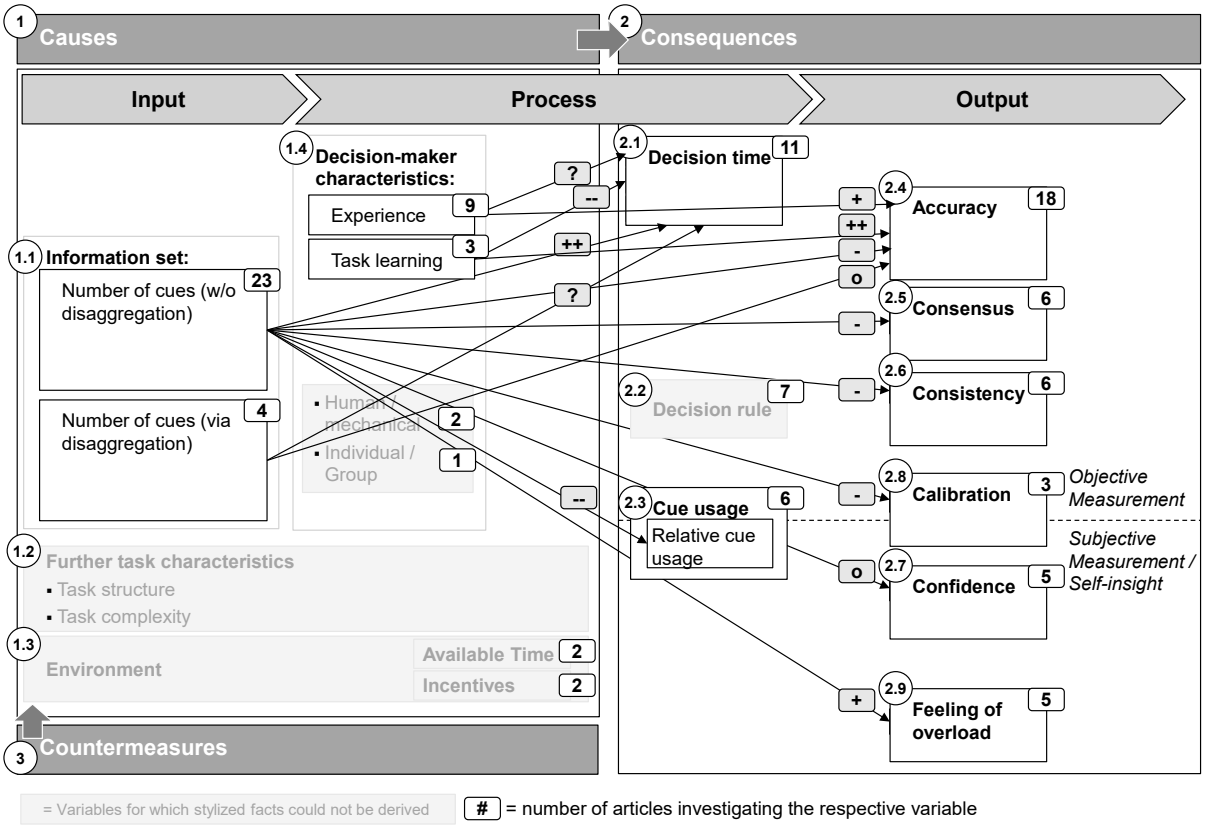


Figure 16: Overview Framework with Stylized Facts

Referring to Figure 16, the following section summarizes the key findings:

1) Not all information cues are equal: it is important to distinguish between relevant, irrelevant, and redundant information. Depending on information characteristics, effects of increased information load on decision accuracy are likely to have different effects. In particular, disaggregating information does not have the same impact as providing additional information cues. Management accountants as providers of information must therefore be aware of the type of information they provide to decision-makers. While redundant or irrelevant information should never be provided, the trade-off between increased decision accuracy and the risk of information overload should be considered for relevant information cues. In addition, they must be aware of the effects that aggregating or disaggregating information has on the decision-maker.

2) Do not give decision-makers what they want: while a "feeling of overload" seems to increase with additional information, self-insight into decision quality (as measured by calibration) seems to decrease when information load increases. Increasing information load does not impact decision confidence in the same way that it does decision accuracy. Complying with decision-makers' demands for additional information is therefore likely to increase information overload. This is especially relevant when considering initiatives for increased self-service reporting. Users must be effectively trained or at least made aware of the pitfalls associated with making decisions based on reports that contain a high number of information cues.
3) Consider the trade-offs: while providing decision-makers with more (relevant) information can increase decision accuracy up to a certain point, decision time is likely to increase. The same is true for implementing countermeasures that might be costly.
4) Experience is not always a good thing: while it is likely to increase decision accuracy, the effect on decision time is not clear.
5) There is more to a task than just information input: While this is not immediately visible from the summary of stylized facts as there are only few papers which have investigated the issue, depending on the task (e.g., structured vs. unstructured), increases in information load are likely to have differing effects. Increasing information load past an optimal level in an unstructured task is likely to have a more negative effect than increasing information load in a structured task. Tuttle and Burton (1999), for example, did not find increases in information load to negatively impact consistency or accuracy when a specific decision model should be applied. In addition, further task characteristics, for example viewing conditions or incentives, are likely to further impact or at least interact with information load in influencing decision-making performance.

8. Opportunities for Future Research

The high number of articles included in this review on information overload research in accounting underlines the interest in the topic. However, some aspects have been researched in more detail than others. The framework presented in section 5 and the main topics researched as described in section 3 serve as a basis for categorizing opportunities for future research. In addition, the stylized facts summarized in Figure 16 can be used to identify fields in which additional research is warranted (Loos et al., 2011; Winter, 2009).

The first aspect that becomes apparent are the domains that are being researched. Much research concentrates on financial distress prediction. This focus is understandable, considering the combination of a high relevance for practice and the unique benefits of being able to analyze an

unstructured decision-making task that allows researchers to investigate either decision accuracy or cue usage conveniently. Other areas, such as the field of management accounting, have received less attention and thus offer potential for new findings.

The next aspect considers the categories of variables researched, that is, causes, consequences, and countermeasures. Most research addresses the link between causes and consequences. Although possible countermeasures are discussed by the authors and in some cases investigated in the course of the experiment (see section 6.3), further direct empirical investigation of possible countermeasures might offer valuable insights for practice.

Another aspect refers to the distinction between input, process, and output variables. Most research addresses how changes in input variables affect output variables, such as decision accuracy or decision confidence. Fewer papers have investigated process variables, such as the information acquisition process or decision rules applied, especially not in conjunction with decision accuracy as a measure for decision quality. Gaining more insight into the decision process might provide valuable insights into how information use and decision rules influence decision performance.

As described above, most empirical research on information overload in accounting (with the exception of Stocks & Harrell, 1995) is concerned with individual decision-making. This fact has already been highlighted by Birnberg (2011) for the domain of behavioral accounting research in general. However, it is likely that major decisions are not taken by individuals, but rather by groups. Investigating how groups manage increases in accounting information load is therefore warranted.

Currently, new technological developments are reshaping the accounting landscape; big data is just one example. Decision models (that have been considered in few articles) will become more important, and as highlighted by Brown-Liburd et al. (2015), it is not yet clear how decision-makers will deal with the output of these models.

With regards to research methodology, some suggestions can be derived from the literature reviewed. Experiments are the dominant method when it comes to researching information overload in the accounting domain as experiments are an excellent tool for showing cause and effect relationships. Nevertheless, other methods, such as surveys or case studies, can complement these findings with evidence from practice. As discussed above (section 6.1.1), manipulations of the information set can be operationalized in a variety of ways, the effects on decision performance differing markedly depending on the change investigated. It is therefore necessary to clearly define which aspects of the information set have been manipulated and whether relevant, redundant, or irrelevant information is being investigated. The same applies to the manipulation of further variables (e.g., task variables) and the measurement of dependent variables.

In general, designing the perfect information overload research project is no easy task, starting with, as described above, the limitations when it comes to measuring decision accuracy in unstructured decision-making. A clear focus is therefore necessary.

All in all, as noted already by Eppler and Mengis (2004), the field still lacks integration: while most of the research articles are based upon the same theory, the settings in which increases in information load are investigated differ. While it is beneficial to investigate different task settings, it makes comparison of results difficult. As summarized by Loos et al. (2011), stylized facts, as formulated in this review article, can contribute to putting a focus on the key links within the information overload model that might need further clarification.

9. Conclusion

This literature review synthesizes accounting-related information load literature. It provides a framework for analysis and clusters the major variables researched and their operationalization, presenting the relationships between causes and effects of changes in information load. In addition to giving an overview of the fields that have been researched, summarizing the development of research over the years, and presenting some methodological advice, this literature review suggests opportunities for future research. With regards to practice, useful implications can be derived, especially with regards to possible countermeasures. The strength of this literature review, focusing on accounting related topics and therefore allowing an exploration of the mechanisms at work in greater detail – for example allowing for the discussion of contradictory findings – is also a limitation: there might be findings from other disciplines that are helpful in deriving further recommendations. With major technological changes currently occurring and data analysis and decision-making becoming increasingly automated, the role of the human decision-maker will change and most likely shift from structuring and analyzing data to dealing with the output of an algorithm. This shift is unlikely to make human decision-making irrelevant in the near to mid-term. In the future, unless decision-making is completely automated, even the output of an algorithm will need to be managed by human decision-makers (e.g., Richins, Stapleton, Stratopoulos, & Wong, 2017). The effects and relationships between variables discussed here are therefore relevant even in a more automated decision-making environment.

References

Abdel-Khalik, A. R. (1973). The effect of aggregating accounting reports on the quality of the lending decision: An empirical investigation. *Journal of Accounting Research*, *11*, 104–138.

Agnew, J. R., & Szykman, L. R. (2005). Asset allocation and information overload: The influence of information display, asset choice, and investor experience. *Journal of Behavioral Finance*, *6*(2), 57–70.

Ariely, D., Gneezy, U., Loewenstein, G., & Mazar, N. (2009). Large stakes and big mistakes. *The Review of Economic Studies*, *76*(2), 451–469.

Arnold, V., Collier, P. A., Leech, S. A., & Sutton, S. G. (2000). The effect of experience and complexity on order and recency bias in decision making by professional accountants. *Accounting and Finance*, *40*(2), 109–134.

Ashton, R. H. (1974). Behavioral implications of information overload in managerial accounting reports. *Cost and Management*, 37–40.

Ashton, A. H. (1985). Does consensus imply accuracy in accounting studies of decision making? *The Accounting Review*, *60*(2), 173–185.

Barefield, R. M. (1972). The effect of aggregation on decision making success: A laboratory study. *Journal of Accounting Research*, *10*(2), 229–242.

Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, *46*(3), 610–620.

Belkaoui, A. (1984). The effects of diagnostic and redundant information on loan officers' predictions. *Accounting & Business Research*, *14*(55), 249–256.

Benbasat, I., & Dexter, A. S. (1979). Value and events approaches to accounting: An experimental evaluation. *The Accounting Review*, *54*(4), 735–749.

Berlyne, D. E. (1960). *Conflict, arousal, and curiosity*. New York, NY: McGraw-Hill Book Company.

Birnberg, J. G. (2011). A proposed framework for behavioral accounting research. *Behavioral Research in Accounting*, *23*(1), 1–43.

Bonner, S. E., & Sprinkle, G. B. (2002). The effects of monetary incentives on effort and task performance: theories, evidence, and a framework for research. *Accounting, Organizations and Society*, *27*(4–5), 303–345.

Bonner, S. E. (1999). Judgment and decision-making research in accounting. *Accounting Horizons*, *13*(4), 385–398.

Bonner, S. E., Hastie, R., Sprinkle, G. B., & Young, S. M. (2000). A review of the effects of financial incentives on performance in laboratory tasks: Implications for management accounting. *Journal of Management Accounting Research*, *12*(1), 19–64.

Brown-Liburd, H., Issa, H., & Lombardi, D. (2015). Behavioral implications of big data's impact on audit judgment and decision making and future research directions. *Accounting Horizons*, *29*(2), 451–468.

Casey, C. J. (1980). Variation in accounting information load: The effect on loan officers' predictions of bankruptcy. *The Accounting Review*, *55*(1), 36–49.

Chan, S. Y. (2001). The use of graphs as decision aids in relation to information overload and managerial decision quality. *Journal of Information Science*, *27*(6), 417–425.

Chervany, N. L., & Dickson, G. W. (1974). An experimental evaluation of information overload in a production environment. *Management Science*, *20*(10), 1335–1344.

Chewning, E. G., & Harrell, A. M. (1990). The effect of information load on decision makers' cue utilization levels and decision quality in a financial distress decision task. *Accounting, Organizations and Society*, *15*(6), 527–542.

Dickson, G. W., Senn, J. A., & Chervany, N. L. (1977). Research in management information systems: The Minnesota experiments. *Management Science*, *23*(9), 913–923.

Ding, S., & Beaulieu, P. R. (2011). The role of financial incentives in balanced scorecard-based performance evaluations: Correcting mood congruency biases. *Journal of Accounting Research*, *49*(5), 1223–1247.

Einhorn, H. J., Kleinmuntz, D. N., & Kleinmuntz, B. (1979). Linear regression and process-tracing models of judgment. *Psychological Review*, *86*(5), 465–485.

Eppler, M. J., & Mengis, J. (2004). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines. *The Information Society*, *20*(5), 325–344.

Eysenck, M. W. (1982). *Attention and arousal, cognition and performance*. Heidelberg, Germany: Springer-Verlag Berlin Heidelberg.

Fertakis, J. P. (1969). On communication, understanding, and relevance in accounting reporting. *The Accounting Review*, *44*(4), 680–691.

Gadenne, D., & Iselin, E. R. (2000). Properties of accounting and finance information and their effects on the performance of bankers and models in predicting company failure. *Journal of Business Finance & Accounting*, *27*(1–2), 155–193.

Gorry, G. A., & Scott Morton, M. S. (1971). A framework for management information systems. *Sloan management review*, *13*(1), 55–70.

Harvey, O., Hunt, D. E., & Schroder, H. M. (1961). *Conceptual systems and personality organization.* Hoboken, New Jersey: John Wiley & Sons.

Heine, B.-O., Meyer, M., & Strangfeld, O. (2007). Das Konzept der stilisierten Fakten zur Messung und Bewertung wissenschaftlichen Fortschritts. *Die Betriebswirtschaft*, *67*(5), 583–601.

Hines, R. D. (1988). Financial accounting: In communicating reality, we construct reality. *Accounting, Organizations and Society*, *13*(3), 251–261.

Hirsch, B., & Volnhals, M. (2012). Information Overload im betrieblichen Berichtswesen – ein unterschätztes Phänomen. *Die Betriebswirtschaft*, *72*(1), 23-55.

Hwang, M. I., & Lin, J. W. (1999). Information dimension, information overload and decision quality. *Journal of Information Science*, *25*(3), 213–218.

Iselin, E. R. (1988). The effects of information load and information diversity on decision quality in a structured decision task. *Accounting, Organizations and Society*, *13*(2), 147–164.

Iselin, E. R. (1989). The impact of information diversity on information overload effects in unstructured managerial decision making. *Journal of Information Science*, *15*(3), 163–173.

Iselin, E. R. (1990). Information, uncertainty and managerial decision quality: an experimental investigation. *Journal of Information Science*, *16*(4), 239–248.

Iselin, E. R. (1993). The effects of the information and data properties of financial ratios and statements on managerial decision quality. *Journal of Business Finance & Accounting*, *20*(2), 249–266.

Iselin, E. R. (1996). Accounting information and the quality of financial managerial decisions. *Journal of Information Science*, *22*(2), 147–153.

Judd, P., Paddock, C., & Wetherbe, J. (1981). Decision impelling differences: An investigation of management by exception reporting. *Information & Management*, *4*(5), 259–267.

Kaldor, N. (1961). Capital accumulation and economic growth. In F. A. Lutz & D. C. Hague (Eds.), *The Theory of Capital* (pp. 177–222). London, UK: Palgrave Macmillan UK.

Kelton, A. S., & Murthy, U. S. (2016). The effects of information disaggregation and financial statement interactivity on judgments and decisions of nonprofessional investors. *Journal of Information Systems*, *30*(3), 99–118.

Libby, R., & Lewis, B. L. (1977). Human information processing research in accounting: The state of the art. *Accounting, Organizations and Society*, *2*(3), 245–268.

Loos, P., Fettke, P., Weißenberger, B. E., Zelewski, S., Heinzl, A., Frank, U., & Iivari, J. (2011). What in fact is the role of stylized facts in fundamental research of business and information systems engineering? *Business & Information Systems Engineering*, *3*(2), 107–125.

Luft, J., & Shields, M. D. (2010). Psychology models of management accounting. *Foundations and Trends in Accounting*, *4*(3–4), 199–345.

Mason, R. O., & Mitroff, I. I. (1973). A program for research on management information systems. *Management Science*, *19*(5), 475–487.

Miller, D., & Gordon, L. A. (1975). Conceptual levels and the design of accounting information systems. *Decision Sciences*, *6*(2), 259–269.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81–97.

Miller, H. (1972). Environmental complexity and financial reports. *The Accounting Review*, *47*(1), 31–37.

Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.

Oppenländer, K.-H. (1991). Stilisierte Fakten des Innovationsprozeßes und ihre Analyse. *ifo Studien: Zeitschrift für empirische Wirtschaftsforschung*, *37*(2), 151–158.

Rakoto, P. (2005). Caractéristiques de l'information, surcharge d'information et qualité de la prédiction. *Comptabilité - Contrôle - Audit*, *11*(1), 23.

Reisen, N., & Hoffrage, U. M. F. W. (2008). Identifying decision strategies in a consumer choice situation. *Judgment and Decision Making*, *3*(8), 641–658.

Revsine, L. (1970). Data expansion and conceptual structure. *The Accounting Review*, *45*(4), 704–711.

Richins, G., Stapleton, A., Stratopoulos, T. C., & Wong, C. (2017). Big data analytics: Opportunity or threat for the accounting profession? *Journal of Information Systems*, *31*(3), 63–79.

Roetzel, P. G. (2019). Information overload in the information age: a review of the literature from business administration, business psychology, and related disciplines with a bibliometric approach and framework development. *Business Research*, *12*(2), 479–522.

Rose, J. M. (2005). Decision aids and experiential learning. *Behavioral Research in Accounting*, *17*(1), 175–189.

Rose, J. M., Roberts, F., & Rose, A. M. (2004). Affective responses to financial data and multimedia: the effects of information load and cognitive load. *International Journal of Accounting Information Systems*, *5*(1), 5–24.

Rose, J.M., & Wolfe, C. J. (2000). The effects of system design alternatives on the acquisition of tax knowledge from a computerized tax decision aid. *Accounting, Organizations and Society*, *25*(3), 285–306.

Schick, A. G., Gordon, L. A., & Haka, S. (1990). Information overload: A temporal approach. *Accounting, Organizations and Society*, *15*(3), 199–220.

Schipper, K. (1991). On analysts' forecasts. *Accounting Horizons*, *5*(4), 105–121.

Schooler, J. W. (2014). Metascience could rescue the 'replication crisis'. *Nature*, *515*(7525), 9.

Schroder, H., Driver, M., & Streufert, S. (1967). *Human information processing*. New York, NY: Holt, Rinehard & Winston.

Schwerin, J. (2001). *Wachstumsdynamik in Transformationsökonomien: Strukturähnlichkeiten seit der Industriellen Revolution und ihre Bedeutung für Theorie und Politik*. Köln, Germany: Böhlau.

Shields, M. D. (1980). Some effects on information load on search patterns used to analyze performance reports. *Accounting, Organizations and Society*, *5*(4), 429–442.

Shields, M. D. (1983). Effects of information supply and demand on judgment accuracy: Evidence from corporate managers. *The Accounting Review*, *58*(2), 284–303.

Simnett, R. (1996). The effect of information selection, information processing and task complexity on predictive accuracy of auditors. *Accounting, Organizations and Society*, *21*(7-8), 699–719.

Simon, H. A. (1960). *The new science of management decision: the Ford distinguished lectures* (3rd ed.). New York, NY: Harper.

Snowball, D. (1979). Information load and accounting reports: too much, too little or just right? *Cost and Management,* 15(3), 22–28.

Snowball, D. (1980). Some effects of accounting expertise and information load: An empirical study. *Accounting, Organizations and Society*, *5*(3), 323–338.

Sprinkle, G. B. (2003). Perspectives on experimental research in managerial accounting. *Accounting, Organizations and Society*, *28*(2-3), 287–318.

Stocks, M. H., & Harrell, A. (1995). The impact of an increase in accounting information level on the judgment quality of individuals and groups. *Accounting, Organizations and Society*, *20*(7–8), 685–700.

Stocks, M. H., & Tuttle, B. (1998). An examination of information presentation effects on financial distress predictions. In S. G. Sutton (Ed.), *Advances in accounting information systems* (6th ed.) (pp. 107–128). Stamford, Conn.: JAI Press.

Streufert, S., & Schroder, H. M. (1965). Conceptual structure, environmental complexity and task performance. *Journal of Experimental Research in Personality*, *1*(2), 132–137.

Swain, M. R., & Haka, S. F. (2000). Effects of information load on capital budgeting decisions. *Behavioral Research in Accounting*, *12*, 171–198.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285.

Tuttle, B., & Burton, F. (1999). The effects of a modest incentive on information overload in an investment analysis task. *Accounting, Organizations and Society*, *24*(8), 673–687.

Volnhals, M. (2010). *Information Overload und Controlling: Analyse kognitiver Restriktionen bei der Wahrnehmung von Berichtsinformationen*. Hamburg, Germany: Kovač.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, *26*(2), 8-13.

Weißenberger, B. E., & Löhr, B. (2008). Planung und Unternehmenserfolg: Stylized Facts aus der empirischen Controllingforschung im deutschsprachigen Raum von 1990–2007. *Zeitschrift für Planung & Unternehmenssteuerung*, *18*(4), 335–363.

Wilson, D. A. (1973). A note on "environmental complexity and financial reports". *The Accounting Review*, *48*(3), 586–588.

Winter, R. (2009). What in fact is fundamental research in business and information systems engineering? *Business & Information Systems Engineering*, *1*(2), 192–199.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes*, *37*(1), 60–82.

Wright, W. F. (1988). Audit judgment consensus and experience. In K. Ferris (Ed.), *Behavioral accounting research: a critical analysis* (pp. 305–328). Bloomington, Indiana: Century VII Publishing Company.

C Decision-Making in the Capital Budgeting Context – Effects of Type of Decision Aid and Increases in Information Load

Authors:

Maren Hartmann

Heinrich Heine University Düsseldorf

Prof. Dr. Barbara E. Weißenberger

Chair of Management Control and Accounting

Heinrich Heine University Düsseldorf

Decision-Making in the Capital Budgeting Context – Effects of Type of Decision Aid and Increases in Information Load

ABSTRACT

This paper experimentally investigates how different types of decision aids interact with increases in data load in a structured capital budgeting decision-making task. The experiment employed a 2x2 between-subjects design and was run in a course on management control systems with 136 master's degree students at a German university. Subjects were tasked with reviewing investment proposals that contained differing amounts of information (low vs. high data load, i.e., irrelevant information cues in addition to those relevant for the decision). The second manipulation referred to the type of decision aid – either a detailed, rules-based capital budgeting guideline with clear cut-off rates, or the advice to employ generally accepted criteria for investment decision-making. The dependent variables investigated were perceived task complexity, decision accuracy, and decision confidence. Increases in data load led to an increase in perceived task complexity. There was only limited evidence for experimental conditions affecting decision accuracy. The group of subjects relying on the capital budgeting manual reported significantly higher decision confidence. Implications for practice on how to provide decision-makers with information for investment decision-making are derived.

Keywords: information overload, decision-making, decision aid, capital budgeting

JEL Classification: M41; D83; C91; D91

1. Introduction

Even though capital budgeting decisions generally have a major impact on financial performance, many firms decentralize at least some of these decisions. Despite potential agency problems, delegating authority to lower levels of the organizational hierarchies can be beneficial, for example, as information is only available at the local or divisional level, or is costly to obtain and process (see the summary by Hoang, Gatzer, & Ruckes, 2018). To ensure that the firm's capital is still allocated wisely to the most profitable projects, while considering both opportunities and risks, decision-makers are provided with accounting information on these projects. Often, additional guidelines are provided that must be followed during the decision-making process to further ensure that capital budgeting decisions are made in compliance with corporate goals (e.g., Istvan, 1961; Mukherjee, 1988; Segelod, 1995, 1997).

Nevertheless, there is no evidence to date on how the design of these guidelines and the information provided within investment proposals affect individual decision-making. Therefore, this paper analyzes the effects of increases in information load on decision-making performance and confidence under the presence of two forms of decision aids, that is, a rules-based capital budgeting manual and general principles for investment valuation.

Information overload research in accounting has a long history and goes back to the 1960s. At that time, based on the model by Schroder, Driver and Streufert (1967), researchers investigated the extent to which providing more detailed information in external reporting might influence decision quality on a conceptual level (e.g., Fertakis, 1969; Miller, 1972). Since then, the effects of increases in information load have been researched more broadly, ranging from investigations into the effects of increasing information load on financial distress predictions (e.g., Iselin, 1993; Stocks & Harrell, 1995) to capital budgeting decisions (e.g., Swain & Haka, 2000), performance report analysis (Shields, 1980, 1983), and auditing (e.g., Arnold, Collier, Leech, & Sutton, 2000). While the information set is one input factor into models for task performance (see Bonner, 1999; Bonner & Sprinkle, 2002), the task at hand (e.g., complexity of the task; Wood, 1986) is likely to impact the quality of managerial decisions as well. Employing different kinds of decision aids ultimately changes the nature of the task. However, few papers address both increases in information load, or more specifically, data load (used here to refer to irrelevant information; Iselin, 1993), in conjunction with changes in the way a task is designed. The types of decision aids provided are inspired by the debate around rules versus principles (e.g., Nelson, 2003): one decision aid employs a detailed checklist, while the other relies on general investment principles. To investigate the described interaction between increases in data load and different forms of decision aids, an experiment was set in a capital budgeting context and placed subjects in the role of employees in the management accounting department, their jobs involving the

approval or rejection of investment proposals. In all groups, subjects received investment proposals and information on budget constraints for different product segments of a fictitious company.

Manipulations were implemented via (1) data load in the investment proposals (“low” vs. “high”) and (2) the decision aid to be used ("capital budgeting manual" vs. "general principles"). Regarding the manipulation of data load in the investment proposals, one version contained relevant information cues and very few irrelevant information cues ("low data load"), whereas the other version contained the same relevant information cues plus a high number of irrelevant information cues ("high data load"). For the manipulation of the decision aid, subjects in the "capital budgeting manual" condition were advised to rely on an investment manual that clearly specified which thresholds to use, for example regarding the discount rates to be employed for different investment categories and countries and the required payback period. Subjects in the "general principles" condition were instructed to rely on generally accepted criteria for investment valuation: net present value (NPV), payback period, and risk. In addition, they received information with regards to comparative riskiness of different investment categories and countries. Thus, whereas subjects in the "capital budgeting manual" condition were employing a checklist-type approach, comparing the values in the investment proposals to the thresholds specified in the capital budgeting manual, subjects in the "general principles" condition needed to prioritize investment proposals per product segment based on the principles described in the instructions.

The results from the experiment shed light on how important variables in the domain of decision performance, such as decision accuracy, decision confidence and perceived task complexity, are influenced by variations in the data load and decision aids provided. It contributes to the existing literature by allowing the derivation of implications as to how to provide individuals with management accounting information for structured decision-making within the capital budgeting domain.

2. Literature Review

A central element of management accounting research is the evaluation of different practices with regards to their effectiveness in improving judgment and decision-making performance (Sprinkle, 2003). A way to do this is to study individual judgments and decisions, evaluating how different factors influence the variables of interest, for example judgment or decision accuracy (Luft & Shields, 2003). An experimental approach is considered especially useful if the impact of managerial accounting practices on individual behavior is explored (Sprinkle, 2003). Among the factors shown to affect decision-making processes and outcomes are the amount of information available and the context (e.g., task type, instructions) in which decision-making takes place (e.g., Libby & Lewis, 1977).

The effects of increases in information load have been analyzed in a variety of fields and have since long been of special interest to accounting researchers (Schick, Gordon, & Haka, 1990). In the capital budgeting domain, Swain and Haka (2000) provide evidence that an increase in information load leads to changes in search patterns. More recently, based on the experiment conducted in Volnhals (2010), Hirsch and Volnhals (2012) describe that decision quality decreased beyond a certain point of information input and that managers were not sufficiently aware of information overload effects and therefore exhibited overconfidence concerning the quality of their decisions.

Nevertheless, decision-making should not be analyzed solely with reference to information load – Bonner and Sprinkle (2002), extending the model proposed by Bonner (1999), describe performance in a given task as being determined by a broad set of variables relating to person, task, environmental, and incentive scheme characteristics. Therefore, to comprehensively assess the impact of increases in information (or data) load (irrelevant information cues; Iselin, 1993), task characteristics must also be taken into account (Iselin, 1988; Libby & Lewis, 1977; Schroder et al., 1967).

Nevertheless, to date, only few studies have addressed information load and further task characteristics in conjunction. One of the few exceptions is Chan (2001), who found no significant effect of graphs as decision aids in improving decision-making under information overload. Kelton and Murthy (2016) investigated the impact of interactive drilldowns and found them to reduce perceived cognitive load and earnings fixation under certain conditions. In the capital budgeting context, management accounting researchers have not yet investigated the question of whether a variation in task structure through different kinds of decision aids influences individuals' ability to cope with increases in data load, even though capital budgeting manuals are widely used in organizations (Istvan, 1961; Mukherjee, 1988; Segelod, 1995, 1997).

Additionally, literature has found variations in the effectiveness of different types of decision aids. Wheeler and Arunachalam (2008), for example, found that a checklist-type decision aid might lead to an increase in confirmatory search behavior. Another potential limitation of decision aid use is an overly mechanistic behavior (Dowling & Leech, 2007). A comparison of different kinds of capital budgeting guidelines (e.g., rules-based vs. principles-based decision aids) thus contributes to our understanding of which type of decision aid might be preferable.

3. Hypotheses Development

3.1. Task Complexity

Concerning task characteristics, an important dimension is the complexity of a given task (Bonner & Sprinkle, 2002). According to Wood (1986), task complexity can be divided into three elements of complexity: component complexity, coordinative complexity, and dynamic complexity. The level of

component complexity depends on the number of actions required to perform a task and the number of information cues that must be processed for each action. Coordinative complexity refers to the form of the relationship between task input (actions and information cues) and task output (the resulting product). The more constraints (e.g., timing, sequence) are to be considered when performing a task, the higher is the coordinative complexity. Both dimensions are relevant in our research context. Wood (1986, p. 71) describes dynamic complexity as being "due to changes in the states of the world which have an effect on the relationships between task inputs and products," thus requiring subjects to adapt to changes in the input-output relationship of a task, for example using different information cues or doing a task in a different order. This is not relevant in this context, as the relationship between task inputs and task outputs does not change during our experiment (Bonner, Hastie, Sprinkle, & Young, 2000).

The design of the two forms of decision aids employed in the experiment discussed here can be related to the principles versus rules-based discussion in accounting contexts (e.g., Nelson, 2003). Whereas decisions in the "capital budgeting manual" condition needed to be made based on thresholds and a set of clear rules, decisions in the "general principles" condition had to be made by prioritizing investment based on principles. Applying the task-complexity concept of Wood (1986) to this issue, Nelson (2003) states that additional rules (as it is the case in the "capital budgeting manual" condition) have ambiguous effects on task complexity, as more rules are likely to increase component complexity but might also reduce coordinative complexity. According to Wood (1986), it is not possible to specify exact weights for the different types of complexity to calculate overall task complexity, but he notes that the weights associated to the different components should be highest for dynamic complexity, followed by coordinative complexity, then component complexity. We expect the decrease in coordinative complexity to be larger than the increase in component complexity when subjects are provided with a capital budgeting manual, which leads to the first hypothesis:

Hypothesis 1: Perceived task complexity will be higher for the "general principles" condition than for the "capital budgeting manual" condition.

Increases in data load are likely to result in increased component complexity, as more information cues must be considered (Wood, 1986), leading to an increase in perceived overall task complexity:

Hypothesis 2: Perceived task complexity will be higher for the "high data load" condition than for the "low data load" condition.

3.2. Decision Accuracy

According to Bonner and Sprinkle (2002), task complexity may affect performance in several ways: by decreasing effort duration and intensity; by making individuals focus more or less on strategy development; or by requiring higher skills for more complex tasks, influencing the relationship between effort and performance. More specifically, Bonner and Sprinkle (2002); citing expected utility theory and the adaption by Payne, Bettman, and Johnson (1993), assume effort duration and intensity to decrease when the task is more complex as individuals might consider the relationship between effort and performance as less favorable. This might lead them to invest less effort, which can be amplified further when self-efficacy regarding the task is low or cannot easily be assessed, as may be the case for simpler tasks. Compared to simpler tasks, more complex tasks also require higher skill levels and more strategy development, which is only beneficial in repeated settings but defers effort from the task in the short run (Bonner & Sprinkle, 2002).

As task structure increases, task complexity decreases (Bonner & Sprinkle, 2002; Wood, 1986). With regards to the experiment, subjects in the "capital budgeting manual" condition faced a more structured task than subjects in the "general principles" condition. In addition, subjects in the "general principles" condition needed to rely on their knowledge to prioritize the investment alternatives, which was not the case in the "capital budgeting manual" condition. It is also likely that in the "general principles" condition, more strategy development would be necessary.

However, there are also factors that might counteract these effects. Firstly, subjects in the "capital budgeting manual" condition needed to familiarize themselves with longer and more detailed instructions, which might divert effort to the instructions away from the task. In addition, a decision aid employing checklist mechanisms might lead to a bureaucratization effect and an overly "mechanical" behavior that might in turn lead to errors.

Nevertheless, we assume the previously named factors to have a stronger influence on decision accuracy, which leads to the third hypothesis:

Hypothesis 3: Decision accuracy will be higher for the "capital budgeting manual" condition than for the "general principles" condition.

As noted above, increases in data load might also cause increases in task complexity, affecting performance. There are different mechanisms through which increases in data load affect decision-making performance. Luft and Shields (2010) highlight two reasons why increases in information load above a certain level are likely to impair decision quality: firstly, via sub-optimal strategies in selecting information, an increase in absolute quantity of information might decrease the relative amount of information investigated (Payne et al., 1993). Secondly, with an increase in information quantity, the

selection process requires more of the limited human information processing capacity, which leads to an inverted-U relationship between information quantity and information integration (Schroder et al., 1967). In a related research avenue, Iselin (1993) differentiates between information load and data load, defining data load as information cues that are irrelevant to the decision. In the experiment at hand, we manipulated data load (additional irrelevant information cues). Research in different fields has shown that individuals seek irrelevant information and subsequently incorporate it into their judgments (Bastardi & Shafir, 1998). The presence of additional information, even if irrelevant, can lead to diluted judgments in audit settings (Hackenbrack, 1992) or to overconfidence in accuracy of one's answers (Fleisig, 2011). Moreover, irrelevant information is likely to increase demands on the capacity for filtering, which can lead to errors (Iselin, 1993). All in all, the presence of irrelevant information can be hypothesized to impair decision-making performance:

Hypothesis 4: Decision accuracy will be lower for the "high data load" condition than for the "low data load" condition.

3.3. Decision Confidence

Decision confidence is of interest to researchers as people are more likely to act upon their judgments if they are more confident (Chung & Monroe, 2000; Norman, 1975). It is thus desirable that decision confidence is high when decision accuracy is high. If the opposite is true, high confidence might lead to non-desirable actions (Chung & Monroe, 2000). Chung and Monroe (2000) found a negative relationship between task difficulty and confidence in an audit setting. In the context of general knowledge questions, Kelley and Lindsay (1993, p. 2) argue that the "fluency" with which an answer comes to mind has positively affects confidence in one's answer. As described above, task difficulty is hypothesized to be lower in the "capital budgeting manual" condition, which should positively affect decision confidence. Lower task difficulty might also contribute to the "fluency" (Kelley & Lindsay, 1993, p. 2) of the decisions made:

Hypothesis 5: Decision confidence will be higher for the "capital budgeting manual" than for the "general principles" condition.

Concerning the effects of increases in information load on decision confidence, the predictions are less clear. On the one hand, increases in information load might lead to a decrease in decision confidence via increases in task complexity (see hypothesis 2). On the other hand, additional information might lead to overconfidence via the impression of having used many information cues (Einhorn, Kleinmuntz, & Kleinmuntz, 1979; Shepard, 1964). Fleisig (2011) experimentally demonstrated that adding information may lead to overconfidence in knowledge retrieval. As we cannot predict which effect might be stronger, we do not formulate a hypothesis for the effects of increases in data load on decision confidence.

4. Research Design

4.1. Overview of the Experimental Task

The experimental task employed a 2x2 between-subjects design, referring to differing decision aids ("capital budgeting manual" vs. "general principles") and data load ("low" vs. "high"). The experiment was conducted with 136 master's degree students participating in a course on management control systems at a German university in December 2013. As the experimental task contributed to the learning goals of the course, there were no monetary incentives. The materials were pretested by twelve people with an educational background in business administration. There was no time limit for the completion of the task and the experiment lasted for approximately 50 minutes. The experimental materials can be found in the appendix and are summarized in the following sections.

In all groups, subjects received seven investment proposals and information on budget constraints for different product segments of a fictitious company ("Smith PLC"). As noted above, manipulations were implemented through (1) data load in the investment proposals ("low" vs. "high") and (2) the decision aid to be used ("capital budgeting manual" vs. "general principles"). Both groups received the same instructions with regards to budget constraints, saying that they should not approve more investment proposals than would be covered by the budget available for the different product segments (household, entertainment, and telecommunications). This was followed by the manipulation of the decision aid by providing the subjects with either a capital budgeting manual or an overview on general principles. Subjects then reviewed the investment proposals, which they received as a separate handout and which constituted the data load manipulation. They were then asked to decide whether to accept or reject the investment proposal ("Do you approve the investment described in investment proposal X? – yes or no") and indicated decision confidence on a 7-point Likert scale for each decision ("On a scale from 1 to 7, how sure are you of the decision made?"). If they decided to reject a proposal, subjects were also asked for a short comment on the reasons. The experiment concluded with a post-experimental questionnaire. At certain points during the experiment, subjects were asked to write down the time (a stopwatch was projected at the wall). The primary dependent variables of interest were perceived task complexity, decision accuracy (this was possible as there was a clear solution to the task; Wheeler & Murthy, 2011), and subjective decision confidence. Figure 1 illustrates the structure of the experiment.

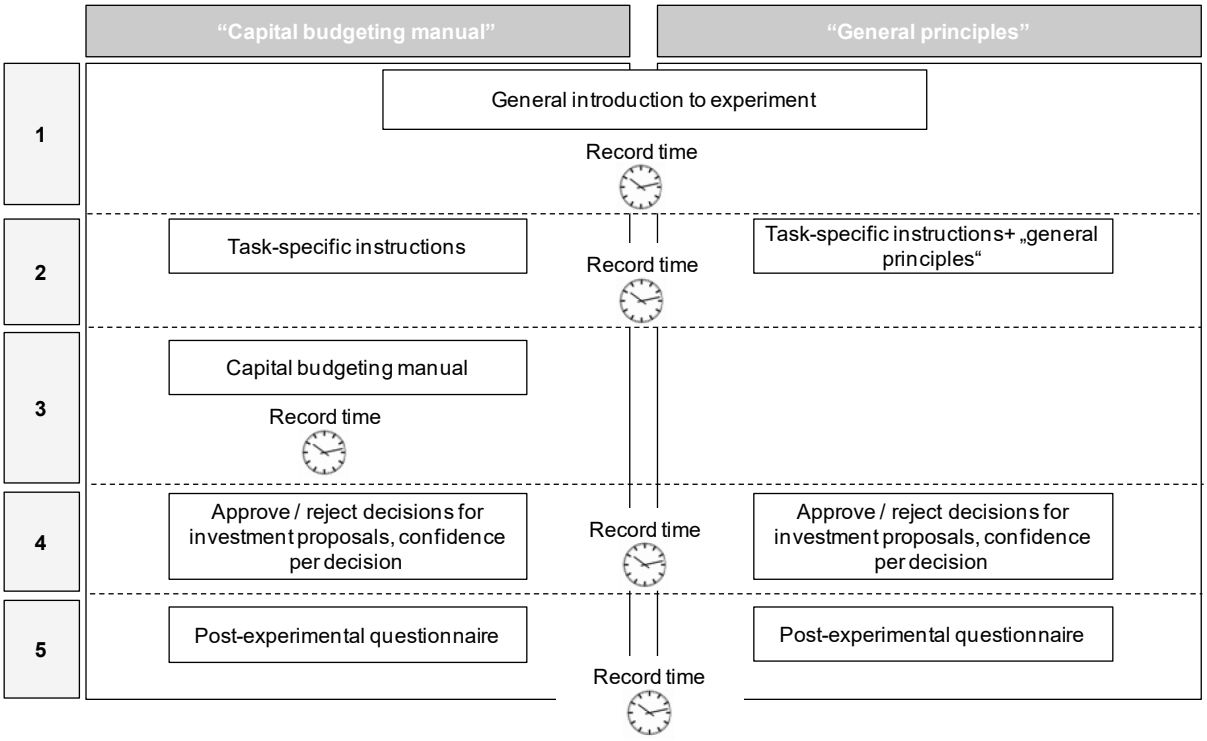


Figure 1: Overview - Structure of Experiment

4.2. Manipulation of the Decision Aid

For the manipulation of the decision aid, subjects in the "capital budgeting manual" condition were advised to rely on an investment manual (three pages) that clearly specified which thresholds to use, for example regarding the discount rates to be employed for different investment categories and countries or the required payback period. Subjects in the "general principles" condition were instructed to rely on generally accepted criteria for investment valuation that were then specified as net present value, payback period, and risk. In addition, they received information concerning the order of riskiness of different investment categories and countries: "the risk of the specific country must be taken into account: Japan > USA > Switzerland > France > Germany" and "the risk regarding the investment category must be taken into account: new investment (risk category 3) > expansion investment, rationalization investment, compliance investment (each one risk category 2) > replacement investment (risk category 1)." Subjects in the "general principles" condition were also reminded that the discount rate mirrored the risk already incorporated in the calculation of the net present value and that it consisted of the weighted average cost of capital (WACC, 12%), an adjustment for the risk category of the investment category, and a country-specific adjustment.

Subjects in the "capital budgeting manual" condition were to compare the values in the investment proposals to the thresholds specified in the capital budgeting manual, whereas subjects in the "general principles" condition needed to prioritize investment proposals per product segment based on the principles described in the instructions. The two groups should thus arrive at the same decisions, but through different argumentations.

The following example illustrates the rationale for the decision regarding the investment proposals in the telecommunications segment. There were two investment proposals, each with an initial investment of €250,000. From the budget constraint for the telecommunications segment (€250,000), it was clear that only one investment proposal could be approved. Subjects relying on the capital budgeting manual would see that the payback period for investment proposal "F" was above the threshold specified in the capital budgeting manual, whereas subjects in the "general principles" condition would compare the two investment proposals on the criteria described in the general principles sections and see that alternative "G" dominates alternative "F," being equal on all criteria except for the payback period, which was lower for "G."

Table 1 provides an overview of the rationale for approving or rejecting decisions for each investment proposal. The decision to reject was described as giving the investment proposal back to the requestor. All groups received a glossary with definitions for the terms used in the experimental materials (e.g., NPV, payback period, WACC). We included a reverse order of investment proposals across all cells to control for possible order effects.

Table 1: Overview of Investment Proposals and Appropriate Approve/Reject Decision

Identi-fier	Segment	Budget per Segment	Acquisition cost	NPV	Payback Period	Risk-category	Country	Type of investment	Discount rate	Ranking	Decision based on rules-based capital budgeting manual	Decision based on "general principles"
A	Household	3,000,000.00 €	3,000,000.00 €	600,000.00 €	3	3	DE	New investment	17.00%	A>B	Approve, as all criteria in the capital budgeting manual are fulfilled	Approve, as alternative A dominates alternative B (relevant criteria are the same, except for country risk, which is lower for alternative A). Due to the budget constraint, only one alternative can be approved.
B	Household	3,000,000.00 €	3,000,000.00 €	600,000.00 €	3	3	J	New investment	17.00%	A>B	Reject, as the discount rate used is too low (country-specific risk is only taken into account with 0,00%, should be 2,00%)	Reject, as alternative A dominates alternative B. Alternative reason: the discount rate used is the same as in alternative A, although a higher addition for country risk should be taken into account. If a higher discount rate were used, the investment's NPV would be lower than that of alternative A. Due to the budget constraint, only one alternative can be approved.
C	Entertainment	1,500,000.00 €	1,500,000.00 €	300,000.00 €	3	1	F	Replacement	11.50%	C>D and C>E	Approve, as all criteria in the capital budgeting manual are fulfilled	Approve, as alternative C dominates alternatives D and E. Due to the budget constraint, only one alternative can be approved.
D	Entertainment	1,500,000.00 €	1,500,000.00 €	- 235,178.09 €	5	1	F	Replacement	11.50%	C>D and C>E	Reject, as NPV negative and payback period too high	Reject, as NPV negative - the alternative is thus less attractive than alternative C.
E	Entertainment	1,500,000.00 €	1,500,000.00 €	300,000.00 €	3	2	F	Expansion investment	11.50%	C>D and C>E	Reject, as discount rate used is too low (risk adjustment based on risk category is too low: -1,00% used instead of 0,00%)	Reject, as alternative C dominates alternative E: relevant criteria are the same, except for risk with regards to the investment category, which is lower for alternative C. Alternative reason: the discount rate used is the same as in alternative A, although a higher addition for risk with regards to the investment category should be taken into account. If a higher discount rate were used, the investment's NPV would be lower than that of alternative C. Due to the budget constraint, only one alternative can be approved.
F	Telecommunication	250,000.00 €	250,000.00 €	100,000.00 €	4	2	CH	Rationalisation investment	13.00%	G>F	Reject, as payback period is too high	Reject, as alternativ G dominates alternative F (relevant criteria are the same, except for payback period, which is higher for alternative F). Due to the budget constraint, only one alternative can be approved.
G	Telecommunication	250,000.00 €	250,000.00 €	100,000.00 €	3	2	CH	Expansion investment	13.00%	G>F	Approve, as all criteria in the capital budgeting manual are fulfilled	Approve, as alternative G dominates alternative F. Due to the budget constraint, only one alternative can be approved.

=accept
= reject = back to requestor

4.3. Design of the Capital Budgeting Manual and Investment Proposals

The layout and contents of the fictitious capital budgeting manual and the investment proposals used in the experiment were inspired by empirical studies on capital budgeting, in particular those analyzing capital budgeting manuals (Mukherjee, 1988; Segelod, 1995, 1997). We also used studies on capital budgeting practice (Arnold & Hatzopoulos, 2000; Brunzell, Liljeblom, & Vaihekoski, 2013; Graham & Harvey, 2001; Istvan, 1961; Oblak & Helm, 1980; Pike, 1996; Ryan & Ryan, 2002), practitioners' literature (Bragg, 2011; Fabozzi, Peterson Drake, & Polimeni, 2008; Moles, Parrino, & Kidwell, 2011; veb.ch, 2011), and textbooks (Ross, 2007), trying to balance the need for a certain degree of realism with the need for a focus on the most important characteristics for the experimental task.

The capital budgeting manual contained the following sections: “goals and contents of the capital budgeting manual,” “classification of investments,” “contents of investment proposals,” and “valuation of investments.” These sections described which discount rates to use depending on country and investment category and when to accept or reject investment alternatives based on thresholds for NPV and payback period.

As noted above, for the manipulation of data load in the investment proposals, there was one version that contained relevant information cues and very few irrelevant information cues ("low data load") whereas the other version contained the same relevant information cues plus a high number of irrelevant information cues ("high data load"). Table 2 illustrates the contents of the investment proposals for low versus high data load.

Table 2: Contents of Investment Proposals

Nr.	Section	Contents	Relevant for decision?	Low data load	High data load
1	**Project identifier**		**yes**	✓	✓
2	**Project name**		**no**	✓	✓
3	**General information**	Name of requestor	**no**	**x**	✓
		Name of project lead	**no**	**x**	✓
		Investment category	**yes**	✓	✓
		Segment	**yes**	✓	✓
		Country	**yes**	✓	✓
4	**Reviews**		**no**	**x**	✓
5	**Brief description**		**no**	✓	✓
6	**Key figures**	Net present value	**yes**	✓	✓
		Payback period	**yes**	✓	✓
		Initial investment	**yes**	✓	✓
		Operating life	**no**	**x**	✓
		Annuity	**no**	**x**	✓
		Internal rate of return	**no**	**x**	✓
		Profitability index	**no**	**x**	✓
		Cash-out in t = 0	**no**	**x**	✓
		Modified internal rate of return	**no**	**x**	✓
		Average accounting return	**no**	**x**	✓
		Average operating costs	**no**	**x**	✓
		Average sales	**no**	**x**	✓
7	**Commentary**		**no**	✓	✓
8	**Calculation of cashflows**		**no**	Aggregated: 3 lines	Detailed: 15 lines
9	**Assumptions for calculations**	Discount rate used	**yes**	✓	✓
		Average price per unit	**no**	**x**	✓
		Market share	**no**	**x**	✓
		Market size	**no**	**x**	✓
		Average variable costs per unit	**no**	**x**	✓
10	**Further information**	Risk category	**yes**	✓	✓
		Composition of the discount rate	**yes**	✓	✓
		Assumptions for sensitivity analysis	**no**	**x**	✓
		Sensitivity analysis for average sales; operating costs; average accounting return; profitability index; and internal rate of return for pessimistic, expected, and optimistic case.	**no**	**x**	✓

✓= included in the investment proposal; **x** = not included in the investment proposal,

= relevant for decision-making; = irrelevant for decision-making

4.4. Post-Experimental Questionnaire

Besides manipulation checks focusing on the experimental materials the subjects received, a variety of items to control for possible intervening variables were included. We employed scales that measured personal characteristics, that is, subjective knowledge and experience in investment decision-making; the "Big Five" dimensions on personality, especially conscientiousness (Lang, Lüdtke, & Asendorpf, 2001; Rammstedt & John, 2007); subjects' time perspectives (Zhang, Howell, & Bowerman, 2013); and general sociological factors. With regards to perceived task characteristics, we included scales for task complexity and task attractiveness (Fessler, 2003; Scott & Erskine, 1980). As a measure for effort duration, we used the time spent on the tasks recorded by the subjects (Bonner & Sprinkle, 2002), and we also asked subjects to fill in a self-report measure of effort intensity (Yeo & Neal, 2004), time pressure (Glover, 1997), motivation, and expected performance on the task.

5. Results

5.1. Descriptives and Manipulation Checks

In the course of the experiment, 136 questionnaires were collected. As manipulation checks for the between-subjects variables, we used two basic questions regarding the experimental materials the subjects received.

The first manipulation check referred to the "capital budgeting manual" versus "general principles" manipulation. Subjects chose one out of three possible answers regarding the experimental materials received:

- "Investment proposals needed to be evaluated based on a capital budgeting manual comprising several pages" (the correct answer for the "capital budgeting manual" condition)
- "There was no capital budgeting with several pages, but the instructions provided general principles for prioritization of investments" (the correct answer for the "general principles" condition)
- "In the materials received, there were no instructions as how to evaluate the investment proposals; evaluation could be performed by self-selected criteria" (this answer should not be chosen by either of the two groups).

The second manipulation check referred to the amount of information in the investment proposals (high vs. low data load manipulation). Again, one out of three answers had to be chosen:

- "The investment proposals contained no key figures" (this statement was wrong for both groups)
- "The field 'key figures overview (expected scenario)' contains fewer than 5 key figures" (applies to the "low data load" condition)

- "The field 'key figures overview (expected scenario)' contains more than 5 key figures" (applies to the "high data load" condition).

Out of the 136 subjects, 98 subjects answered both questions correctly, and two out of the 98 subjects, based on their comments, apparently did not take the task seriously or did not complete the questionnaire. This leaves us with 96 questionnaires. The analyses were also run for the total subject pool, including the subjects who failed to answer either one or both manipulation check questions correctly. When taking all 136 subjects into account, a total of four subjects were excluded from analysis as they did not take the task seriously (two in addition to the two subjects mentioned above), which then resulted in a group of 132 subjects. Results based on the total (n = 132) subject pool were qualitatively the same for most analyses. Where this was not the case, the results for the total group are reported in the footnotes.[1]

The following analysis results are based on the 96 subjects described above. All of these subjects indicated that they studied business or economics as a major. 89 subjects indicated German as their mother tongue. The average age was 25.03 years (n = 94; two subjects did not indicate their age; the mean age was approximately equal across groups, ranging from 24.80 to 25.52). 54 subjects were female; 42 subjects were male. The following table shows the resulting number of subjects by gender in each cell:

Table 3: Number of Subjects in Each Cell

		data load			
		low data load		high data load	
		female	male	female	male
decision aid	general principles	12	13	10	10
	capital budgeting manual	13	8	19	11

In the post-experimental questionnaire, several questions were included that were used to verify that there were no systematic differences between the groups. One-way ANOVAs conducted across all four groups revealed no significant differences between groups for self-reports (7-point Likert scales) for motivation, the influence of seeing a stopwatch and having to report the time, estimated theoretical

[1] "n=132" in the footnotes refers to the total number of subjects included in the respective analysis. However, as not all questions have been answered by all subjects, some results include missing values, effectively reducing the n for which the analysis could be run.

knowledge on investment decision-making, practical experience in investment decision-making, and motivation for completing the task. Furthermore, there was no significant difference across groups for age, the grade they presented to enter university, or the score for a selected number of questions on investment decision-making.

In addition to the basic manipulation checks described above, we were interested in how subjects perceived the information load in the investment proposals. This can be considered an additional check to verify whether the data load manipulation was effective. We therefore included a question regarding the perceived amount of information in the investment proposals (on a 7-point Likert scale anchored by “very little information” and “very much information”) and a question regarding the estimated percentage of information used.

Subjects in the high data load condition were expected to score higher on the first question and lower on the second question; the reverse was expected for the subjects in the low data load condition. The following tables show the means, standard errors, and medians for the two variables across experimental cells.

Table 4: Perceived Information Load – Descriptives

Perceived information load

		Data load		
		low data load	high data load	low data load and high data load combined
Decision aid	general principles	n = 25 M = 3.36 SE = 0.28 Mdn = 4	n = 20 M = 5.35 SE = 0.23 Mdn = 5.50	n = 45 M = 4.24 SE = 0.24 Mdn = 4
	capital budgeting manual	n = 21 M = 3.67 SE = 0.22 Mdn = 4	n = 30 M = 5.33 SE = 0.21 Mdn = 6	n = 51 M = 4.65 SE = 0.19 Mdn = 5
	"general principles" and "capital budgeting manual" combined	n = 46 M = 3.5 SE = 0.18 Mdn = 4	n = 50 M = 5.34 SE = 0.16 Mdn = 6	

Table 5: Percentage of Information Used – Descriptives

Used information

		Data load		
		low data load	high data load	low data load and high data load combined
Decision aid	general principles	n = 25 M = 52.8% SE = 4.16% Mdn = 50.00%	n = 19 M = 28.74% SE = 4.22% Mdn = 25.00%	n = 44 M = 42.41% SE = 3.47% Mdn = 37.50%
	capital budgeting manual	n = 21 M = 69.52% SE = 4.05% Mdn = 70.00%	n = 30 M = 32.27% SE = 3.91% Mdn = 30.00%	n = 51 M = 47.61% SE = 3.83% Mdn = 50.00%
	"general principles" and "capital budgeting manual" combined	n = 46 M = 60.43% SE = 3.15% Mdn = 65.00%	n = 49 M = 30.9% SE = 2.88% Mdn = 30.00%	

As predicted, the scores for "perceived information load" are significantly higher in the "high data load" condition (*Mdn* = 6) than in the "low data load" condition (*Mdn* = 4); U = 1,986.50, z = 6.27, $p < .001$, r = .64. Correspondingly, subjects in the "high data load" condition reported significantly lower scores for "percentage of information used" than in the "low data load" condition. Medians are 30.00% and 65.00% respectively (U = 360.50, z = -5.73, $p < .001$, r = -.59).

Interestingly, for the "low data load" condition, there was a statistically significant difference for "percentage of information used" between the "capital budgeting manual" and the "general principles" groups, although the number of information cues inspected should be the same for both groups. Subjects in the "capital budgeting manual" condition reported having used more information (*Mdn* = 70.00%) than subjects in the "general principles" condition (*Mdn* = 50.00%); U = 382.00, z = 2.66, p = .008, r = .39.[2] A possible reason for the "capital budgeting manual" group reporting having used more information might be that subjects subconsciously considered the contents of the capital budgeting manual as information cues. There is, however, no statistically significant difference for "used information" between those who relied on the capital budgeting manual and those who relied on general principles for the "high data load" condition.

[2] For n = 132, the difference was only marginally significant with *Mdn* = 60% for the "general principles" condition and *Mdn* = 70% for the "capital budgeting manual" condition: U = 608.50, z = 1.73 , p = .087, r = .22

In addition to the questions regarding perceived information load and use, questions regarding the characteristics of the decision aid ("general principles" vs. "capital budgeting manual") were included. With regards to the rules versus principles discussion, we wanted to discover if there was a difference between the conditions with regards to typical characteristics of rules-based instructions. We therefore included statements referring to "bright-line thresholds," a high number of rules, very detailed rules, and very precise rules; inspired by Nelson (2003, p. 91). There was also one question asking if general principles had to be followed. For this purpose, 7-point Likert scales with anchors "does not apply at all" and "completely applies" were used. Our data provide evidence for the "bright-line thresholds," as with respect to this question, subjects in the "general principles" condition scored higher (*Mdn* = 7) than subjects in the "capital budgeting manual" condition (*Mdn* = 5.50);[3] *U* = 1,489.50, *z* = 2.88, *p* = .004, *r* = .30.[4]

5.2. Perceived Task Complexity

Hypothesis 1 predicted that subjects in the "general principles" condition would perceive the task as being more complex than subjects in the "capital budgeting manual" condition; hypothesis 2 predicted that perceived task complexity would be higher for the "high data load" condition.

Perceived task complexity was measured using the scale employed by Scott and Erskine (1980) – three 7-point Likert scales anchored by "difficult-easy," "complex-simple," and "varied–routine." Reliability, as measured by Cronbach's Alpha, improved from .69 to .83 when the item "varied-routine" was deleted. A score was calculated by summing the scores on the two remaining items.

A two-way independent ANOVA revealed a significant main effect of data load on perceived task complexity, $F(1, 92) = 7.07$, $p = .009$. The main effect of whether subjects received general principles or the capital budgeting manual was only marginally significant , $F(1, 92) = 3.34$, $p = .071$.[5] The interaction term was not significant, $F(1, 92) = 0.11$, $p = .746$. The detailed results can be found in the appendix (Tables 7–9).[6]

[3] One subject answered "5-6," which was coded as 5.5.

[4] For n = 132 subjects, there was a significant difference for two additional questions: the "general principles" group scored higher (*Mdn* = 6.00) than the "capital budgeting manual" group (*Mdn* = 5.00) on the question of whether general principles had to be followed: *U* = 1,740.50, *z* = -2.03, *p* = .043, *r* = -.18. In addition, surprisingly, the general principles group scored also higher (*Mdn* = 4.00) than the capital budgeting manual group (*Mdn* = 3.00) on the question of whether a high number of rules needed to be considered: *U* = 1,741.50, *z* = -2.02, *p* = .044, *r* = -.18.

[5] The effect of whether subjects received general principles or a capital budgeting manual is significant when including n = 132 subjects: $F(1, 127) = 7.07$, $p = .009$.

[6] To investigate whether the distribution of the perceived task complexity score is approximately normal, normality of residuals across all experimental group was investigated, a Shapiro-Wilk test and the histogram and normal Q-Q plot of residuals indicate that data are sufficiently close to normality (see Tables 10–12 and Figures 10–11 in the appendix).

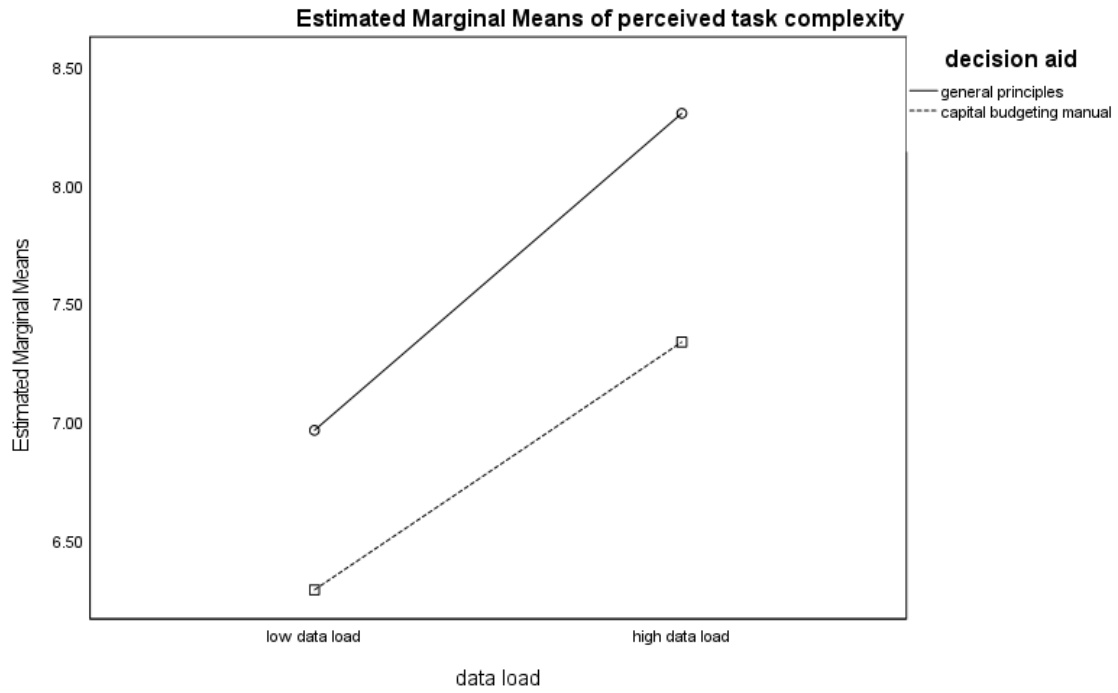


Figure 2: Estimated Marginal Means of Perceived Task Complexity

The use of a Mann-Whitney *U*-test revealed the differences in perceived task complexity triggered by increases in data load in the "general principles" and "capital budgeting manual" conditions: the increase in perceived task complexity caused by an increase in data load was only statistically significant for the "general principles" group ($U = 339.50$, $z = 2.07$, $p = .039$, $r = .31$) but not for the "capital budgeting manual" group ($U = 389.50$, $z = 1.44$, $p = .150$, $r = .20$).[7]

[7] The effect was also significant for the capital budgeting manual condition when including n = 132 subjects: $U = 651.50$, $z = 2.09$, $p = .037$, $r = .26$.

Using the Jonckheere-Terpstra test for ordered alternatives, we found evidence that perceived task complexity was influenced by both increases in data load and whether subjects relied on general principles or the capital budgeting manual. This result indicates a trend in increasing perceived task complexity from "capital budgeting manual" and "low data load" to "general principle" and "high data load" (J = 2,122.00, z = 2.72, p = .007, r = .28; Figure 3).

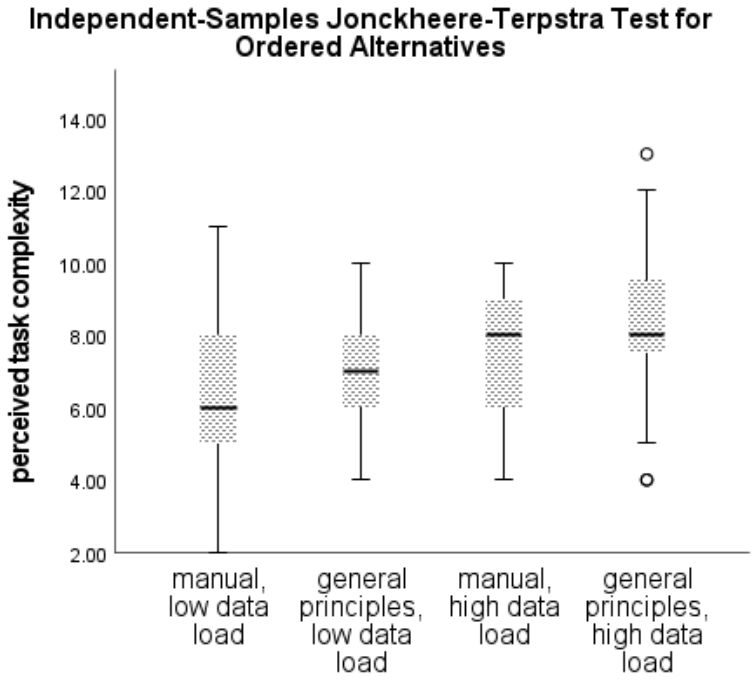


Figure 3: Independent-Samples Jonckheere-Terpstra Test for Ordered Alternatives – Perceived Task Complexity

5.3. Decision Accuracy

To test hypothesis 3 (decision accuracy will be higher for the "capital budgeting manual" condition than for the "general principles" condition) and hypothesis 4 (decision accuracy will be lower for the "high data load" condition than for the "low data load" condition), we investigated two outcome measures.

The first outcome measure was a score computed as the sum of correct decisions. The second measure was the correct budget allocation per segment (household, telecommunications, or entertainment), coded as a dummy variable with "1" signifying a correct budget allocation and "0" signifying an incorrect budget allocation. In the case of the telecommunications budget, for example, the dummy variable was coded as "1" if subjects approved proposal "G" and rejected proposal "F" based on the payback period (see Table 1) and as "0" in all other cases.

Figures 4 and 5 show the frequency distributions for the sum of correct decisions, the first comparing the conditions "high data load" and "low data load" (across both decision aid groups) and the second comparing by "general principles" and "capital budgeting manual" (across both data load groups). Both figures indicate that there was a concentration of high values at the maximum number of correct decisions (which was 7) and that the distributions are quite similar, suggesting that neither manipulation affected decision accuracy as measured as the sum of correct decisions.

The median for the sum of correct decisions was 7.00 for both the "high data load" and the "low data load" groups. As can be assumed from the frequency distribution, the difference between scores in the two groups was not significant (U = 1,089.50, z = -.34, p = .732, r = -.04). The same was the case for general principles versus capital budgeting manual: the medians are 7, and the difference for scores in the two groups was not statistically significant (U = 1,212.00, z = 0.84, p = .401, r = .09).[8]

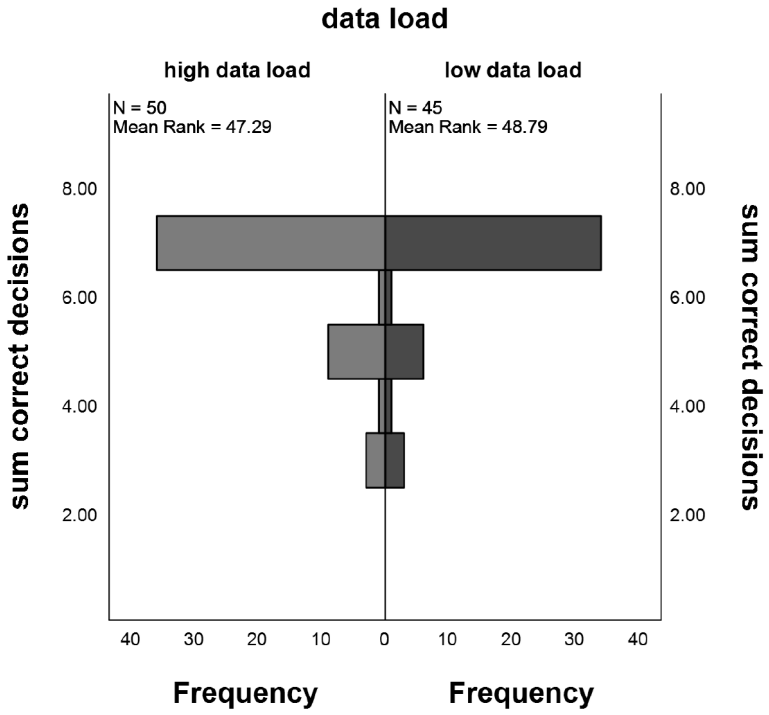


Figure 4: Frequency Distribution – Sum of Correct Decisions by Data Load

[8] One of the 96 subjects did not answer all questions and was excluded from this analysis.

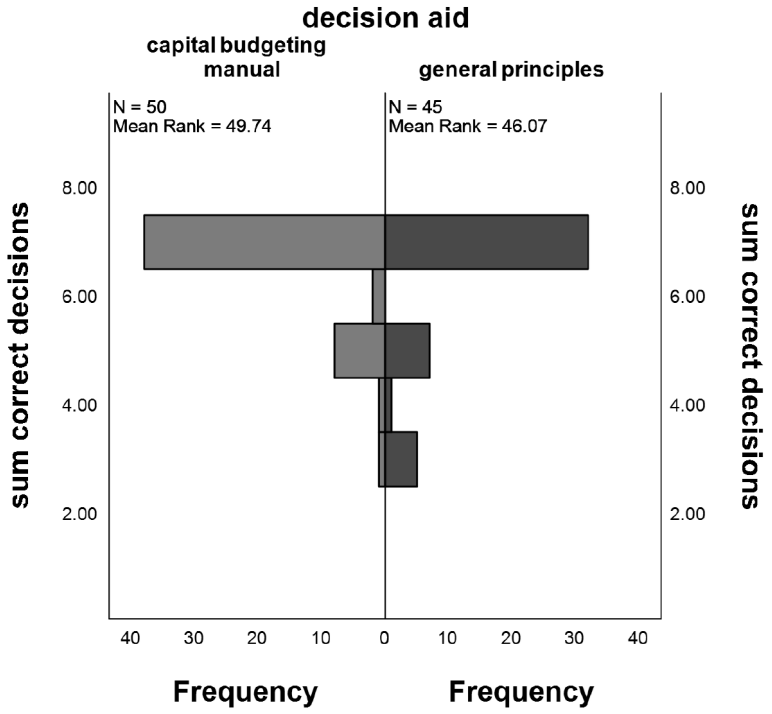


Figure 5: Frequency Distribution – Sum Correct Decisions by Decision Aid

Nevertheless, based on the second measure of decision accuracy described above (the correct allocation of the available budget per segment), the distribution of the scores for the correct allocation of the telecommunications budget (rejecting investment proposal F and approving investment proposal G) suggests that in the "capital budgeting manual" condition, a higher proportion of subjects allocated the budget correctly (98.00% vs. 77.78%). The association between the type of decision aid subjects received and whether they would allocate the telecommunications budget correctly was significant (Fisher's exact test: $p = .003$, odds ratio 14.00). Still, the odds ratio must be interpreted with caution, as there was only one subject who did not allocate the budget correctly in the "capital budgeting manual" condition (Table 6).

This effect was primarily driven by the "high data load" condition. There was a significant effect of type of decision aid in the high data load condition (Fisher's exact $p = .002$), whereas this was not the case for the "low data load" condition (Fisher's exact $p = .362$). Table 6 shows the crosstabulation with the resulting and expected counts for correctly and incorrectly allocated telecommunication budgets. While there was no significant difference for the low data group, the difference between correct and incorrect allocations differs significantly between the general principles and the capital budgeting manual conditions for the high data load group. In the general principles condition, only 14 subjects allocated the budget correctly; in the capital budgeting manual condition, 30 subjects allocated the budget correctly.

For the allocation of the budgets for household and entertainment, the proportions of correct decisions do not differ statistically across cells (not tabulated).

There was also no statistically significant difference when comparing proportions of correct decisions between low and high data load.

Table 6: Crosstabulation – Budget Allocation Telecommunications

*correct allocation telco-budget * decision aid * data load Crosstabulation*

data load				decision aid: general principles	decision aid: capital budgeting manual	Total
low data load	allocation telco-budget	Not correctly allocated	Count	4[a]	1[a]	5
			Expected Count	2.78	2.22	5.00
			% within correct allocation telco-budget	80.00%	20.00%	100.00%
			% within decision aid	16.00%	5.00%	11.11%
			% of Total	8.89%	2.22%	11.11%
			Standardized Residual	0.73	-0.82	
		correctly allocated	Count	21[a]	19[a]	40
			Expected Count	22.22	17.78	40.00
			% within correct allocation telco-budget	52.50%	47.50%	100.00%
			% within decision aid	84.00%	95.00%	88.89%
			% of Total	46.67%	42.22%	88.89%
			Standardized Residual	-0.26	0.29	
	Total		Count	25	20	45
			Expected Count	25.00	20.00	45.00
			% within correct allocation telco-budget	55.56%	44.44%	100.00%
			% within decision aid	100.00%	100.00%	100.00%
			% of Total	55.56%	44.44%	100.00%
high data load	allocation telco-budget	Not correctly allocated	Count	6[a]	0[b]	6
			Expected Count	2.40	3.60	6.00
			% within correct allocation telco-budget	100.00%	0.00%	100.00%
			% within decision aid	30.00%	0.00%	12.00%
			% of Total	12.00%	0.00%	12.00%
			Standardized Residual	2.32	-1.90	
		correctly allocated	Count	14[a]	30[b]	44
			Expected Count	17.60	26.40	44.00
			% within correct allocation telco-budget	31.82%	68.18%	100.00%
			% within decision aid	70.00%	100.00%	88.00%
			% of Total	28.00%	60.00%	88.00%
			Standardized Residual	-0.86	0.70	
	Total		Count	20	30	50
			Expected Count	20.00	30.00	50.00
			% within correct allocation telco-budget	40.00%	60.00%	100.00%
			% within decision aid	100.00%	100.00%	100.00%
			% of Total	40.00%	60.00%	100.00%

*correct allocation telco-budget * decision aid * data load Crosstabulation*

data load				decision aid: general principles	decision aid: capital budgeting manual	Total
Total	allocation telco-budget	Not correctly allocated	Count	10[a]	1[b]	11
			Expected Count	5.21	5.79	11.00
			% within correct allocation telco-budget	90.9%	9.1%	100.0%
			% within decision aid	22.2%	2.0%	11.6%
			% of Total	10.5%	1.1%	11.6%
			Standardized Residual	2.10	-1.99	
		correctly allocated	Count	35[a]	49[b]	84
			Expected Count	39.79	44.21	84.00
			% within correct allocation telco-budget	41.67%	58.33%	100.00%
			% within decision aid	77.78%	98.00%	88.42%
			% of Total	36.84%	51.58%	88.42%
			Standardized Residual	-0.76	0.72	
	Total		Count	45	50	95
			Expected Count	45.00	50.00	95.00
			% within correct allocation telco-budget	47.37%	52.63%	100.00%
			% within decision aid	100.00%	100.00%	100.00%
			% of Total	47.37%	52.63%	100.00%

Each superscript letter denotes a subset of decision aid categories whose column proportions do not differ significantly from each other at the .05 level.

5.4. Decision Confidence

Decision confidence was hypothesized to be higher in the "capital budgeting manual" condition than in the "general principles" condition (Hypothesis 5). Subjects indicated their confidence on a 7-point Likert scale after each of the seven approve or reject decisions. These scores were summed to calculate a confidence score.[9]

A two-way independent ANOVA with decision confidence as the dependent variable revealed a significant main effect of whether subjects relied on the capital budgeting manual or on general principles, $F(1, 81) = 10.30$, $p = .002$. In addition, there was a marginally significant main effect of an increase in data load, $F(1, 81) = 3.58$, $p = .062$;[10] Figure 6. The interaction between the two

[9] Analysis of decision confidence included 85 subjects as some subjects did not fill out the confidence scales for all decisions.

[10] When including n=132, the effect was significant with $F(1,107) = 4.21$, $p = .043$.

independent variables was not significant, $F(1, 81) = 0.08$, $p = .783$. The detailed results can be found in the appendix (Tables 13–15).

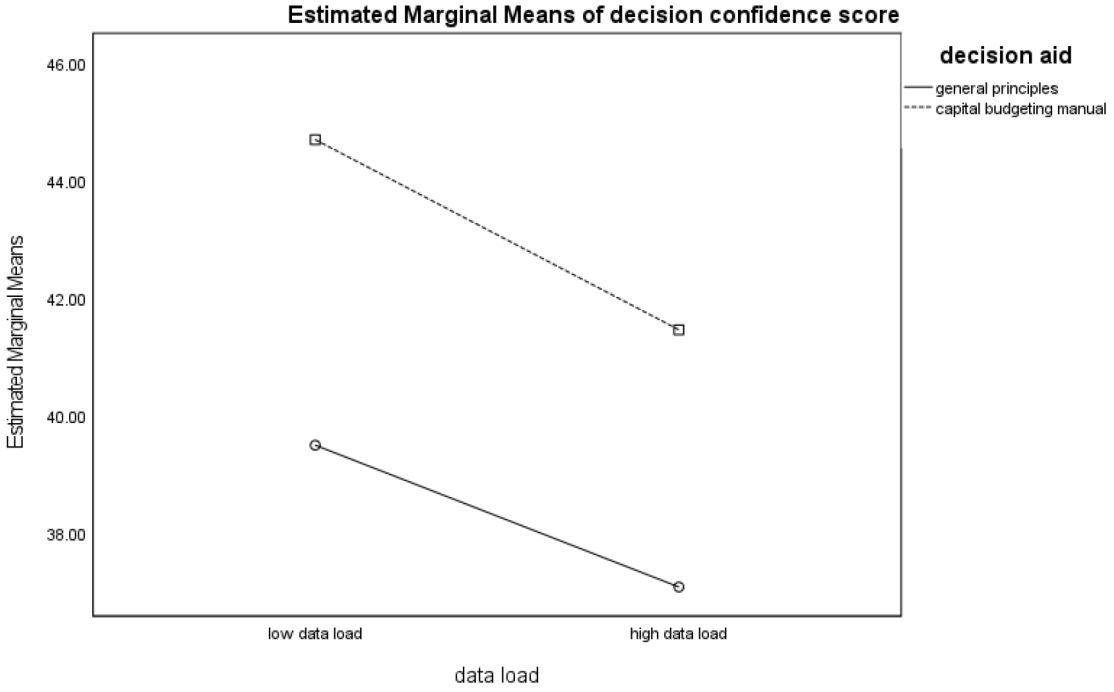


Figure 6: Estimated Marginal Means of Decision Confidence Score

Calculating Kendall's tau, there was a significant positive correlation between decision confidence and decision accuracy ($\tau_b = .26$, $p = .005$), suggesting that higher decision confidence goes hand in hand with increases in decision accuracy.

To investigate whether the distribution of the decision confidence score was approximately normal, the normality of residuals across all experimental groups was investigated. A Shapiro-Wilk test indicates a deviation from normality (see Tables 16–18 in the appendix). However, a histogram and the normal Q-Q plot of residuals (see Figures 12 and 13 in the appendix) and the values for skewness (-0.74) and kurtosis (0.47) do not indicate an extreme deviation. To cross-validate results, a robust Welch-ANOVA with decision confidence as the dependent variable was run across all groups, supporting the above results overall (details can be found in the appendix in Tables 19–20).

The Jonckheere-Terpstra test for ordered alternatives indicates a trend (decline in decision confidence) from "capital budgeting manual" and "low data load" to "general principles" and "high data load" ($J = 926.00$, $z = -3.26$, $p = .001$, $r = -.35$; Figure 7).

As predicted, values for Kendall's tau show that perceived task complexity and decision confidence are negatively correlated ($\tau_b = -.31$, $p < .001$).

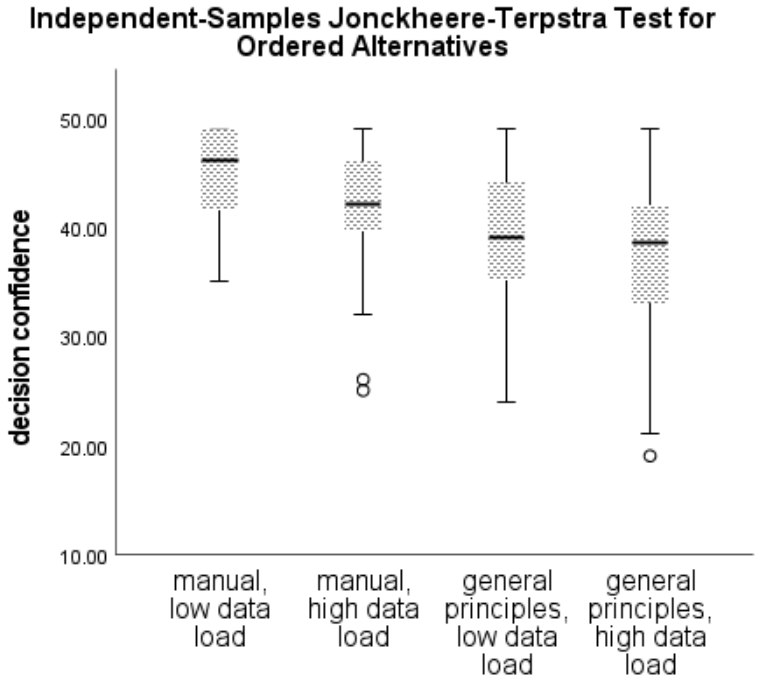


Figure 7: Independent-Samples Jonckheere-Terpstra Test for Ordered Alternatives – Decision Confidence

Overall, the results support hypothesis 2 (perceived task complexity will be higher for the "high data load" condition than for the "low data load" condition) and hypothesis 5 (decision confidence will be higher for the "capital budgeting manual" than for the "general principles" condition).

There is moderate support for hypothesis 1 (perceived task complexity will be higher for the "general principles" condition than for the "capital budgeting manual" condition) and hypothesis 3 (decision accuracy will be higher for the "capital budgeting manual" condition than for the "general principles" condition).

Hypothesis 4, which predicted lower decision accuracy for high data load, was not supported.

Trends in perceived task complexity suggest that increases in data load and the move from the "capital budgeting manual" condition to the "general principles" condition resulted in increasing perceived task complexity, with data load being the more important factor with regards to changes in perceived task complexity. Correspondingly, trends in decision confidence suggested a decline in confidence. In this case, however, the move from the "capital budgeting manual" to the "general principles" had a more pronounced effect on the decline in decision confidence than an increase in data load.

5.5. Additional Analyses

When providing information to decision-makers or offering a decision aid, one could wonder whether personal characteristics of the decision-maker affect how effectively information or a decision aid is

utilized. If there are notable differences, a standardized decision aid or provision of the same amount of information might not lead to the same desired results for every decision-maker. Early management information systems articles called for further research to investigate how to provide personalized information based on decision-maker characteristics (e.g., Mason & Mitroff, 1973). However, it would be costly to develop personalized decision aids or provide information based on individuals' preferences or individual choice processes, and this would also require insights into individuals' decision processes (Snowball, 1979). Early articles dealing with information overload on a conceptual level discussed whether individuals with differing structures would face information overload at similar levels (e.g., Wilson, 1973). In addition, a number of articles analyzed the effect of experience on decision-making performance (e.g., Iselin, 1988; Simnett, 1996). However, with some exceptions (e.g., Benbasat & Dexter, 1979, who analyze low vs. high analytic personality types) personality traits of the decision-maker have received less attention. We therefore analyzed whether personality dimensions and a measure of individuals' time perspectives influence decision-making performance in our experimental setting to derive whether a standardized approach is suitable.

As described above, in the post-experimental questionnaire, subjects answered a number of questions on personal characteristics, in particular the "Big Five" dimensions (Lang et al., 2001; Rammstedt & John, 2007) and time perspectives (Zhang et al., 2013; Zimbardo & Boyd, 1999).

The "Big Five" have emerged as a widely used measure for personality, consisting of the dimensions extraversion, agreeableness, conscientiousness, neuroticism, and openness (Digman, 1990). The "conscientiousness" dimension was of particular interest. Barrick and Mount (1991) summarize the dimension as measuring "personal characteristics such as persistent, planful, careful, responsible, and hardworking, which are important attributes for accomplishing work tasks in all jobs" (Barrick & Mount, 1991, p. 5). In their meta-reviews, Barrick and Mount (1991) and Hurtz and Donovan (2000) analyze the influence of the big five personality dimensions on different criteria for job performance across several occupational groups. They found conscientiousness to consistently predict job performance, while other personality dimensions only correlated with either selected criteria or selected job groups.

The post-experimental questionnaire included a short version of the big five inventory (Rammstedt & John, 2007), with the exception of the conscientiousness scale, where the long form was used (Lang et al., 2001). Cronbach's Alpha for the conscientiousness scale improved from .780 to .785 when excluding the item "tend to be disorganized" from the analysis. Including conscientiousness in the models for perceived task complexity and decision confidence as a covariate did not improve the models; there was no significant influence of the covariate. The same was the case for decision time (see Tables 21–29 in the appendix for results). However, when running a two-way independent ANCOVA, with effort intensity as the dependent variable and decision aid and data load as the

between-subject factors, conscientiousness as a covariate had a significant positive effect. Subjects scoring high on the conscientiousness scale also scored higher on effort intensity, $F(1, 90) = 14.96$, $p < .001$; details can be found in the appendix in Tables 30–32.[11] Analyzing Kendall's tau as a non-parametric measure for correlation, there was a significant positive correlation between conscientiousness and effort intensity ($\tau_b = .31$, $p < .001$).

Analysis of time perspectives was of a more exploratory nature. Zimbardo and Boyd (1999) describe time perspective as the processes "partitioning human experience into past, present, and future temporal frames" (Zimbardo & Boyd, 1999, p. 1271), suggesting that time perspectives significantly influence how humans act. The time perspectives are labeled as past-negative, present-hedonistic, future, past-positive, and present-fatalistic. The goal for this analysis was to investigate whether subjects scoring high on the "future-orientation" dimension would perform differently or perceive the task differently from subjects scoring lower on the "future-orientation" dimension. The factor "future-orientation" describes an attitude that is oriented towards the attainment of future goals and has been shown to correlate with conscientiousness (Zimbardo & Boyd, 1999). However, the score for future orientation did not have a significant effect when included as a covariate in models with perceived task complexity, decision confidence, or effort intensity as dependent variables (see Tables 36–44 in the appendix for results).[12]

Finally, our analysis shows a significant influence when including gender as an additional independent variable in the model for decision confidence, $F(1, 77) = 4.98$, $p = .029$. The effect of the type of decision aid continued to be significant in the model, $F(1, 77) = 10.86$, $p = .001$. Male subjects were more confident with their decisions than female subjects (also see Tables 45–47 in the appendix).

In addition, there was a three-way interaction effect between gender, data load, and decision aid in the ANOVA with task complexity as the dependent variable, $F(1, 88) = 4.00$, $p = .049$.[13] With general principles as a decision aid, male subjects reacted with an increase in perceived task complexity, while the score for perceived task complexity stayed flat for female subjects (see Figure 8). This was not the case with the capital budgeting manual as decision aid, where task complexity increased for both male and female subjects when data load increased (see Figure 9, also see Tables 48–50 in the appendix).

[11] Results should be interpreted considering the following deviations from assumptions for ANCOVA: Levene's test was significant, pointing to heteroscedasticity. In addition, the Shapiro-Wilk test was also significant, indicating a deviation from normality. Distribution of residuals in a histogram, a Q-Q plot, and values for skewness (-0.90) and kurtosis (0.84), however, do not indicate an extreme departure from normality (see Tables 33–35 and Figures 14–15 in the appendix).

[12] Cronbach's Alpha improved from 0.716 to 0.718 when excluding one of the three items, "When I want to achieve something, I set goals and consider specific means for reaching those goals."

[13] When including n = 132 subjects, the interaction effect was no longer significant with $F(1, 123) = 1.33$, $p = .250$.

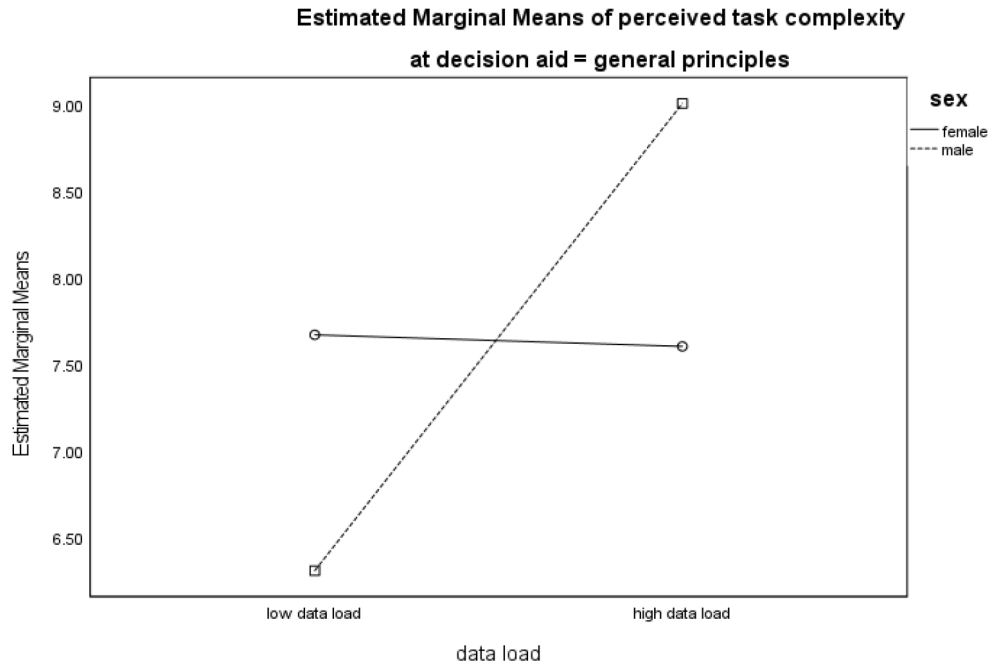


Figure 8: Gender, Data Load Interaction Effect on Per. Task Compl. for General Principles

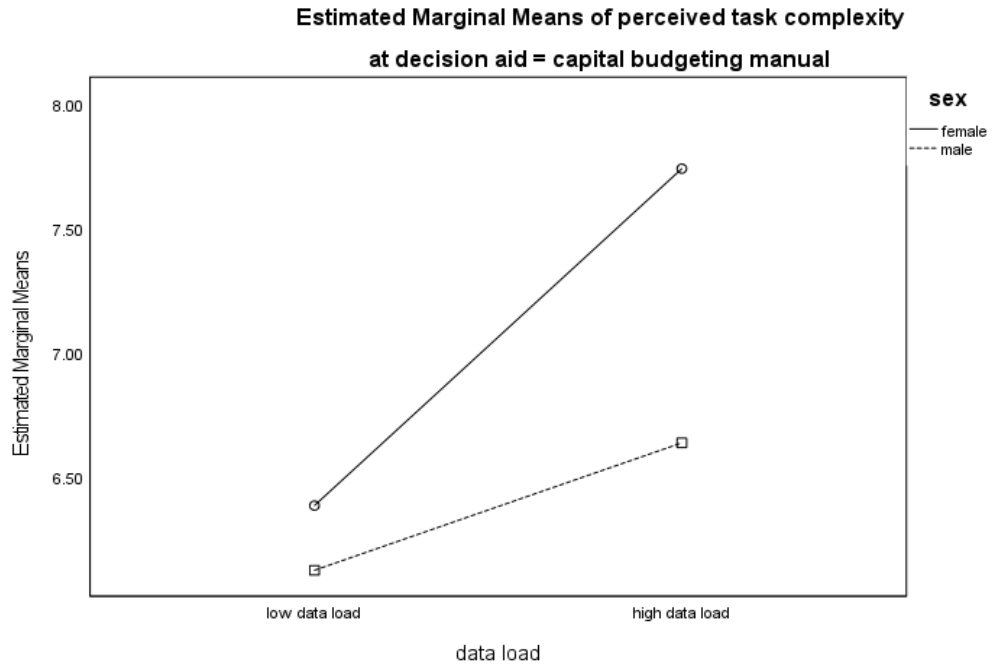


Figure 9: Gender, Data Load Interaction Effect on Perceived Task Complexity for Capital Budgeting Manual

However, including gender as an additional between-subjects factor reduces group sizes further (see Tables 51–53 in the appendix). The results therefore must be interpreted with caution.

6. Discussion

The results from our experiment contribute to our understanding of how to design capital budgeting guidelines and investment proposals.

In our experiment, reliance on a capital budgeting manual resulted in an increase of the second measure of decision accuracy (correct budget allocation per segment), although this was only the case for one out of three budget allocations. In addition, decision confidence was higher in the "capital budgeting manual" condition and correlated with decision accuracy. This indicates support for providing decision-makers with a capital budgeting manual. However, the experimental task was not designed to detect any drawbacks a capital budgeting manual might have (e.g., bureaucratization effects). The experimental task was restricted to a short time period, whereas in practice, management accountants are likely to review investment proposals repeatedly over a longer time span. In addition, the organizational context in which decision-making in the capital budgeting domain typically takes place cannot easily be induced in an experimental setting. The fact that subjects in the capital budgeting manual condition reported having used more information compared to subjects in the "general principles" condition for the "low data load" groups might indicate that the use of a capital budgeting manual influences the way decision-makers judge the amount of information considered. Subjects relying on a capital budgeting manual exhibited higher decision confidence. As long as decision confidence is positively associated with decision accuracy, this is a desirable result. However, if the use of a capital budgeting manual leads to very high confidence in decisions made and decision-makers become overconfident, there may be adverse effects.

With regards to the amount of information figuring in the investment proposals, perceived task complexity was higher for the "high data load" condition. As indicated above, increases in task complexity may lead to decreases in performance. Increases in perceived task complexity can therefore be considered as a first step towards a potential decline in decision-making performance. This implies that decision-makers should only be provided with the information essential for the decision at hand, even if the additional information is irrelevant. The observed effect on perceived task complexity should be a conservative measure, as the distinction between relevant and irrelevant information cues was relatively easily made in the experimental task. In a field setting, irrelevant information might not be as easily distinguishable from the more important information cues, and the effect on perceived task complexity is thus likely to be higher.

Furthermore, concluding from the additional effects of the type of decision aid provided, task structure and data load should be considered in conjunction – the less structured a task, the more important it is to not provide too much data.

Unlike Iselin (1993), we did not find a significant effect of increases in data load on decision accuracy. This might be because Iselin (1993) used an unstructured decision task, namely a bankruptcy prediction task, whereas our results are based on a structured decision task with an unambiguous solution. Similarly to Chung and Monroe (2000), we found that increases in task complexity are negatively associated with decision confidence.

With regards to the realism of the experimental task, we adapted the format of the investment proposals to the documents typically used in practice: information was not presented in tabular format with alternatives in rows and attributes in columns, a format typically employed to study search strategies (Shields, 1980; Swain & Haka, 2000), but was presented in the form of investment proposals. We assume this format is quite close to the format decision-makers are likely to encounter in practice. As mentioned above, we employed a structured decision task. In practice, most decision tasks taking place in upper and middle management are unstructured decision tasks (Iselin, 1993). As there was a clear dominance of one alternative in the "general principles" condition, subjects did not need to trade off attributes against each other (non-compensatory decision strategy), which in turn should not lead to the decision-maker experiencing conflict (Zakay, 1985). A clear dominance of such kind, however, is unlikely to be encountered in practice. The changes in perceived task complexity, decision accuracy, and decision confidence triggered by the provision of a capital budgeting manual or by increases in information load seen in our results are thus likely to be at the lower end of possible effects. The highly structured task, combined with a clear dominance of one investment alternative over others, is likely to have contributed to the clustering of scores for decision accuracy at the maximum point of the scale. Extending the task to less structured decisions or to decisions between alternatives where dominance is less obvious would add to our understanding of how these mechanisms operate in a different task environment. However, the drawback of employing a less structured task would probably be that formulation of a clear measure of task performance is difficult to implement if there are no clear right or wrong answers (Wheeler & Murthy, 2011).

In experimental decision aid research, there is often a control group that does not receive any decision aid (Wheeler & Murthy, 2011). We chose not to include a group without any decision aid as this would have altered the task in a substantial way – differentiating between relevant and irrelevant information would not have been possible without guidelines as to which information cues to consider.

In addition, the experiment relied on a student sample and there were no monetary incentives. Whether student subjects should be used as a surrogate for practitioners in experimental accounting research has long been a matter of discussion (e.g., Ashton & Kramer, 1980; Liyanarachchi, 2007). There is moderate support that in decision-making experiments such as the one described here, results for students are not too different from those of practitioners (Ashton & Kramer, 1980). In addition, as the students were majoring in business or economics, it can be assumed that they had sufficient knowledge

to complete the task and that results therefore should not differ substantially from those that professionals would have achieved.

Besides task characteristics, personal characteristics may also impact task performance (Bonner & Sprinkle, 2002). However, the analysis conducted here only produced limited evidence with regards to the effect of personal characteristics.

From the experimental data, it is unclear which information subjects integrated into their judgments, for example whether subjects in the "high data load" condition considered information that was irrelevant to the decision. Although the comments on the reason for rejection of an investment proposal provide some general hints as to which information cues were used, this does not allow for a systematic analysis of information acquired during the decision process. Process tracing methods, as utilized by, for example, Swain and Haka (2000), can be a way to discover more about the information acquisition process during the capital budgeting review process.

Some of the limitations mentioned above are closely linked to opportunities for future research. Future research could further investigate decision aids for unstructured decision-making, capital budgeting decisions in an organizational context, and the application of process tracing technology to further investigate information use. Summarizing the implications for practice, management accountants should ensure to only provide relevant information to the decision-maker. In addition, provision of a clearly structured decision aid was beneficial in the context investigated. While a decision aid is relevant for aiding human decision-making, a next step to improve decision-making could be to have a decision model either make suggestions or even replace human decision-makers. This step is especially relevant and feasible for highly structured tasks, such as the one investigated here. Overall, the experiment further contributes to our understanding of how a decision aid can improve decision-making in the capital budgeting context.

References

Arnold, G. C., & Hatzopoulos, P. D. (2000). The theory-practice gap in capital budgeting: Evidence from the United Kingdom. *Journal of Business Finance & Accounting*, *27*(5–6), 603–626.

Arnold, V., Collier, P. A., Leech, S. A., & Sutton, S. G. (2000). The effect of experience and complexity on order and recency bias in decision making by professional accountants. *Accounting and Finance*, *40*(2), 109–134.

Ashton, R. H., & Kramer, S. S. (1980). Students as surrogates in behavioral accounting research: Some evidence. *Journal of Accounting Research*, *18*(1), 1–15.

Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personnel Psychology*, *44*(1), 1–26.

Bastardi, A., & Shafir, E. (1998). On the pursuit and misuse of useless information. *Journal of Personality and Social Psychology*, *75*(1), 19–32.

Benbasat, I., & Dexter, A. S. (1979). Value and events approaches to accounting: An experimental evaluation. *The Accounting Review*, *54*(4), 735–749.

Bonner, S. E., & Sprinkle, G. B. (2002). The effects of monetary incentives on effort and task performance: theories, evidence, and a framework for research. *Accounting, Organizations and Society*, *27*(4-5), 303–345.

Bonner, S. E. (1999). Judgment and decision-making research in accounting. *Accounting Horizons*, *13*(4), 385–398.

Bonner, S. E., Hastie, R., Sprinkle, G. B., & Young, S. M. (2000). A review of the effects of financial incentives on performance in laboratory tasks: Implications for management accounting. *Journal of Management Accounting Research*, *12*(1), 19–64.

Bragg, S. M. (2011). *The new CFO financial leadership manual* (3rd ed.). Hoboken, N.J: Wiley.

Brunzell, T., Liljeblom, E., & Vaihekoski, M. (2013). Determinants of capital budgeting methods and hurdle rates in Nordic firms. *Accounting and Finance*, *53*(1), 85–110.

Chan, S. Y. (2001). The use of graphs as decision aids in relation to information overload and managerial decision quality. *Journal of Information Science*, *27*(6), 417–425.

Chung, J., & Monroe, G. (2000). The effects of experience and task difficulty on accuracy and confidence assessments of auditors. *Accounting and Finance*, *40*(2), 135–151.

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, *41*(1), 417–440.

Dowling, C., & Leech, S. (2007). Audit support systems and decision aids: Current practice and opportunities for future research. *International Journal of Accounting Information Systems*, *8*(2), 92–116.

Einhorn, H. J., Kleinmuntz, D. N., & Kleinmuntz, B. (1979). Linear regression and process-tracing models of judgment. *Psychological Review*, *86*(5), 465–485.

Fabozzi, F. J., Peterson Drake, P., & Polimeni, R. S. (2008). *The complete CFO handbook: From accounting to accountability*. Hoboken, N.J: John Wiley & Sons.

Fertakis, J. P. (1969). On communication, understanding, and relevance in accounting reporting. *The Accounting Review*, *44*(4), 680–691.

Fessler, N. J. (2003). Experimental evidence on the links among monetary incentives, task attractiveness, and task performance. *Journal of Management Accounting Research*, *15*(1), 161–176.

Fleisig, D. (2011). Adding information may increase overconfidence in accuracy of knowledge Retrieval. *Psychological Reports*, *108*(2), 379–392.

Glover, S. M. (1997). The influence of time pressure and accountability on auditors' processing of nondiagnostic information. *Journal of Accounting Research*, *35*(2), 213–226.

Graham, J. R., & Harvey, C. R. (2001). The theory and practice of corporate finance: evidence from the field. *Journal of Financial Economics*, *60*(2–3), 187–243.

Hackenbrack, K. (1992). Implications of seemingly irrelevant evidence in audit judgment. *Journal of Accounting Research*, *30*(1), 126.

Hirsch, B., & Volnhals, M. (2012). Information Overload im betrieblichen Berichtswesen – ein unterschätztes Phänomen. *Die Betriebswirtschaft*, *72*(1), 23–55.

Hoang, D., Gatzer, S., & Ruckes, M. (2018). *The economics of capital allocation in firms: Evidence from internal capital markets.* Retrieved from https://econpapers.wiwi.kit.edu/downloads/KITe_WP_115.pdf

Hurtz, G. M., & Donovan, J. J. (2000). Personality and job performance: The big five revisited. *Journal of Applied Psychology*, *85*(6), 869–879.

Iselin, E. R. (1988). The effects of information load and information diversity on decision quality in a structured decision task. *Accounting, Organizations and Society*, *13*(2), 147–164.

Iselin, E. R. (1993). The effects of the information and data properties of financial ratios and statements on managerial decision quality. *Journal of Business Finance & Accounting*, *20*(2), 249–266.

Istvan, D. F. (1961). *Capital-expenditure decisions: how they are made in large corporations*. Bloomington, Indiana: Bureau of Business Research, Graduate School of Business, Indiana University.

Kelley, C. M., & Lindsay, D. (1993). Remembering mistaken for knowing: ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language*, *32*(1), 1–24.

Kelton, A. S., & Murthy, U. S. (2016). The effects of information disaggregation and financial statement interactivity on judgments and decisions of nonprofessional investors. *Journal of Information Systems*, *30*(3), 99–118.

Lang, F. R., Lüdtke, O., & Asendorpf, J. B. (2001). Testgüte und psychometrische Äquivalenz der deutschen Version des Big Five Inventory (BFI) bei jungen, mittelalten und alten Erwachsenen. *Diagnostica*, *47*(3), 111–121.

Libby, R., & Lewis, B. L. (1977). Human information processing research in accounting: The state of the art. *Accounting, Organizations and Society*, *2*(3), 245–268.

Liyanarachchi, G. A. (2007). Feasibility of using student subjects in accounting experiments: a review. *Pacific Accounting Review*, *19*(1), 47–67.

Luft, J., & Shields, M. D. (2003). Mapping management accounting: graphics and guidelines for theory-consistent empirical research. *Accounting, Organizations and Society*, *28*(2–3), 169–249.

Luft, J., & Shields, M. D. (2010). Psychology models of management accounting. *Foundations and Trends in Accounting*, *4*(3–4), 199–345.

Mason, R. O., & Mitroff, I. I. (1973). A program for research on management information systems. *Management Science*, *19*(5), 475–487.

Miller, H. (1972). Environmental complexity and financial reports. *The Accounting Review*, *47*(1), 31–37.

Moles, P., Parrino, R., & Kidwell, D. S. (2011). *Fundamentals of corporate finance*. Hoboken, NJ: Wiley.

Mukherjee, T. K. (1988). The capital budgeting process of large U.S. firms: an analysis of capital budgeting manuals. *Managerial Finance*, *14*(2–3), 28–35.

Nelson, M. W. (2003). Behavioral evidence on the effects of principles- and rules-based standards. *Accounting Horizons*, *17*(1), 91–104.

Norman, R. (1975). Affective-cognitive consistency, attitudes, conformity, and behavior. *Journal of Personality and Social Psychology*, *32*(1), 83–91.

Oblak, D. J., & Helm, R. J., JR. (1980). Survey and analysis of capital budgeting methods used by multinationals. *Financial Management*, *9*(4), 37–41.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. New York, NY: Cambridge University Press.

Pike, R. (1996). A longitudinal survey on capital budgeting practices. *Journal of Business Finance & Accounting*, *23*(1), 79–92.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212.

Ross, S. A. (2007). *Modern financial management* (8th ed.). New York, NY: McGraw-Hill Irwin.

Ryan, P. A., & Ryan, G. P. (2002). Capital budgeting practices of the Fortune 1000: How have things changed? *Journal of Business & Management*, *8*(4), 355.

Schick, A. G., Gordon, L. A., & Haka, S. (1990). Information overload: A temporal approach. *Accounting, Organizations and Society*, *15*(3), 199–220.

Schroder, H., Driver, M., & Streufert, S. (1967). *Human Information Processing*. New York: Holt, Rinehard & Winston.

Scott, W., & Erskine, J. (1980). The effects of variations in task design and monetary reinforcers on task behavior. *Organizational Behavior and Human Performance*, *25*(3), 311–335.

Segelod, E. (1995). *Resource allocation in divisionalized groups: A study of investment manuals and corporate level means of control*. Aldershot, UK: Avebury.

Segelod, E. (1997). The content and role of the investment manual – a research note. *Management Accounting Research*, *8*(2), 221–231.

Shepard, R.N. (1964). On subjectively optimum selection among multi-attribute alternatives. In M.W. Shelley & G. L. Bryan (Eds.), *Human judgments and optimality* (pp. 257–281). New York, NY: Wiley.

Shields, M. D. (1980). Some effects on information load on search patterns used to analyze performance reports. *Accounting, Organizations and Society*, *5*(4), 429–442.

Shields, M. D. (1983). Effects of information supply and demand on judgment accuracy: Evidence from corporate managers. *The Accounting Review*, *58*(2), 284–303.

Simnett, R. (1996). The effect of information selection, information processing and task complexity on predictive accuracy of auditors. *Accounting, Organizations and Society*, *21*(7-8), 699–719.

Snowball, D. (1979). Information load and accounting reports: Too much, too little or just right? *Cost and Management*, *May/June*, 15(3), 22–28.

Sprinkle, G. B. (2003). Perspectives on experimental research in managerial accounting. *Accounting, Organizations and Society*, *28*(2-3), 287–318.

Stocks, M. H., & Harrell, A. (1995). The impact of an increase in accounting information level on the judgment quality of individuals and groups. *Accounting, Organizations and Society*, *20*(7–8), 685–700.

Swain, M. R., & Haka, S. F. (2000). Effects of information load on capital budgeting decisions. *Behavioral Research in Accounting*, *12*, 171–198.

veb.ch. (2011). Schweizer Controlling Standard Nr. 1: Investitionsrechnung. Retrieved from http://veb.ch/fileadmin/documents/publikationen/Controlling_Stand/veb_Controlling_web.pdf

Volnhals, M. (2010). *Information Overload und Controlling: Analyse kognitiver Restriktionen bei der Wahrnehmung von Berichtsinformationen*. Hamburg, Germany: Kovač.

Wheeler, P., & Murthy, U. (2011). Experimental methods in decision aid research. *International Journal of Accounting Information Systems*, *12*(2), 161–167.

Wheeler, P. R., & Arunachalam, V. (2008). The effects of decision aid design on the information search strategies and confirmation bias of tax professionals. *Behavioral Research in Accounting*, *20*(1), 131–145.

Wilson, D. A. (1973). A note on "environmental complexity and financial reports." *The Accounting Review*, *48*(3), 586–588.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes*, *37*(1), 60–82.

Yeo, G. B., & Neal, A. (2004). A multilevel analysis of effort, practice, and performance: Effects of ability, conscientiousness, and goal orientation. *Journal of Applied Psychology*, *89*(2), 231–247.

Zakay, D. (1985). Post-decisional confidence and conflict experienced in a choice process. *Acta Psychologica*, *58*(1), 75–80.

Zhang, J. W., Howell, R. T., & Bowerman, T. (2013). Validating a brief measure of the Zimbardo Time Perspective Inventory. *Time & Society*, *22*(3), 391–409.

Zimbardo, P. G., & Boyd, J. N. (1999). Putting time in perspective: A valid, reliable individual-differences metric. *Journal of Personality & Social Psychology*, *77*(6), 1271–1288.

Appendix 1: Additional Tables and Figures

Abbreviations for variables used in the following tables:

- sum correct decisions: decision accuracy
- dum_inf_load: data load (low vs. high)
- dum_man: decision aid (general principles vs. capital budgeting manual)
- score_conscientiousness: score for conscientiousness
- ztpi_future_score: score for future orientation

Table 7: ANOVA Perceived Task Complexity – Between Subject Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	46
	high data load	50
decision aid	general principles	45
	capital budgeting manual	51

Table 8: ANOVA Perceived Task Complexity – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	perceived task complexity		
F	df1	df2	Sig.
1.301	3	92	.279

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 9: ANOVA Perceived Task Complexity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: perceived task complexity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	43.721[a]	3	14.57	3.09	.031
Intercept	4878.55	1	4878.55	1033.89	.000
dum_inf_load	33.35	1	33.35	7.07	.009
dum_man	15.75	1	15.75	3.34	.071
dum_inf_load * dum_man	0.50	1	0.50	0.11	.746
Error	434.11	92	4.72		
Total	5466.00	96			
Corrected Total	477.83	95			

a. R Squared = .091 (Adjusted R Squared = .062)

Table 10: Residuals for Perceived Task Complexity – Summary

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residual for perceived task complexity	96	100.00%	0	0.00%	96	100.00%

Table 11: Residuals for Perceived Task Complexity – Descriptives

Descriptives

			Statistic	Std. Error
Residual for perceived task complexity	Mean		0.00	0.22
	95% Confidence Interval for Mean	Lower Bound	-0.43	
		Upper Bound	0.43	
	5% Trimmed Mean		0.01	
	Median		-0.12	
	Variance		4.57	
	Std. Deviation		2.14	
	Minimum		-4.30	
	Maximum		4.71	
	Range		9.01	
	Interquartile Range		2.99	
	Skewness		-0.07	0.25
	Kurtosis		-0.41	0.49

Table 12: Residuals for Perceived Task Complexity – Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for perceived task complexity	0.07	96	.200*	0.98	96	0.195

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

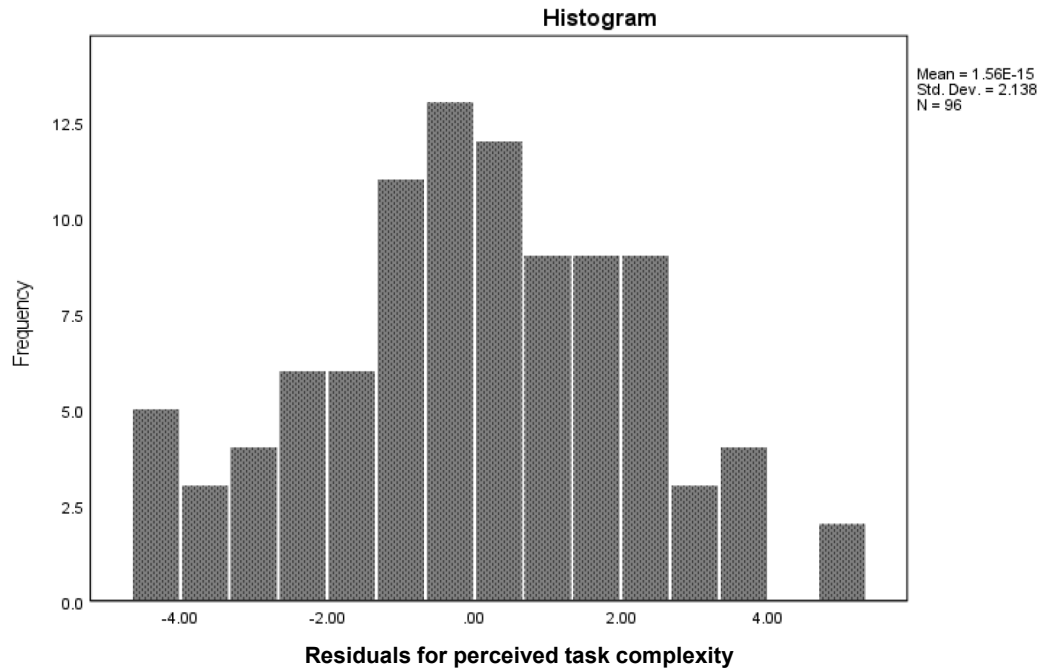


Figure 10: Histogram of Residuals for Perceived Task Complexity

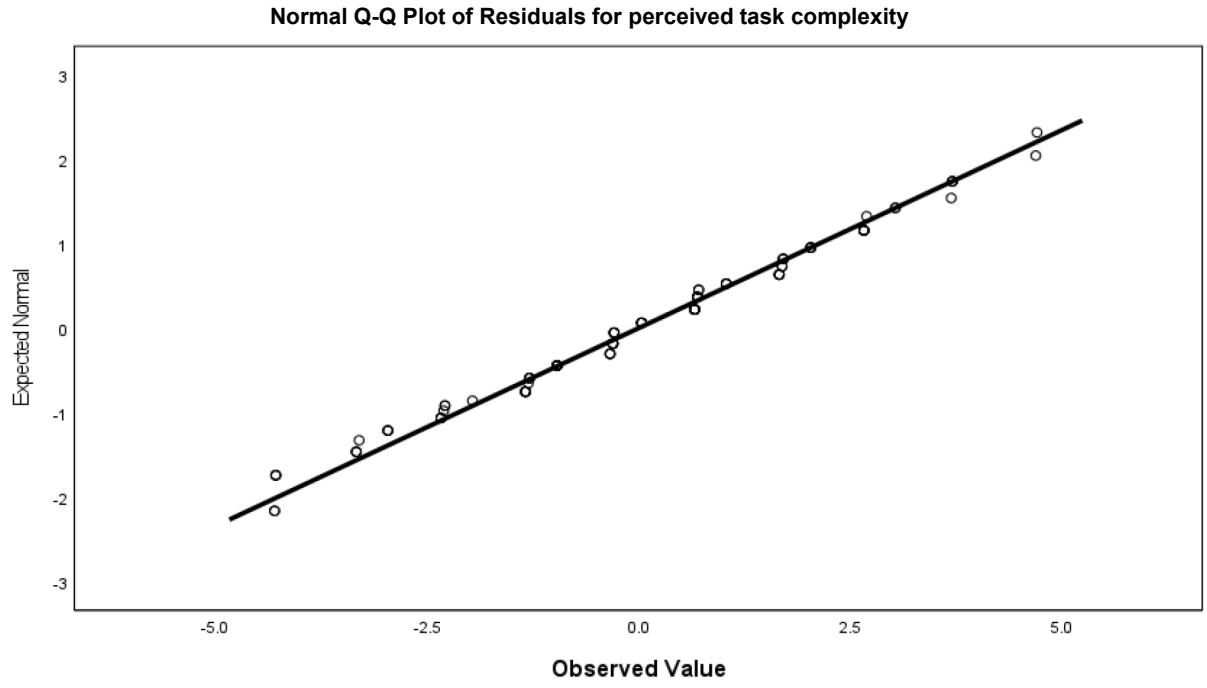


Figure 11: Normal Q-Q Plot of Residuals for Perceived Task Complexity

Table 13: ANOVA Decision Confidence – Between-Subject Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	42
	high data load	43
decision aid	general principles	39
	capital budgeting manual	46

Table 14: ANOVA Decision Confidence – Levene's Test

Levene's Test of Equality of Error Variancesa

Dependent Variable:	decision confidence score		
F	df1	df2	Sig.
2.17	3	81	.098

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 15: ANOVA Decision Confidence – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable:	decision confidence score				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	561.54[a]	3	187.18	4.10	.009
Intercept	135250.50	1	135250.50	2964.54	.000
dum_inf_load	163.48	1	163.48	3.58	.062
dum_man	469.87	1	469.87	10.30	.002
dum_inf_load * dum_man	3.47	1	3.47	0.08	.783
Error	3695.45	81	45.62		
Total	145833.00	85			
Corrected Total	4256.99	84			

a. R Squared = .132 (Adjusted R Squared = .100)

Table 16: Residuals for Decision Confidence – Summary

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residual for decision confidence score	85	88.54%	11	11.46%	96	100.00%

Table 17: Residuals for Decision Confidence – Descriptives

Descriptives

			Statistic	Std. Error
Residual for decision confidence score	Mean		0.00	0.72
	95% Confidence Interval for Mean	Lower Bound	-1.43	
		Upper Bound	1.43	
	5% Trimmed Mean		0.32	
	Median		0.56	
	Variance		43.99	
	Std. Deviation		6.63	
	Minimum		-18.06	
	Maximum		11.94	
	Range		30.00	
	Interquartile Range		7.88	
	Skewness		-0.74	0.26
	Kurtosis		0.47	0.52

Table 18: Residuals for Decision Confidence – Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for decision confidence	0.087	85	0.159	0.950	85	.002

a. Lilliefors Significance Correction

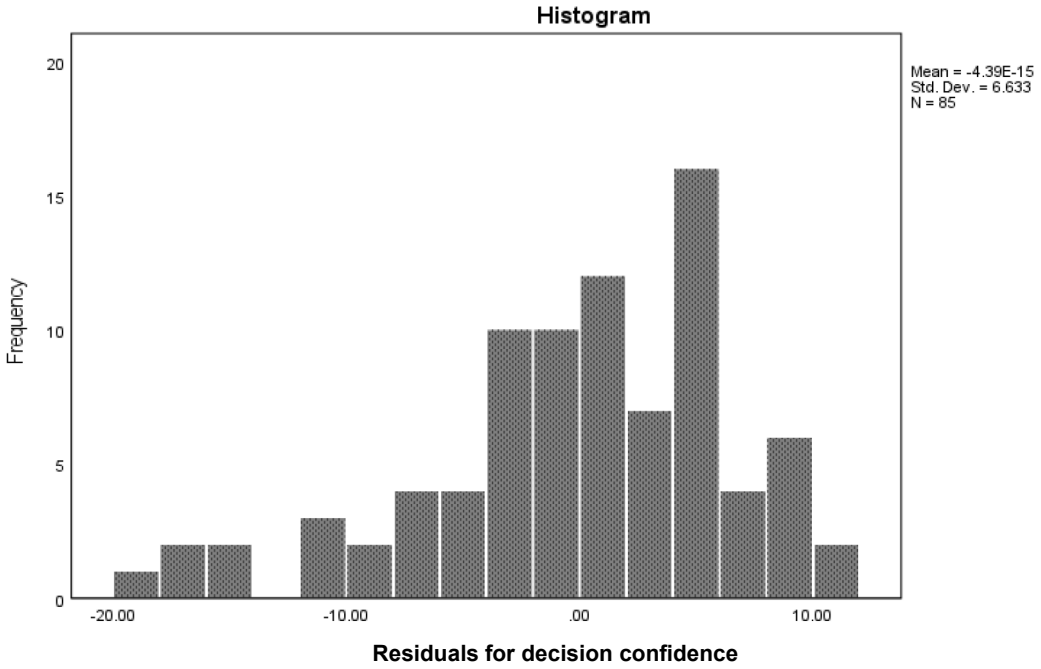


Figure 12: Histogram of Residuals for Decision Confidence

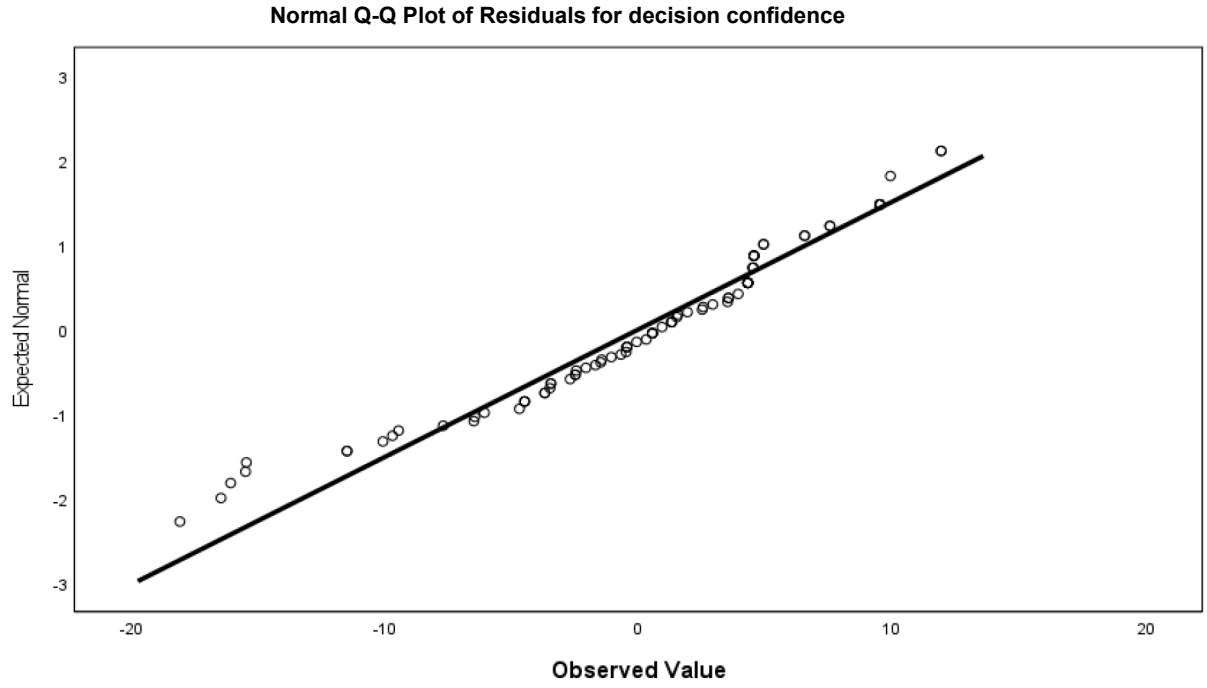


Figure 13: Normal Q-Q Plot of Residuals for Decision Confidence

Table 19: Welch ANOVA Decision Confidence

Robust Tests of Equality of Means

decision confidence score

	Statistic[a]	df1	df2	Sig.
Welch	4.83	3	40.71	.006

a. Asymptotically F distributed.

Table 20: Welch ANOVA Decision Confidence – Post-Hoc Tests

Multiple Comparisons

Dependent Variable:	decision confidence score						
(I) groups	(J) groups		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Games-Howell	manual, low	manual, high	3.24	1.56	.176	-0.92	7.40
		no manual, low	5.21*	1.82	.034	0.30	10.11
		no manual, high	7.62*	2.44	.025	0.81	14.43
	manual, high	manual, low	-3.24	1.56	.176	-7.40	0.92
		no manual, low	1.97	1.93	.739	-3.19	7.12
		no manual, high	4.38	2.52	.328	-2.59	11.35
	no manual, low	manual, low	-5.21*	1.82	.034	-10.11	-0.30
		manual, high	-1.97	1.93	.739	-7.12	3.19
		no manual, high	2.42	2.69	.807	-4.94	9.77
	no manual, high	manual, low	-7.62*	2.44	.025	-14.43	-0.81
		manual, high	-4.38	2.52	.328	-11.35	2.59
		no manual, low	-2.42	2.69	.807	-9.77	4.94

*. The mean difference is significant at the 0.05 level.

Table 21: ANCOVA incl. Conscientiousness Perceived Task Complexity – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	45
	high data load	50
decision aid	general principles	44
	capital budgeting manual	51

Table 22: ANCOVA incl. Conscientiousness Perceived Task Complexity – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	perceived task complexity		
F	df1	df2	Sig.
1.62	3	91	.191

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + score_conscientiousness + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 23: ANCOVA incl. Conscientiousness Perceived Task Complexity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: perceived task complexity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	50.69[a]	4	12.67	2.72	.034
Intercept	48.73	1	48.73	10.46	.002
score_conscientiousness	5.22	1	5.22	1.12	.293
dum_inf_load	37.53	1	37.53	8.06	.006
dum_man	13.86	1	13.86	2.98	.088
dum_inf_load * dum_man	0.50	1	0.50	0.11	.743
Error	419.27	90	4.66		
Total	5366.00	95			
Corrected Total	469.96	94			

a. R Squared = .108 (Adjusted R Squared = .068)

Table 24: ANCOVA incl. Conscientiousness Decision Confidence – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	41
	high data load	43
decision aid	general principles	38
	capital budgeting manual	46

Table 25: ANCOVA incl. Conscientiousness Decision Confidence - Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	decision confidence		
F	df1	df2	Sig.
1.87	3	80	.141

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + score_conscientiousness + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 26: ANCOVA incl. Conscientiousness Decision Confidence – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: decision confidence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	549.71[a]	4	137.43	3.17	.018
Intercept	1936.50	1	1936.50	44.72	.000
score_conscientiousness	23.70	1	23.70	0.55	.462
dum_inf_load	199.71	1	199.71	4.61	.035
dum_man	392.62	1	392.62	9.07	.003
dum_inf_load * dum_man	0.31	1	0.31	0.01	.932
Error	3421.28	79	43.31		
Total	145257.00	84			
Corrected Total	3970.99	83			

a. R Squared = .138 (Adjusted R Squared = .095)

Table 27: ANCOVA incl. Conscientiousness Decision Time – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	45
	high data load	47
decision aid	general principles	42
	capital budgeting manual	50

Table 28: ANCOVA incl. Conscientiousness Decision Time – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	Decision time		
F	df1	df2	Sig.
.93	3	88	.428

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + score_conscientiousness + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 29: ANCOVA incl. Conscientiousness Decision Time – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: Decision time

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	0.04[a]	4	0.00	0.89	.472
Intercept	0.00	1	0.00	10.20	.002
score_conscientiousness	0.00	1	0.00	0.71	.403
dum_inf_load	0.00	1	0.00	2.16	.145
dum_man	0.00	1	0.00	1.07	.305
dum_inf_load * dum_man	0.00	1	0.00	0.23	.632
Error	0.00	87	0.00		
Total	0.01	92			
Corrected Total	0.00	91			

a. R Squared = .039 (Adjusted R Squared = -.005)

Table 30: ANCOVA incl. Conscientiousness Effort Intensity – Betw.-Subjects Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	45
	high data load	50
decision aid	general principles	44
	capital budgeting manual	51

Table 31: ANCOVA incl. Conscientiousness Effort Intensity – Levene's Test

Levene's Test of Equality of Error Variances [a]

Dependent Variable:	Effort intensity		
F	df1	df2	Sig.
4.09	3	91	.009

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + score_conscientiousness + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 32: ANCOVA incl. Conscientiousness Effort Intensity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: Effort intensity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	22,82[a]	4	5.71	4.57	.002
Intercept	2.95	1	2.95	2.36	.128
score_conscientiousness	18.69	1	18.69	14.96	.000
dum_inf_load	4.00	1	4.00	3.21	.077
dum_man	0.01	1	0.01	0.01	.914
dum_inf_load * dum_man	0.13	1	0.13	0.10	.750
Error	112.40	90	1.25		
Total	2201.00	95			
Corrected Total	135.22	94			

a. R Squared = .169 (Adjusted R Squared = .132)

Table 33: Residuals for Effort Intensity – Summary

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Residual for effort intensity	95	98.96%	1	1.04%	96	100.00%

Table 34: Residuals for Effort Intensity – Descriptives

Descriptives

			Statistic	Std. Error
Residual for effort intensity	Mean		0.00	0.11
	95% Confidence Interval for Mean	Lower Bound	-0.22	
		Upper Bound	0.22	
	5% Trimmed Mean		0.07	
	Median		0.05	
	Variance		1.20	
	Std. Deviation		1.09	
	Minimum		-3.41	
	Maximum		2.13	
	Range		5.54	
	Interquartile Range		1.40	
	Skewness		-0.90	0.25
	Kurtosis		0.84	0.49

Table 35: Residuals for Effort Intensity – Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for effort intensity	0.11	95	.010	0.95	95	0.001

a. Lilliefors Significance Correction

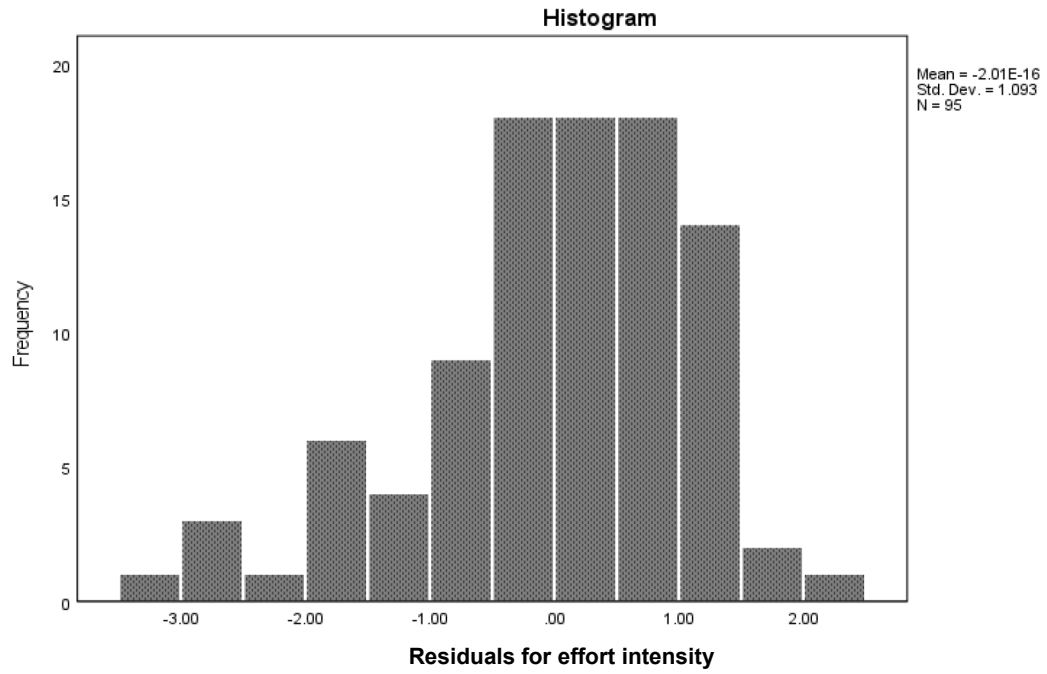


Figure 14: Histogram of residuals for Effort Intensity

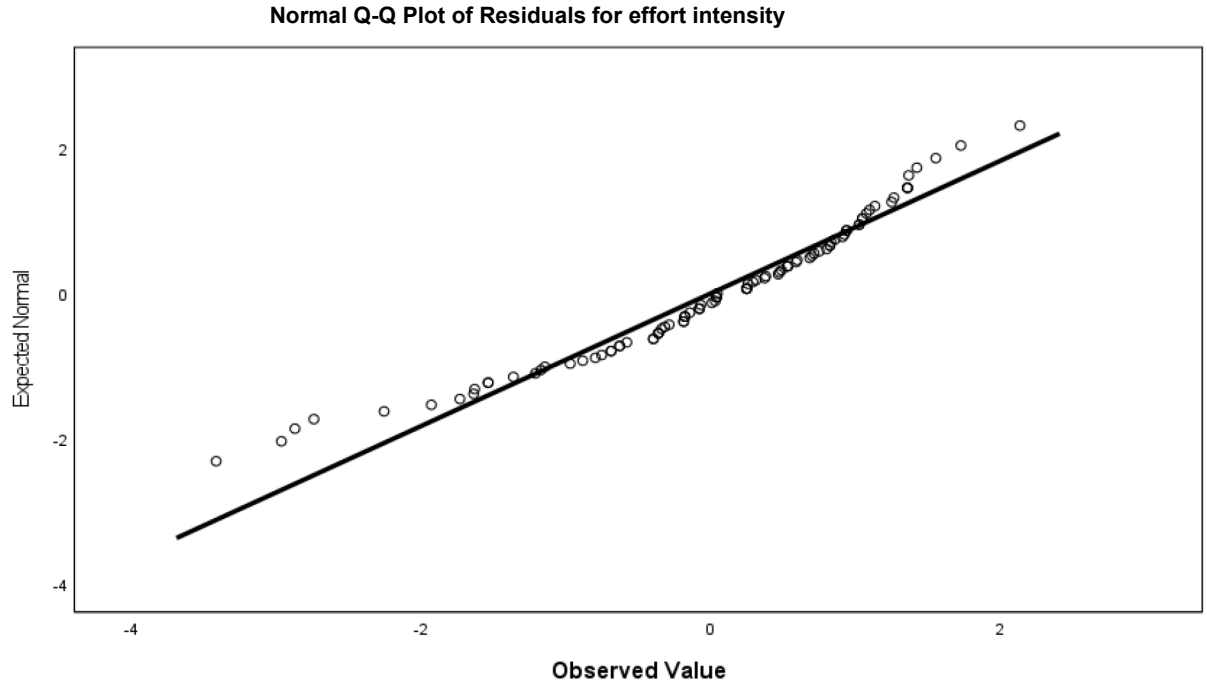


Figure 15: Normal Q-Q Plot of Residuals for Effort Intensity

Table 36: ANCOVA incl. Future Orientation Perceived Task Complexity – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	46
	high data load	48
decision aid	general principles	44
	capital budgeting manual	50

Table 37: ANCOVA incl. Future Orientation Perceived Task Complexity – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	perceived task complexity		
F	df1	df2	Sig.
1.00	3	90	.398

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ztpi_future_score + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 38: ANCOVA incl. Future Orientation Perceived Task Complexity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: perceived task complexity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	44.95[a]	4	11.24	2.40	.056
Intercept	113.20	1	113.20	24.16	.000
ztpi_future_score	7.62	1	7.62	1.63	.205
dum_inf_load	31.66	1	31.66	6.76	.011
dum_man	11.65	1	11.65	2.49	.118
dum_inf_load * dum_man	0.00	1	0.00	0.00	.990
Error	416.98	89	4.69		
Total	5309.00	94			
Corrected Total	461.93	93			

a. R Squared = .097 (Adjusted R Squared = .057)

Table 39: ANCOVA incl. Future Orientation Decision Confidence – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	42
	high data load	41
decision aid	general principles	38
	capital budgeting manual	45

Table 40: ANCOVA incl. Future Orientation Decision Confidence – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable: decision confidence

F	df1	df2	Sig.
2.21	3	79	.094

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ztpi_future_score + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 41: ANCOVA incl. Future Orientation Decision Confidence – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: decision confidence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	652.86[a]	4	163.21	3.54	.011
Intercept	6170.71	1	6170.71	133.65	.000
ztpi_future_score	67.89	1	67.89	1.47	.229
dum_inf_load	177.99	1	177.99	3.86	.053
dum_man	465.18	1	465.18	10.08	.002
dum_inf_load * dum_man	4.20	1	4.20	0.09	.764
Error	3601.24	78	46.17		
Total	142305.00	83			
Corrected Total	4254.10	82			

a. R Squared = .153 (Adjusted R Squared = .110)

Table 42: ANCOVA incl. Future Orientation Effort Intensity – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
data load	low data load	46
	high data load	48
decision aid	general principles	44
	capital budgeting manual	50

Table 43: ANCOVA incl. Future Orientation Effort Intensity – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Effort intensity

F	df1	df2	Sig.
2.98	3	90	.036

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ztpi_future_score + dum_inf_load + dum_man + dum_inf_load * dum_man

Table 44: ANCOVA incl. Future Orientation Effort Intensity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable:	Effort intensity				
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.83[a]	4	1.96	1.37	.250
Intercept	45.43	1	45.43	31.85	.000
ztpi_future_score	3.90	1	3.90	2.73	.102
dum_inf_load	3.79	1	3.79	2.66	.107
dum_man	0.01	1	0.01	0.01	.944
dum_inf_load * dum_man	0.38	1	0.38	0.27	.606
Error	126.95	89	1.43		
Total	2185.00	94			
Corrected Total	134.78	93			

a. R Squared = .058 (Adjusted R Squared = .016)

Table 45: ANOVA incl. Gender Decision Confidence – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
sex	female	47
	male	38
data load	low data load	42
	high data load	43
decision aid	general principles	39
	capital budgeting manual	46

Table 46: ANOVA incl. Gender Decision Confidence – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	decision confidence score		
F	df1	df2	Sig.
2.40	7	77	.028

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + sex + dum_inf_load + dum_man + sex * dum_inf_load + sex * dum_man + dum_inf_load * dum_man + sex * dum_inf_load * dum_man

Table 47: ANOVA incl. Gender Decision Confidence – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: decision confidence score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	867.83[a]	7	123.98	2.82	.011
Intercept	134072.40	1	134072.40	3046.06	.000
sex	218.96	1	218.96	4.97	.029
dum_inf_load	167.31	1	167.31	3.80	.055
dum_man	478.05	1	478.05	10.86	.001
sex * dum_inf_load	8.02	1	8.02	0.18	.671
sex * dum_man	53.61	1	53.61	1.22	.273
dum_inf_load * dum_man	2.19	1	2.19	0.05	.824
sex * dum_inf_load * dum_man	9.06	1	9.06	0.21	.651
Error	3389.16	77	44.02		
Total	145833.00	85			
Corrected Total	4256.99	84			

a. R Squared = .204 (Adjusted R Squared = .131)

Table 48: ANOVA incl. Gender Perceived Task Complexity – Betw.-Subj. Factors

Between-Subjects Factors

	Value Label	N
sex	female	54
	male	42
data load	low data load	46
	high data load	50
decision aid	general principles	45
	capital budgeting manual	51

Table 49: ANOVA incl. Gender Perceived Task Complexity – Levene's Test

Levene's Test of Equality of Error Variances[a]

Dependent Variable:	perceived task complexity		
F	df1	df2	Sig.
.71	7	88	.664

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + sex + dum_inf_load + dum_man + sex * dum_inf_load + sex * dum_man + dum_inf_load * dum_man + sex * dum_inf_load * dum_man

Table 50: ANOVA incl. Gender Perceived Task Complexity – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: perceived task complexity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	73.82[a]	7	10.55	2.30	.034
Intercept	4677.96	1	4677.96	1018.92	.000
sex	2.47	1	2.47	0.54	.466
dum_inf_load	28.56	1	28.56	6.22	.015
dum_man	19.31	1	19.31	4.21	.043
sex * dum_inf_load	5.21	1	5.21	1.14	.290
sex * dum_man	2.78	1	2.78	0.61	.438
dum_inf_load * dum_man	0.82	1	0.82	0.18	.673
sex * dum_inf_load * dum_man	18.36	1	18.36	4.00	.049
Error	404.02	88	4.59		
Total	5466.00	96			
Corrected Total	477.83	95			

a. R Squared = .154 (Adjusted R Squared = .087)

Table 51: Valid n by Group and Gender for Decision Accuracy

			manual, low data load	manual, high data load	general principles, low data load	general principles, high data load	Total
sum correct decisions	sex	female	13	19	12	10	54
		male	7	11	13	10	41
		Total	20	30	25	20	95

Table 52: Valid n by Group and Gender for Perceived Task Complexity

			manual, low data load	manual, high data load	general principles, low data load	general principles, high data load	Total
perceived task complexity	sex	female	13	19	12	10	54
		male	8	11	13	10	42
		Total	21	30	25	20	96

Table 53: Valid N by Group and Gender for Decision Confidence

			manual, low data load	manual, high data load	general principles, low data load	general principles, high data load	Total
decision confidence score	sex	female	11	16	12	8	47
		male	8	11	11	8	38
		Total	19	27	23	16	85

Appendix 2: Experimental Materials

On the following pages, the original materials (in German) are presented, the page size has been scaled down to fit the layout of this dissertation.

1) Instructions, general principles, and questionnaire for “general principles” condition
2) Instructions, capital budgeting manual, and questionnaire for “capital budgeting manual” condition
3) Investment proposals for “high data load” condition
4) Investment proposals for “low data load” condition

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

FACHBEREICH 02

Wirtschaftswissenschaften

Forschungsprojekt

Univ.-Prof. Dr. Barbara E. Weißenberger
Dipl.-Kffr. Maren Hartmann

YA

Allgemeine Hinweise

Im Rahmen dieser Studie werden Sie gebeten, Investitionsanträge zu bewerten und einen Fragebogen auszufüllen. Ihre Teilnahme an dieser Studie ist rein freiwillig und Sie können Ihre Teilnahme jederzeit abbrechen.

Die Daten dieser Studie werden ausschließlich zum Zweck einer wissenschaftlichen Publikation ausgewertet. Sämtliche Angaben werden streng vertraulich behandelt, vollständig anonym ausgewertet und nur in aggregierter Form wiedergegeben, sodass keinerlei Rückschlüsse auf individuelle Antworten möglich sind. Mit der Teilnahme an dieser Studie erklären Sie sich bereit, dass die von Ihnen gegebenen Antworten in eine wissenschaftliche Analyse und in Publikationen mit eingehen.

Ablauf der Studie

Jeder Teilnehmer bearbeitet die Aufgabe für sich alleine. **Wir bitten Sie daher, nicht mit anderen Teilnehmern zu sprechen.** Wenn Sie Fragen haben, dann stellen Sie diese **nicht laut**. Heben Sie Ihre Hand und wir kommen zu Ihnen. Sie können sich bei der Bearbeitung der Aufgabe Notizen machen. Bitte verwenden Sie aber keine Hilfsmittel (Smartphones, Taschenrechner usw.).

Außerdem bitten wir Sie, in den dafür vorgesehenen Feldern den Stand der Stoppuhr zu notieren, welche Sie an der Leinwand sehen. Diese Felder sind mit einer Uhr markiert. Beachten Sie jedoch, dass die benötigte Zeit für Sie **keine** Rolle spielt. Bitte nehmen Sie sich zur Bearbeitung der Aufgabe die Zeit, die Sie für nötig halten.

Es sind unterschiedlich strukturierte Aufgaben vorhanden. Es kann also sein, dass Ihr Sitznachbar leicht abgewandelte Dokumente vorliegen hat und die Aufgabe ggf. schneller / langsamer bearbeitet.

Wenn Sie fertig sind, bleiben Sie bitte an Ihrem Platz sitzen und verhalten sich ruhig, bis die Studie beendet ist.

Vielen Dank für Ihre Teilnahme!

Bevor Sie mit dem Lesen der Anleitung auf der Folgeseite beginnen, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein. Bitte beachten Sie, dass Zeit für Sie **keine** Rolle spielt. Nehmen Sie sich genügend Zeit für die Bearbeitung der Aufgabe.

_____

Professur für BWL IV, insbesondere
Controlling und integrierte Rechnungslegung
http://wiwi.uni-giessen.de/controlling

Unsere Forschungsschwerpunkte:
- Controlling und IFRS-Rechnungslegung
- Best Practice der Controllerarbeit

Anleitung

Sie haben neben dieser Anleitung (Seite 2 bis 3) **die folgenden Dokumente** vorliegen:

- In dieser Unterlage:
  - Bogen für Ihre Antworten, inkl. abschließendem Fragebogen, Titel: "Beurteilung der Investitionsanträge & Fragebogen" (Seite 5 bis 16)
  - Glossar, bei Bedarf zur Erläuterung der Begriffe (Seite 17 bis 18)
- Als gesonderten Bogen:
  - Zu bewertende Investitionsanträge (7 Anträge), Titel: "Investitionsanträge"

Stellen Sie sich folgende Situation vor:

- Sie arbeiten als Controller in der Zentrale eines Unternehmens ("Schmidt AG") und sind dafür zuständig, **Investitionsanträge zu überprüfen**.
- Die Schmidt AG besteht aus mehreren Landesgesellschaften. Die Produktbereiche in den einzelnen Ländern sind jeweils **"Unterhaltung"**, **"Telekommunikation"** und **"Haushalt"**.
- Für die einzelnen Bereiche wurden Investitionsanträge eingereicht. Der Bereich, in dem die Investition getätigt werden soll, ist auf jedem Investitionsantrag aufgeführt.
- Ihre Aufgabe ist es, die Ihnen vorliegenden Investitionsanträge zu bewerten, indem Sie diese entweder **genehmigen** oder an den Antragsteller **zurückgeben**.
- Pro Bereich stehen begrenzte Budgets zur Verfügung, die nicht überschritten werden dürfen.

(Fortsetzung der Anleitung auf der Folgeseite)

Bitte gehen Sie bei der Entscheidungsfindung wie folgt vor:

Budgets pro Bereich: Genehmigen Sie pro Bereich nur so viele Anträge, dass die Summe der **Anschaffungskosten** für die genehmigten Investitionen das jeweilige Bereichsbudget nicht überschreitet:

Bereich	Budget (bezogen auf die Anschaffungskosten):
Unterhaltung	1,50 Mio EUR
Telekommunikation	0,25 Mio EUR
Haushalt	3,00 Mio EUR

Allgemeine Prinzipien zur Priorisierung von Investitionen: Liegen pro Bereich mehr Anträge vor, als über das verfügbare Budget abgedeckt sind, müssen Sie eine Priorisierung vornehmen.

Ziehen Sie zur Priorisierung die üblichen **Prinzipien** für die Bewertung von Investitionen heran (**siehe folgender Kasten**).

Anträge, **die auf Basis Ihrer Priorisierung nicht in Frage kommen**, geben Sie **an den Antragsteller zurück**.

Allgemeine Prinzipien zur Priorisierung von Investitionen:

Prinzip 1: Investitionen sollen nach den folgenden Kriterien priorisiert werden:
- **Nettobarwert**
- **Amortisationsdauer**
- **Risiko**

Bezüglich des **Risikos** der Investitionen gelten die folgenden Prinzipien:

Prinzip 2a): Das Risiko des jeweiligen **Landes** ist zu berücksichtigen:
Japan (J) > USA (US) > Schweiz (CH) > Frankreich (F) > Deutschland (DE)

Prinzip 2b): Das **Risiko nach Investitionsart** ist zu berücksichtigen:
Neuinvestitionen (Risikoklasse 3) > Erweiterungsinvestitionen, Rationalisierungsinvestitionen, Complianceinvestitionen (jeweils Risikoklasse 2) > Ersatzinvestitionen (Risikoklasse 1)

Hinweis: ">" bedeutet "risikoreicher als", also z.B.: Neuinvestitionen sind risikoreicher als Erweiterungsinvestitionen. Erweiterungsinvestitionen sind genauso risikoreich wie Rationalisierungsinvestitionen und Complianceinvestitionen.

Prinzip 3: Der **Diskontierungszinssatz** spiegelt wider, welches Risiko in der Berechnung des Nettobarwerts bereits „eingepreist" ist. Der Diskontierungszinssatz setzt sich zusammen aus dem **WACC** der Schmidt AG (12%), einem Aufschlag / Abschlag für die Risikoklasse der jeweiligen Investitionsart (**Risikoanpassung**) sowie einer **landesspezifischen Anpassung.**

Dokumentation Ihrer Entscheidungen:
- Tragen Sie im Abschnitt für Ihre Antworten "Beurteilung der Investitionsanträge & Fragebogen" (ab Seite 5) pro Investitionsantrag ein, ob Sie...
  - ...diesen **genehmigen**: Ankreuzen des Kästchens "**Ja**"
  - ...oder diesen **an den Antragsteller zurückgeben**: Ankreuzen des Kästchens "**Nein**". Bei Rückgabe des Investitionsantrags an den Antragsteller geben Sie bitte den **Grund** an.
- Sie werden ebenfalls gebeten einzutragen, **wie sicher Sie sich mit Ihrer Entscheidung sind**.

Hinweise:
- In den Investitionsanträgen sind gegebenenfalls mehr Informationen enthalten, als Sie für Ihre Entscheidung benötigen. Bitte treffen Sie Ihre Entscheidung ausschließlich wie oben beschrieben.
- Gehen Sie davon aus, dass die Berechnungen in den Investitionsanträgen mathematisch korrekt sind. Es ist **nicht** erforderlich, die Berechnungen auf mathematische Korrektheit zu überprüfen.
- Beantworten Sie im Anschluss noch die Fragen im abschließenden Fragebogen.

Beginnen Sie nun mit der Beurteilung der Investitionsanträge auf Seite 5.

Seite 3

- Anleitung -

YA

Beurteilung der Investitionsanträge & Fragebogen

Hinweis: Die Investitionsanträge sind bereits nach Bereichen sortiert.

YA

	Bevor Sie mit der Beurteilung der Investitionsanträge beginnen, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein: _____

1. Investitionsantrag A:

Genehmigen Sie die im **Investitionsantrag A** dargestellte Investition?								
Ja ☐							Nein ☐	
Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?								
	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher
In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:								

2. Investitionsantrag B:

Genehmigen Sie die im **Investitionsantrag B** dargestellte Investition?								
Ja ☐							Nein ☐	
Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?								
	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher
In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:								

YA

3. Investitionsantrag C:

Genehmigen Sie die im **Investitionsantrag C** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

4. Investitionsantrag D:

Genehmigen Sie die im **Investitionsantrag D** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

5. Investitionsantrag E:

Genehmigen Sie die im **Investitionsantrag E** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

YA

6. Investitionsantrag F:

Genehmigen Sie die im **Investitionsantrag F** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

7. Investitionsantrag G:

Genehmigen Sie die im **Investitionsantrag G** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

Nachdem Sie alle Investitionsanträge bewertet haben, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein:

_____

YA

Bitte beantworten Sie noch die folgenden Fragen:

1 Fragen zur durchgeführten Aufgabe

Wie haben Sie die Menge der Informationen in den **Investitionsanträgen** wahrgenommen?

	1	2	3	4	5	6	7	
Sehr wenige Informationen	☐	☐	☐	☐	☐	☐	☐	Sehr viele Informationen

Geben Sie bitte eine Einschätzung ab, welchen Anteil (in %) der in den **Investitionsanträgen** enthaltenen Informationen Sie für Ihre Entscheidung berücksichtigt haben. Tragen Sie den Prozentsatz (0% - 100%) ohne Nachkommastellen ein:

Bitte beurteilen Sie, inwiefern die folgenden Aussagen auf die von Ihnen durchgeführte Aufgabe zutreffen:

Zur Beurteilung der Investitionsanträge waren klare Wertgrenzen vorgegeben.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Die zur Beurteilung der Investitionsanträge heranzuziehenden Vorgaben waren sehr detailliert.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Es lagen sehr präzise Regeln für die Beurteilung der Investitionsanträge vor.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Die Investitionsanträge mussten auf Basis allgemeiner Prinzipien beurteilt werden.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Zur Beurteilung der Investitionsanträge musste eine Vielzahl von Regeln beachtet werden.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

YA

Haben Sie die Aufgabenstellung verstanden?								
	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, definitiv

Was haben Sie ggf. nicht verstanden:

_____

Welche Aussage trifft auf die von Ihnen bearbeitete Aufgabe zu? (Bitte kreuzen Sie nur eine der möglichen Antworten an.)	
Die Investitionsanträge mussten auf Basis einer mehrseitigen Richtlinie mit dem Titel "**Investitionsrichtlinie der Schmidt AG**" bewertet werden.	☐
Es lag **keine mehrseitige Richtlinie** mit dem Titel "Investitionsrichtlinie der Schmidt AG" vor. In der Anleitung wurden allerdings **"Allgemeine Prinzipien zur Priorisierung von Investitionen"** aufgeführt.	☐
In den Unterlagen wurden **keinerlei Angaben zur Vorgehensweise** bei der Bewertung der Investitionsanträge gemacht. Die Beurteilung konnte nach selbst gewählten Kriterien vorgenommen werden.	☐

Welche Aussage trifft auf die von Ihnen bearbeitete Aufgabe zu? (Bitte kreuzen Sie nur eine der möglichen Antworten an.)	
In den Investitionsanträgen waren **keine Kennzahlen** aufgeführt.	☐
Im Feld **"Kennzahlenübersicht (erwartetes Szenario)"** auf den Investitionsanträgen waren **weniger** als 5 Kennzahlen aufgeführt.	☐
Im Feld **"Kennzahlenübersicht (erwartetes Szenario)"** auf den Investitionsanträgen waren **mehr** als 5 Kennzahlen aufgeführt.	☐

Wie stark haben Sie sich bei der Bearbeitung der Aufgabe angestrengt?								
	1	2	3	4	5	6	7	
Überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Extrem stark

Wie motiviert waren Sie, die Investitionsanträge zu beurteilen?								
	1	2	3	4	5	6	7	
Überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Extrem stark

Haben Sie sich während der Bearbeitung der Aufgabe unter Zeitdruck gefühlt?								
	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, extrem stark

YA

Nehmen Sie an, für eine komplett korrekt ausgeführte Aufgabe gibt es 100 Punkte - wie viele Punkte glauben Sie erreicht zu haben? Tragen Sie bitte Ihre Einschätzung unten ein (0 - 100 Punkte, ohne Nachkommastellen).

Wie beurteilen Sie die durchgeführte Aufgabe?

	1	2	3	4	5	6	7	
Attraktiv	☐	☐	☐	☐	☐	☐	☐	Abstoßend
Spannend	☐	☐	☐	☐	☐	☐	☐	Öde
Gut	☐	☐	☐	☐	☐	☐	☐	Schlecht
Interessant	☐	☐	☐	☐	☐	☐	☐	Langweilig
Höherwertig	☐	☐	☐	☐	☐	☐	☐	Minderwertig
Bereichernd	☐	☐	☐	☐	☐	☐	☐	Belastend
Macht Spaß	☐	☐	☐	☐	☐	☐	☐	Ist ermüdend
Schwierig	☐	☐	☐	☐	☐	☐	☐	Leicht
Komplex	☐	☐	☐	☐	☐	☐	☐	Einfach
Abwechslungsreich	☐	☐	☐	☐	☐	☐	☐	Gleichbleibend

Sie mussten während der Bearbeitung der Aufgabe Ihre Bearbeitungszeit eintragen. Hat dies Ihre Entscheidungen beeinflusst?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, definitiv

YA

2 Fragen zur Selbsteinschätzung

Wie schätzen Sie Ihr theoretisches Wissen ein, das Sie sich im Rahmen Ihres Studiums (bspw. Vorlesungen, Übungen, Seminare) zum Thema Investitionsbewertung angeeignet haben?								
	1	2	3	4	5	6	7	
Kein Wissen	☐	☐	☐	☐	☐	☐	☐	Sehr viel Wissen

Wie schätzen Sie Ihre praktische Erfahrung ein, die Sie neben Ihrem Studium (bspw. Praktikum, Ausbildung, Werkstudententätigkeit) zum Thema Investitionsbewertung gesammelt haben?								
	1	2	3	4	5	6	7	
Keine Erfahrung	☐	☐	☐	☐	☐	☐	☐	Sehr viel Erfahrung

Bitte beurteilen Sie, ob die folgenden Aussagen richtig oder falsch sind:	
Unter sonst gleichen Bedingungen ("ceteris paribus") ist bei der Bewertung von Investitionen...	
... diejenige Investition mit der **kürzeren Amortisationsdauer** vorzuziehen.	Richtig ☐ Falsch ☐
... diejenige Investition mit dem **niedrigeren Nettobarwert** vorzuziehen.	Richtig ☐ Falsch ☐
... diejenige Investition mit dem **höheren Risiko** vorzuziehen.	Richtig ☐ Falsch ☐

Unter sonst gleichen Bedingungen ("ceteris paribus") führt die Verwendung eines höheren Diskontierungszinssatzes zu einem geringeren Barwert.	Richtig ☐ Falsch ☐
Abschreibungen einer Anlage sind zahlungswirksam und stellen einen Zahlungsmittelabfluss (Cash-Outflow) dar.	Richtig ☐ Falsch ☐

YA

Inwieweit treffen die folgenden Aussagen auf Sie zu? Kreuzen Sie bitte die jeweilige Ziffer an.					
Ich...	Trifft überhaupt nicht zu	Trifft eher nicht zu	Weder noch	Eher zutreffend	Trifft voll und ganz zu
...bin tüchtig und arbeite flott.	(1)	(2)	(3)	(4)	(5)
...bin eher zurückhaltend, reserviert.	(1)	(2)	(3)	(4)	(5)
...mache Pläne und führe diese auch durch.	(1)	(2)	(3)	(4)	(5)
...schenke anderen leicht Vertrauen, glaube an das Gute im Menschen.	(1)	(2)	(3)	(4)	(5)
...bin bequem, neige zur Faulheit.	(1)	(2)	(3)	(4)	(5)
...bin entspannt, lasse mich durch Stress nicht aus der Ruhe bringen.	(1)	(2)	(3)	(4)	(5)
...bin zuverlässig und gewissenhaft.	(1)	(2)	(3)	(4)	(5)
...habe nur wenig künstlerisches Interesse.	(1)	(2)	(3)	(4)	(5)
...gebe nicht auf, ehe die Aufgabe erledigt ist.	(1)	(2)	(3)	(4)	(5)
...gehe aus mir heraus, bin gesellig.	(1)	(2)	(3)	(4)	(5)
...bin leicht ablenkbar, bleibe nicht bei der Sache.	(1)	(2)	(3)	(4)	(5)
...neige dazu, andere zu kritisieren.	(1)	(2)	(3)	(4)	(5)
...erledige Aufgaben gründlich.	(1)	(2)	(3)	(4)	(5)
...werde leicht nervös und unsicher.	(1)	(2)	(3)	(4)	(5)
...kann etwas achtlos sein.	(1)	(2)	(3)	(4)	(5)
...habe eine aktive Vorstellungskraft, bin phantasievoll.	(1)	(2)	(3)	(4)	(5)
...neige dazu, unordentlich zu sein.	(1)	(2)	(3)	(4)	(5)

YA

Bitte kreuzen Sie bei jeder Aussage an, wie sehr diese auf Sie persönlich zutrifft. Dabei bedeutet ein Wert von 1, dass diese Feststellung für Sie sehr unzutreffend ist, ein Wert von 5 bedeutet, dass die Aussage für Sie persönlich sehr zutreffend ist. Werte von 2, 3 oder 4 liegen als Antwortmöglichkeiten dazwischen.					
	Sehr unzu-treffend	Un-zutreffend	Neutral	Zutreffend	Sehr zutreffend
Ich denke oft an die schlechten Dinge, die mir in der Vergangenheit zugestoßen sind.	(1)	(2)	(3)	(4)	(5)
Schmerzhafte Erfahrungen aus der Vergangenheit gehen mir nicht mehr aus dem Kopf.	(1)	(2)	(3)	(4)	(5)
Es fällt mir schwer, unschöne Bilder aus meiner Jugend zu vergessen.	(1)	(2)	(3)	(4)	(5)
Vertraute Bilder, Geräusche und Gerüche aus der Kindheit wecken eine Flut wundervoller Erinnerungen.	(1)	(2)	(3)	(4)	(5)
Glückliche Erinnerungen aus guten Zeiten kommen mir leicht in den Sinn.	(1)	(2)	(3)	(4)	(5)
Ich mag Geschichten über die „guten alten Zeiten“.	(1)	(2)	(3)	(4)	(5)
Das Leben heute ist zu kompliziert; ich würde das einfachere Leben, wie es früher war, bevorzugen.	(1)	(2)	(3)	(4)	(5)
Da ohnehin alles so kommt wie es kommt, ist es egal, was ich tue.	(1)	(2)	(3)	(4)	(5)
Oft macht sich Glück mehr bezahlt als harte Arbeit.	(1)	(2)	(3)	(4)	(5)
Entscheidungen treffe ich spontan.	(1)	(2)	(3)	(4)	(5)
Risiken einzugehen bewahrt mich vor Langeweile in meinem Leben.	(1)	(2)	(3)	(4)	(5)
Ich brauche Aufregung im Leben.	(1)	(2)	(3)	(4)	(5)
Wenn ich etwas erreichen will, setze ich mir Ziele und überlege genau, mit welchen Mitteln ich diese erreichen kann.	(1)	(2)	(3)	(4)	(5)
Bevor man sich am Abend vergnügt, ist es wichtiger, bevorstehende Termine einzuhalten und andere notwendige Arbeiten zu erledigen.	(1)	(2)	(3)	(4)	(5)
Ich erledige meine Vorhaben pünktlich, indem ich konsequent daran arbeite.	(1)	(2)	(3)	(4)	(5)

YA

3 Allgemeine Angaben

Abgeschlossene Fachsemester Ihres BWL/VWL-Studiums (inklusive der Fachsemester Ihres Bachelor-Studiums)

____ Semester

Studieren Sie BWL/VWL im Hauptfach?

☐ Ja
☐ Nein, mein Hauptfach ist _____

Haben Sie vor Ihrem Studienbeginn bereits eine kaufmännische Ausbildung (z.B. als Bürokaufmann/-frau) absolviert?

☐ Ja
☐ Nein

Muttersprache

☐ Deutsch (bitte auch ankreuzen, wenn Sie zweisprachig aufgewachsen sind und Deutsch eine Ihrer Muttersprachen ist)
☐ Andere, nämlich _____

Wo haben Sie Ihre Hochschulzugangsberechtigung (also bspw. Abitur) erworben?

☐ Deutschland
☐ Anderes Land, nämlich _____

Bitte kreuzen Sie die Note Ihrer Hochschulzugangsberechtigung (bspw. Abitur) an:

☐	☐	☐	☐
Sehr gut (1,0-1,5)	Gut (1,6-2,5)	Befriedigend (2,6-3,5)	Ausreichend (3,6-4,0)

Geschlecht

☐ Männlich
☐ Weiblich

Lebensalter

____ Jahre

Haben Sie vor dieser Studie schon einmal an einer anderen wissenschaftlichen Studie teilgenommen?

☐ Ja
☐ Nein

Wenn ja, bitte beschreiben Sie diese kurz:

YA

Bitte tragen Sie vor dem Abschluss des Fragebogens noch ein letztes Mal den Stand der Stoppuhr ein:

_____

Herzlichen Dank für Ihre Teilnahme

Ihre Kommentare sind willkommen:

Rückfragen beantwortet Ihnen gerne Maren Hartmann:

E-Mail: maren.j.hartmann@wirtschaft.uni-giessen.de

YA

Glossar

YA

Glossar

Annuität: Berechnete Größe, die angibt, wie hoch eine für die einzelnen Perioden gleichbleibende Zahlung sein müsste, die den gleichen Barwert wie das betrachtete Projekt hat.

Amortisationsdauer: Anzahl der Jahre, nach denen die Anfangsauszahlungen eines Projekts wieder eingenommen wurden.

Barwert einer Zahlungsreihe: Die auf den heutigen Zeitpunkt diskontierten zukünftigen Ein- und Auszahlungen.

Diskontierungszinssatz: Derjenige Zinssatz, der für die Diskontierung genutzt wird, um den Barwert zukünftiger Zahlungen zu ermitteln (auch Kalkulationszinsfuß genannt).

Durchschnittliche Buchrendite: Der durchschnittliche Projektgewinn nach Steuern und Abschreibungen geteilt durch den durchschnittlichen Buchwert der Investition über die Projektdauer.

Interner Zinsfuß: Der Diskontierungszinssatz, bei dem der Barwert der erwarteten Auszahlungen dem Barwert der erwarteten Einzahlungen des Projekts entspricht. Im Allgemeinen ist der interne Zinsfuß derjenige Zinssatz, der zu einem Nettobarwert des Projekts von 0 führt, wenn er zur Diskontierung der zukünftigen Zahlungsströme eingesetzt wird.

Modifizierter interner Zinsfuß: Während bei der Berechnung des internen Zinsfußes angenommen wird, dass die aus dem Projekt resultierenden Einzahlungen zum internen Zinsfuß des Projekts wieder reinvestiert werden können, wird der modifizierte interne Zinsfuß unter Verwendung einer gesonderten Rate für die Reinvestition ermittelt (bspw. dem WACC).

Nettobarwert: Die Differenz zwischen dem Barwert des zukünftigen erwarteten Cashflows eines Projekts und dem Barwert der Anfangsauszahlung (auch Kapitalwert genannt).

Net Working Capital: Auch Nettoumlaufvermögen genannt. Differenz zwischen Umlaufvermögen und kurzfristigen Verbindlichkeiten.

Opportunitätskosten: Entgangene Einkünfte der alternativen Verwendung von Vermögensgegenständen, die im Projekt genutzt werden und somit nicht mehr für andere Alternativen zur Verfügung stehen.

Kapitalwertrate: Das Verhältnis aus dem Barwert der zukünftigen erwarteten Zahlungen (ohne Anfangsauszahlung) und der Anfangsauszahlung.

Sensitivitätsanalyse: Untersucht, wie sich Veränderungen in den zugrundeliegenden Annahmen auf Kenngrößen der Investition auswirken.

Hierbei werden bestimmte Kennzahlen für drei Szenarien berechnet:

- Pessimistisches Szenario
- Erwartetes Szenario
- Optimistisches Szenario

WACC (weighted average cost of capital bzw. gewichteter durchschnittlicher Kapitalkostensatz): Der gewichtete Durchschnitt der durchschnittlichen Kapitalkosten (Fremd- und Eigenkapital). Gewichtung mit dem Anteil der jeweiligen Größe an der Finanzierung des Unternehmens.

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

FACHBEREICH 02

Wirtschaftswissenschaften

Forschungsprojekt

Univ.-Prof. Dr. Barbara E. Weißenberger
Dipl.-Kffr. Maren Hartmann

XYA

Allgemeine Hinweise

Im Rahmen dieser Studie werden Sie gebeten, Investitionsanträge zu bewerten und einen Fragebogen auszufüllen. Ihre Teilnahme an dieser Studie ist rein freiwillig und Sie können Ihre Teilnahme jederzeit abbrechen.

Die Daten dieser Studie werden ausschließlich zum Zweck einer wissenschaftlichen Publikation ausgewertet. Sämtliche Angaben werden streng vertraulich behandelt, vollständig anonym ausgewertet und nur in aggregierter Form wiedergegeben, sodass keinerlei Rückschlüsse auf individuelle Antworten möglich sind. Mit der Teilnahme an dieser Studie erklären Sie sich bereit, dass die von Ihnen gegebenen Antworten in eine wissenschaftliche Analyse und in Publikationen mit eingehen.

Ablauf der Studie

Jeder Teilnehmer bearbeitet die Aufgabe für sich alleine. **Wir bitten Sie daher, nicht mit anderen Teilnehmern zu sprechen.** Wenn Sie Fragen haben, dann stellen Sie diese **nicht laut**. Heben Sie Ihre Hand und wir kommen zu Ihnen. Sie können sich bei der Bearbeitung der Aufgabe Notizen machen. Bitte verwenden Sie aber keine Hilfsmittel (Smartphones, Taschenrechner usw.).

Außerdem bitten wir Sie, in den dafür vorgesehenen Feldern den Stand der Stoppuhr zu notieren, welche Sie an der Leinwand sehen. Diese Felder sind mit einer Uhr markiert. Beachten Sie jedoch, dass die benötigte Zeit für Sie **keine** Rolle spielt. Bitte nehmen Sie sich zur Bearbeitung der Aufgabe die Zeit, die Sie für nötig halten.

Es sind unterschiedlich strukturierte Aufgaben vorhanden. Es kann also sein, dass Ihr Sitznachbar leicht abgewandelte Dokumente vorliegen hat und die Aufgabe ggf. schneller / langsamer bearbeitet.

Wenn Sie fertig sind, bleiben Sie bitte an Ihrem Platz sitzen und verhalten sich ruhig, bis die Studie beendet ist.

Vielen Dank für Ihre Teilnahme!

Bevor Sie mit dem Lesen der Anleitung auf der Folgeseite beginnen, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein. Bitte beachten Sie, dass Zeit für Sie **keine** Rolle spielt. Nehmen Sie sich genügend Zeit für die Bearbeitung der Aufgabe.

_____

Professur für BWL IV, insbesondere
Controlling und integrierte Rechnungslegung
http://wiwi.uni-giessen.de/controlling

Unsere Forschungsschwerpunkte:
- Controlling und IFRS-Rechnungslegung
- Best Practice der Controllerarbeit

Anleitung

Sie haben neben dieser Anleitung (Seite 2 bis 3) **die folgenden Dokumente** vorliegen:

- In dieser Unterlage:
  - Investitionsrichtlinie, Titel: "Investitionsrichtlinie der Schmidt AG" (Seite 4 bis 9)
  - Bogen für Ihre Antworten, inkl. abschließendem Fragebogen, Titel: "Beurteilung der Investitionsanträge & Fragebogen" (Seite 11 bis 22)
  - Glossar, bei Bedarf zur Erläuterung der Begriffe (Seite 23 bis 24)
- Als gesonderten Bogen:
  - Zu bewertende Investitionsanträge (7 Anträge), Titel: "Investitionsanträge"

Stellen Sie sich folgende Situation vor:

- Sie arbeiten als Controller in der Zentrale eines Unternehmens ("Schmidt AG") und sind dafür zuständig, **Investitionsanträge zu überprüfen**.
- Die Schmidt AG besteht aus mehreren Landesgesellschaften. Die Produktbereiche in den einzelnen Ländern sind jeweils "**Unterhaltung**", "**Telekommunikation**" und "**Haushalt**".
- Für die einzelnen Bereiche wurden Investitionsanträge eingereicht. Der Bereich, in dem die Investition getätigt werden soll, ist auf jedem Investitionsantrag aufgeführt.
- Ihre Aufgabe ist es, die Ihnen vorliegenden Investitionsanträge zu bewerten, indem Sie diese entweder **genehmigen** oder an den Antragsteller **zurückgeben**.
- Pro Bereich stehen begrenzte Budgets zur Verfügung, die nicht überschritten werden dürfen.

(Fortsetzung der Anleitung auf der Folgeseite)

Bitte gehen Sie bei der Entscheidungsfindung wie folgt vor:

Budgets pro Bereich: Genehmigen Sie pro Bereich nur so viele Anträge, dass die Summe der **Anschaffungskosten** für die genehmigten Investitionen das jeweilige Bereichsbudget nicht überschreitet:

Bereich	Budget (bezogen auf die Anschaffungskosten):
Unterhaltung	1,50 Mio EUR
Telekommunikation	0,25 Mio EUR
Haushalt	3,00 Mio EUR

Vorgaben der Investitionsrichtlinie: Die Schmidt AG verwendet eine **Investitionsrichtlinie.** Diese Investitionsrichtlinie haben Sie in Ihren Unterlagen ab Seite 4 vorliegen ("Investitionsrichtlinie der Schmidt AG").

Genehmigen Sie einen Antrag nur dann, wenn dieser alle Vorgaben der **Investitionsrichtlinie zur Bewertung von Investitionen** erfüllt.

Sollte eine Vorgabe der **Investitionsrichtlinie nicht erfüllt sein**, geben Sie den **Antrag an den Antragsteller zurück.**

Dokumentation Ihrer Entscheidungen:

- Tragen Sie im Abschnitt für Ihre Antworten "Beurteilung der Investitionsanträge & Fragebogen" (ab Seite 11) pro Investitionsantrag ein, ob Sie...
  - ...diesen **genehmigen**: Ankreuzen des Kästchens "**Ja**"
  - ...oder diesen **an den Antragsteller zurückgeben**: Ankreuzen des Kästchens "**Nein**". Bei Rückgabe des Investitionsantrags an den Antragsteller geben Sie bitte den **Grund** an.
- Sie werden ebenfalls gebeten einzutragen, **wie sicher Sie sich mit Ihrer Entscheidung sind**.

Hinweise:

- In den Investitionsanträgen sind gegebenenfalls mehr Informationen enthalten, als Sie für Ihre Entscheidung benötigen. Bitte treffen Sie Ihre Entscheidung ausschließlich wie oben beschrieben.
- Gehen Sie davon aus, dass die Berechnungen in den Investitionsanträgen mathematisch korrekt sind. Es ist **nicht** erforderlich, die Berechnungen auf mathematische Korrektheit zu überprüfen.
- Beantworten Sie im Anschluss noch die Fragen im abschließenden Fragebogen.

Nachdem Sie die Aufgabenstellung gelesen haben und bevor Sie mit dem Lesen der Investitionsrichtlinie beginnen: Bitte tragen Sie hier den aktuellen Stand der Stoppuhr ein:

_____

Beginnen Sie nun mit dem Lesen der Investitionsrichtlinie auf Seite 4.

Investitionsrichtlinie

Bitte lesen Sie die Investitionsrichtlinie gründlich durch ("Investitionsrichtlinie der Schmidt AG").

Investitionsrichtlinie der Schmidt AG

Vorstandsbeschluss vom 20.05.2013

Inhalte

1. Ziele und Inhalte der Investitionsrichtlinie

Die Schmidt AG ist ein multinationales produzierendes Unternehmen, welches 5 Tochterunternehmen in verschiedenen Ländern hat. In den einzelnen Ländern tritt die Schmidt AG mit folgenden Tochterunternehmen auf:

- DE GmbH (Deutschland - DE)
- F SARL (Frankreich - F)
- CH GmbH (Schweiz - CH)
- US LLC. (USA - US)
- Japan G.K. (Japan - J)

Die Produktbereiche in den einzelnen Landesgesellschaften sind "Unterhaltung", "Telekommunikation" und "Haushalt".

Die Investitionsrichtlinie hat zum Ziel, im Unternehmen einheitliche und verbindliche Kriterien zur Bewertung von Investitionen festzulegen. Die vorliegende Investitionsrichtlinie gilt unternehmensweit für sämtliche Tochterunternehmen.

Für das Unternehmen ist wichtig, dass die Vorgaben der Investitionsrichtlinie befolgt werden, um sicherzustellen, dass alle Investitionen im Unternehmen nach den gleichen Kriterien bewertet werden. Die Koordination sowie finale Genehmigung der Investitionsanträge obliegt dem zentralen Investitionscontrolling.

2. Klassifizierung von Investitionen

Je nach Art der Investition gelten unterschiedliche Anforderungen. Daher teilt die Schmidt AG Investitionen in die folgenden Klassen ein:

Klassifizierung nach **Investitionsart**:

- **Neuinvestition**
- **Erweiterungsinvestition**
- **Ersatzinvestition**
- **Rationalisierungsinvestition**
- **Complianceinvestition**

3. Inhalte des Investitionsantrags

Der Investitionsantrag sollte folgende Informationen enthalten:

- **Allgemeine Informationen:**
  - Kennung des Antrags
  - Allgemeine Daten, z.B. Art der Investition, Bereich, Land
- **Kennzahlen:** wichtigste Kennzahlen zur Investition
- **Kurzbeschreibung der Investition**
- **Kommentarfeld** zur Erläuterung des Investitionsvorhabens
- **Angabe zur Risikoklasse**
- Angaben zum **verwendeten Diskontierungszinssatz** sowie dessen Zusammensetzung

Optional können folgende weitere Informationen hinzugefügt werden:

- **Reviews:** Angabe zu Titel (Rollenbezeichnung) und Namen der Reviewer / des Reviewers
- **Investitionsrechnung des Projekts:** Cash Flows, Ergebniswirksame Sachverhalte
- **Sensitivitätsanalyse** sowie Annahmen zur Sensitivitätsanalyse

4. Bewertung von Investitionen

4.1 Zu nutzender Diskontierungszinssatz

Die Berücksichtigung der Unterschiede im Risikoprofil der Investitionen geschieht in der Schmidt AG über eine Anpassung des Diskontierungszinssatzes.

Der in der Berechnung der diskontierten Zahlungsströme zu verwendende Zinssatz ("Diskontierungszinssatz") ist abhängig von der Risikoklasse der Investitionsart sowie von dem Sitz des Tochterunternehmens:

- Für Tochterunternehmen in **Deutschland** gilt: **WACC + Risikoanpassung**
- Für Tochterunternehmen im **Ausland** gilt: **WACC + Risikoanpassung + landesspezifische Anpassung**

Der **WACC** berechnet sich als gewichteter Durchschnitt von Fremd- und Eigenkapitalkosten und **beträgt 12%** (zentrale Vorgabe des Controllings für die gesamte Schmidt AG).

Risikoanpassung: Die Investitionen sind einer **Risikoklasse** zuzuordnen. Je nach Risikoklasse wird ein anderer Diskontierungszinssatz verwendet, um in der Bewertung den unterschiedlichen Risiken gerecht zu werden. Die Beschreibung der Risikoklassen sowie der anzuwendende Aufschlag bzw. Abschlag auf den WACC können Tabelle 1 entnommen werden:

Tabelle 1: Risikoklassen und Anpassungen des Zinssatzes

Risikoklasse:	Beschreibung:	Welche Investitionsarten fallen in diese Risikoklasse?	Aufschlag / Abschlag auf WACC (Risikoanpassung)
1	Projektrisiko geringer als durchschnittliches Risiko	Gilt für alle Ersatzinvestitionen	-1,00%
2	Projektrisiko entspricht dem durchschnittlichen Risiko	Gilt für Erweiterungsinvestitionen, Rationalisierungsinvestitionen, Complianceinvestitionen	+0,00%
3	Projektrisiko ist wesentlich höher als das durchschnittliche Risiko	Gilt für alle Neuinvestitionen	+5,00%

Die landesspezifischen Anpassungen sind der folgenden Tabelle zu entnehmen:

Tabelle 2: Anpassung des Diskontierungszinssatzes bei Investitionen im Ausland

Land	**Spezifische Anpassung pro Land:**
Frankreich (F)	+0,50%
Schweiz (CH)	+1,00%
USA (US)	+1,50%
Japan (J)	+2,00%

Beispiel:

Für ein Investitionsvorhaben, bei dem es sich um eine Complianceinvestition in den USA handelt, wäre somit der folgende Diskontierungszinssatz zu nutzen:

12,00% (WACC) + 0,00% (Risikoanpassung aus Tabelle 1) + 1,50% (landesspezifische Anpassung aus Tabelle 2) = 13,50%

4.2 Welche Kriterien muss ein Investitionsvorhaben erfüllen?

Es dürfen nur Investitionen durchgeführt werden, die im erwarteten Szenario die folgenden Mindestkriterien erfüllen:

Amortisationsdauer: höchstens 3 Jahre

Nettobarwert: im erwarteten Szenario muss die Investition unter Verwendung des risikoangepassten sowie ggfs. um die landesspezifische Komponente angepassten WACC einen positiven Nettobarwert haben.

XYA

Beurteilung der Investitionsanträge & Fragebogen

Hinweis: Die Investitionsanträge sind bereits nach Bereichen sortiert.

XYA

	Nachdem Sie die Investitionsrichtlinie gelesen haben und bevor Sie mit der Beurteilung der Investitionsanträge beginnen, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein: _____

1. Investitionsantrag A:

Genehmigen Sie die im **Investitionsantrag A** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

_____

2. Investitionsantrag B:

Genehmigen Sie die im **Investitionsantrag B** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

_____

XYA

3. Investitionsantrag C:

Genehmigen Sie die im **Investitionsantrag C** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

4. Investitionsantrag D:

Genehmigen Sie die im **Investitionsantrag D** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

5. Investitionsantrag E:

Genehmigen Sie die im **Investitionsantrag E** dargestellte Investition?

Ja ☐ Nein ☐

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher

In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:

XYA

6. Investitionsantrag F:

Genehmigen Sie die im **Investitionsantrag F** dargestellte Investition?								
	Ja ☐						Nein ☐	
Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?								
	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher
In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:								

7. Investitionsantrag G:

Genehmigen Sie die im **Investitionsantrag G** dargestellte Investition?								
	Ja ☐						Nein ☐	
Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?								
	1	2	3	4	5	6	7	
Sehr unsicher	☐	☐	☐	☐	☐	☐	☐	Sehr sicher
In dem Fall, dass Sie den Investitionsantrag an den Antragsteller zurückgeben (Ankreuzen von "Nein"): bitte tragen Sie hier den Grund ein:								

	Nachdem Sie alle Investitionsanträge bewertet haben, tragen Sie bitte hier den aktuellen Stand der Stoppuhr ein: _____

XYA

Bitte beantworten Sie noch die folgenden Fragen:

1 Fragen zur durchgeführten Aufgabe

Wie haben Sie die Menge der Informationen in den **Investitionsanträgen** wahrgenommen?

	1	2	3	4	5	6	7	
Sehr wenige Informationen	☐	☐	☐	☐	☐	☐	☐	Sehr viele Informationen

Geben Sie bitte eine Einschätzung ab, welchen Anteil (in %) der in den **Investitionsanträgen** enthaltenen Informationen Sie für Ihre Entscheidung berücksichtigt haben. Tragen Sie den Prozentsatz (0% - 100%) ohne Nachkommastellen ein:

Bitte beurteilen Sie, inwiefern die folgenden Aussagen auf die von Ihnen durchgeführte Aufgabe zutreffen:

Zur Beurteilung der Investitionsanträge waren klare Wertgrenzen vorgegeben.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Die zur Beurteilung der Investitionsanträge heranzuziehenden Vorgaben waren sehr detailliert.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Es lagen sehr präzise Regeln für die Beurteilung der Investitionsanträge vor.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Die Investitionsanträge mussten auf Basis allgemeiner Prinzipien beurteilt werden.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

Zur Beurteilung der Investitionsanträge musste eine Vielzahl von Regeln beachtet werden.

	1	2	3	4	5	6	7	
Trifft überhaupt nicht zu	☐	☐	☐	☐	☐	☐	☐	Trifft voll und ganz zu

XYA

Haben Sie die Aufgabenstellung verstanden?								
	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, definitiv

Was haben Sie ggf. nicht verstanden:

_____

Welche Aussage trifft auf die von Ihnen bearbeitete Aufgabe zu? (Bitte kreuzen Sie nur eine der möglichen Antworten an.)	
Die Investitionsanträge mussten auf Basis einer mehrseitigen Richtlinie mit dem Titel "**Investitionsrichtlinie der Schmidt AG**" bewertet werden.	☐
Es lag **keine mehrseitige Richtlinie** mit dem Titel "Investitionsrichtlinie der Schmidt AG" vor. In der Anleitung wurden allerdings **"Allgemeine Prinzipien zur Priorisierung von Investitionen"** aufgeführt.	☐
In den Unterlagen wurden **keinerlei Angaben zur Vorgehensweise** bei der Bewertung der Investitionsanträge gemacht. Die Beurteilung konnte nach selbst gewählten Kriterien vorgenommen werden.	☐

Welche Aussage trifft auf die von Ihnen bearbeitete Aufgabe zu? (Bitte kreuzen Sie nur eine der möglichen Antworten an.)	
In den Investitionsanträgen waren **keine Kennzahlen** aufgeführt.	☐
Im Feld **"Kennzahlenübersicht (erwartetes Szenario)"** auf den Investitionsanträgen waren **weniger** als 5 Kennzahlen aufgeführt.	☐
Im Feld **"Kennzahlenübersicht (erwartetes Szenario)"** auf den Investitionsanträgen waren **mehr** als 5 Kennzahlen aufgeführt.	☐

Wie stark haben Sie sich bei der Bearbeitung der Aufgabe angestrengt?								
	1	2	3	4	5	6	7	
Überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Extrem stark

Wie motiviert waren Sie, die Investitionsanträge zu beurteilen?								
	1	2	3	4	5	6	7	
Überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Extrem stark

Haben Sie sich während der Bearbeitung der Aufgabe unter Zeitdruck gefühlt?								
	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, extrem stark

XYA

Nehmen Sie an, für eine komplett korrekt ausgeführte Aufgabe gibt es 100 Punkte - wie viele Punkte glauben Sie erreicht zu haben? Tragen Sie bitte Ihre Einschätzung unten ein (0 - 100 Punkte, ohne Nachkommastellen).

_____

Wie beurteilen Sie die durchgeführte Aufgabe?

	1	2	3	4	5	6	7	
Attraktiv	☐	☐	☐	☐	☐	☐	☐	Abstoßend
Spannend	☐	☐	☐	☐	☐	☐	☐	Öde
Gut	☐	☐	☐	☐	☐	☐	☐	Schlecht
Interessant	☐	☐	☐	☐	☐	☐	☐	Langweilig
Höherwertig	☐	☐	☐	☐	☐	☐	☐	Minderwertig
Bereichernd	☐	☐	☐	☐	☐	☐	☐	Belastend
Macht Spaß	☐	☐	☐	☐	☐	☐	☐	Ist ermüdend
Schwierig	☐	☐	☐	☐	☐	☐	☐	Leicht
Komplex	☐	☐	☐	☐	☐	☐	☐	Einfach
Abwechslungsreich	☐	☐	☐	☐	☐	☐	☐	Gleichbleibend

Sie mussten während der Bearbeitung der Aufgabe Ihre Bearbeitungszeit eintragen. Hat dies Ihre Entscheidungen beeinflusst?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	☐	☐	☐	☐	☐	☐	☐	Ja, definitiv

XYA

2 Fragen zur Selbsteinschätzung

Wie schätzen Sie Ihr theoretisches Wissen ein, das Sie sich im Rahmen Ihres Studiums (bspw. Vorlesungen, Übungen, Seminare) zum Thema Investitionsbewertung angeeignet haben?								
	1	2	3	4	5	6	7	
Kein Wissen	☐	☐	☐	☐	☐	☐	☐	Sehr viel Wissen

Wie schätzen Sie Ihre praktische Erfahrung ein, die Sie neben Ihrem Studium (bspw. Praktikum, Ausbildung, Werkstudententätigkeit) zum Thema Investitionsbewertung gesammelt haben?								
	1	2	3	4	5	6	7	
Keine Erfahrung	☐	☐	☐	☐	☐	☐	☐	Sehr viel Erfahrung

Bitte beurteilen Sie, ob die folgenden Aussagen richtig oder falsch sind:	
Unter sonst gleichen Bedingungen ("ceteris paribus") ist bei der Bewertung von Investitionen...	
... diejenige Investition mit der **kürzeren Amortisationsdauer** vorzuziehen.	Richtig ☐ Falsch ☐
... diejenige Investition mit dem **niedrigeren Nettobarwert** vorzuziehen.	Richtig ☐ Falsch ☐
... diejenige Investition mit dem **höheren Risiko** vorzuziehen.	Richtig ☐ Falsch ☐

Unter sonst gleichen Bedingungen ("ceteris paribus") führt die Verwendung eines höheren Diskontierungszinssatzes zu einem geringeren Barwert.	Richtig ☐ Falsch ☐
Abschreibungen einer Anlage sind zahlungswirksam und stellen einen Zahlungsmittelabfluss (Cash-Outflow) dar.	Richtig ☐ Falsch ☐

XYA

Inwieweit treffen die folgenden Aussagen auf Sie zu? Kreuzen Sie bitte die jeweilige Ziffer an.					
Ich...	Trifft überhaupt nicht zu	Trifft eher nicht zu	Weder noch	Eher zutreffend	Trifft voll und ganz zu
...bin tüchtig und arbeite flott.	(1)	(2)	(3)	(4)	(5)
...bin eher zurückhaltend, reserviert.	(1)	(2)	(3)	(4)	(5)
...mache Pläne und führe diese auch durch.	(1)	(2)	(3)	(4)	(5)
...schenke anderen leicht Vertrauen, glaube an das Gute im Menschen.	(1)	(2)	(3)	(4)	(5)
...bin bequem, neige zur Faulheit.	(1)	(2)	(3)	(4)	(5)
...bin entspannt, lasse mich durch Stress nicht aus der Ruhe bringen.	(1)	(2)	(3)	(4)	(5)
...bin zuverlässig und gewissenhaft.	(1)	(2)	(3)	(4)	(5)
...habe nur wenig künstlerisches Interesse.	(1)	(2)	(3)	(4)	(5)
...gebe nicht auf, ehe die Aufgabe erledigt ist.	(1)	(2)	(3)	(4)	(5)
...gehe aus mir heraus, bin gesellig.	(1)	(2)	(3)	(4)	(5)
...bin leicht ablenkbar, bleibe nicht bei der Sache.	(1)	(2)	(3)	(4)	(5)
...neige dazu, andere zu kritisieren.	(1)	(2)	(3)	(4)	(5)
...erledige Aufgaben gründlich.	(1)	(2)	(3)	(4)	(5)
...werde leicht nervös und unsicher.	(1)	(2)	(3)	(4)	(5)
...kann etwas achtlos sein.	(1)	(2)	(3)	(4)	(5)
...habe eine aktive Vorstellungskraft, bin phantasievoll.	(1)	(2)	(3)	(4)	(5)
...neige dazu, unordentlich zu sein.	(1)	(2)	(3)	(4)	(5)

XYA

Bitte kreuzen Sie bei jeder Aussage an, wie sehr diese auf Sie persönlich zutrifft. Dabei bedeutet ein Wert von 1, dass diese Feststellung für Sie sehr unzutreffend ist, ein Wert von 5 bedeutet, dass die Aussage für Sie persönlich sehr zutreffend ist. Werte von 2, 3 oder 4 liegen als Antwortmöglichkeiten dazwischen.					
	Sehr unzu-treffend	Un-zutreffend	Neutral	Zutreffend	Sehr zutreffend
Ich denke oft an die schlechten Dinge, die mir in der Vergangenheit zugestoßen sind.	(1)	(2)	(3)	(4)	(5)
Schmerzhafte Erfahrungen aus der Vergangenheit gehen mir nicht mehr aus dem Kopf.	(1)	(2)	(3)	(4)	(5)
Es fällt mir schwer, unschöne Bilder aus meiner Jugend zu vergessen.	(1)	(2)	(3)	(4)	(5)
Vertraute Bilder, Geräusche und Gerüche aus der Kindheit wecken eine Flut wundervoller Erinnerungen.	(1)	(2)	(3)	(4)	(5)
Glückliche Erinnerungen aus guten Zeiten kommen mir leicht in den Sinn.	(1)	(2)	(3)	(4)	(5)
Ich mag Geschichten über die „guten alten Zeiten“.	(1)	(2)	(3)	(4)	(5)
Das Leben heute ist zu kompliziert; ich würde das einfachere Leben, wie es früher war, bevorzugen.	(1)	(2)	(3)	(4)	(5)
Da ohnehin alles so kommt wie es kommt, ist es egal, was ich tue.	(1)	(2)	(3)	(4)	(5)
Oft macht sich Glück mehr bezahlt als harte Arbeit.	(1)	(2)	(3)	(4)	(5)
Entscheidungen treffe ich spontan.	(1)	(2)	(3)	(4)	(5)
Risiken einzugehen bewahrt mich vor Langeweile in meinem Leben.	(1)	(2)	(3)	(4)	(5)
Ich brauche Aufregung im Leben.	(1)	(2)	(3)	(4)	(5)
Wenn ich etwas erreichen will, setze ich mir Ziele und überlege genau, mit welchen Mitteln ich diese erreichen kann.	(1)	(2)	(3)	(4)	(5)
Bevor man sich am Abend vergnügt, ist es wichtiger, bevorstehende Termine einzuhalten und andere notwendige Arbeiten zu erledigen.	(1)	(2)	(3)	(4)	(5)
Ich erledige meine Vorhaben pünktlich, indem ich konsequent daran arbeite.	(1)	(2)	(3)	(4)	(5)

XYA

3 Allgemeine Angaben

Abgeschlossene Fachsemester Ihres BWL/VWL-Studiums (inklusive der Fachsemester Ihres Bachelor-Studiums)

____ Semester

Studieren Sie BWL/VWL im Hauptfach?

☐ Ja
☐ Nein, mein Hauptfach ist _____

Haben Sie vor Ihrem Studienbeginn bereits eine kaufmännische Ausbildung (z.B. als Bürokaufmann/-frau) absolviert?

☐ Ja
☐ Nein

Muttersprache

☐ Deutsch (bitte auch ankreuzen, wenn Sie zweisprachig aufgewachsen sind und Deutsch eine Ihrer Muttersprachen ist)
☐ Andere, nämlich _____

Wo haben Sie Ihre Hochschulzugangsberechtigung (also bspw. Abitur) erworben?

☐ Deutschland
☐ Anderes Land, nämlich _____

Bitte kreuzen Sie die Note Ihrer Hochschulzugangsberechtigung (bspw. Abitur) an:

☐	☐	☐	☐
Sehr gut (1,0-1,5)	Gut (1,6-2,5)	Befriedigend (2,6-3,5)	Ausreichend (3,6-4,0)

Geschlecht

☐ Männlich
☐ Weiblich

Lebensalter

____ Jahre

Haben Sie vor dieser Studie schon einmal an einer anderen wissenschaftlichen Studie teilgenommen?

☐ Ja
☐ Nein

Wenn ja, bitte beschreiben Sie diese kurz:

Seite 21

- Beurteilung der Investitionsanträge & Fragebogen -

XYA

Bitte tragen Sie vor dem Abschluss des Fragebogens noch ein letztes Mal den Stand der Stoppuhr ein:

_____

Herzlichen Dank für Ihre Teilnahme

Ihre Kommentare sind willkommen:

Rückfragen beantwortet Ihnen gerne Maren Hartmann:

E-Mail: maren.j.hartmann@wirtschaft.uni-giessen.de

XYA

Glossar

XYA

Glossar

Annuität: Berechnete Größe, die angibt, wie hoch eine für die einzelnen Perioden gleichbleibende Zahlung sein müsste, die den gleichen Barwert wie das betrachtete Projekt hat.

Amortisationsdauer: Anzahl der Jahre, nach denen die Anfangsauszahlungen eines Projekts wieder eingenommen wurden.

Barwert einer Zahlungsreihe: Die auf den heutigen Zeitpunkt diskontierten zukünftigen Ein- und Auszahlungen.

Diskontierungszinssatz: Derjenige Zinssatz, der für die Diskontierung genutzt wird, um den Barwert zukünftiger Zahlungen zu ermitteln (auch Kalkulationszinsfuß genannt).

Durchschnittliche Buchrendite: Der durchschnittliche Projektgewinn nach Steuern und Abschreibungen geteilt durch den durchschnittlichen Buchwert der Investition über die Projektdauer.

Interner Zinsfuß: Der Diskontierungszinssatz, bei dem der Barwert der erwarteten Auszahlungen dem Barwert der erwarteten Einzahlungen des Projekts entspricht. Im Allgemeinen ist der interne Zinsfuß derjenige Zinssatz, der zu einem Nettobarwert des Projekts von 0 führt, wenn er zur Diskontierung der zukünftigen Zahlungsströme eingesetzt wird.

Modifizierter interner Zinsfuß: Während bei der Berechnung des internen Zinsfußes angenommen wird, dass die aus dem Projekt resultierenden Einzahlungen zum internen Zinsfuß des Projekts wieder reinvestiert werden können, wird der modifizierte interne Zinsfuß unter Verwendung einer gesonderten Rate für die Reinvestition ermittelt (bspw. dem WACC).

Nettobarwert: Die Differenz zwischen dem Barwert des zukünftigen erwarteten Cashflows eines Projekts und dem Barwert der Anfangsauszahlung (auch Kapitalwert genannt).

Net Working Capital: Auch Nettoumlaufvermögen genannt. Differenz zwischen Umlaufvermögen und kurzfristigen Verbindlichkeiten.

Opportunitätskosten: Entgangene Einkünfte der alternativen Verwendung von Vermögensgegenständen, die im Projekt genutzt werden und somit nicht mehr für andere Alternativen zur Verfügung stehen.

Kapitalwertrate: Das Verhältnis aus dem Barwert der zukünftigen erwarteten Zahlungen (ohne Anfangsauszahlung) und der Anfangsauszahlung.

Sensitivitätsanalyse: Untersucht, wie sich Veränderungen in den zugrundeliegenden Annahmen auf Kenngrößen der Investition auswirken.

Hierbei werden bestimmte Kennzahlen für drei Szenarien berechnet:

- Pessimistisches Szenario
- Erwartetes Szenario
- Optimistisches Szenario

WACC (weighted average cost of capital bzw. gewichteter durchschnittlicher Kapitalkostensatz): Der gewichtete Durchschnitt der durchschnittlichen Kapitalkosten (Fremd- und Eigenkapital). Gewichtung mit dem Anteil der jeweiligen Größe an der Finanzierung des Unternehmens.

Hinweis: Die Investitionsanträge sind bereits nach Bereichen sortiert.

YA

Investitionsantrag A

Antragskennung:

A

Projektname:

OkoDesign

Allgemeine Daten:

Antragsteller:	A. Mayer
Projektleiter:	T. Stark
Art der Investition:	Neuinvestition
Bereich:	Haushalt
Land:	DE

Kurzbeschreibung Investitionsvorhaben:

Einführung einer neuen Produktlinie (Spülmaschinen)

Reviews:

Reviewer 1:	W. Bäcker, Produktionscontroller
Reviewer 2:	L. Schmidt, Investitionscontroller
Reviewer 3:	Z. Reeder, Geschäftsführer
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	600.000,00 €
Annuität:	187.538,32 €
Interner Zinsfuß:	25,98%
Kapitalwertrate:	1,19
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 3.107.473,81 €
Modifizierter interner Zinsfuß:	19,08%
Amortisationsdauer (Jahre):	3
Durchschnittliche Buchrendite:	24,61%
Anschaffungskosten:	- 3.000.000,00 €
Durchschnittliche Betriebskosten:	- 708.290,38 €
Durchschnittliche Umsatzerlöse:	1.800.440,00 €

Kommentar:

Die Einführung der neuen Produktlinie ist ein Bestandteil der definierten Unternehmensstrategie, vermehrt Kunden im Segment "designbewusst und ökologisch verantwortungsvoll" anzusprechen. Die Einführung erlaubt es, die Produkte klar von den bisher existierenden Angeboten im Markt abzugrenzen. Schwerpunkt der neuen Produktlinie ist eine Konstruktion, welche sowohl den Wasser- als auch den Stromverbrauch wesentlich reduziert.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 3.000.000,00 €						
(2)	Kumulierte Abschreibungen		- 600.000,00 €	- 1.200.000,00 €	- 1.800.000,00 €	- 2.400.000,00 €	- 3.000.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		2.400.000,00 €	1.800.000,00 €	1.200.000,00 €	600.000,00 €	- €	- €
(4)	Opportunitätskosten	- 97.473,81 €	- €	- €	- €	- €	97.473,81 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 3.107.473,81 €**	**- €**	**- €**	**- €**	**- €**	**107.473,81 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		2.132.100,00 €	2.132.100,00 €	1.895.200,00 €	1.468.780,00 €	1.374.020,00 €	- €
(9)	Betriebskosten		- 814.591,90 €	- 768.560,00 €	- 668.560,00 €	- 668.560,00 €	- 621.180,00 €	- €
(10)	Abschreibungen		- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		717.508,10 €	763.540,00 €	626.640,00 €	200.220,00 €	152.840,00 €	- €
(12)	Steuern (t=0,25)		- 179.377,02 €	- 190.885,00 €	- 156.660,00 €	- 50.055,00 €	- 38.210,00 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**538.131,07 €**	**572.655,00 €**	**469.980,00 €**	**150.165,00 €**	**114.630,00 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**1.317.508,10 €**	**1.363.540,00 €**	**1.226.640,00 €**	**800.220,00 €**	**752.840,00 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 3.107.473,81 €**	**1.317.508,10 €**	**1.363.540,00 €**	**1.226.640,00 €**	**800.220,00 €**	**860.313,81 €**	**- €**

Annahmen:

Diskontierungszinssatz:	17,00%	Marktgröße (Stück):	206.000,00
Durchschn. Stückpreis:	38,00 €	Durchschn. variable Stückkosten:	- 12,00 €
Marktanteil:	23,00%		

Weitere Angaben:

Risikoklasse:	3
Zusammensetzung des Diskontierungszinssatzes:	
WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	5,00%
+ Landesspezifische Anpassung:	0,00%
= verwendeter Diskontierungszinssatz:	**17,00%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	0,00%	-10,00%	0,00%
Optimistisch	0,00%	10,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	1.620.396,00 €	1.800.440,00 €	1.980.484,00 €	360.088,00 €
Durchschnittliche Betriebskosten:	- 651.434,38 €	- 708.290,38 €	- 765.146,38 €	- 113.712,00 €
Durchschnittliche Buchrendite:	18,45%	24,61%	30,77%	12,32%
Kapitalwertrate:	1,06	1,19	1,33	0,27
Interner Zinsfuß:	19,83%	25,98%	31,96%	12,13%

Investitionsantrag B

Antragskennung:

B

Projektname:

StandardClean

Allgemeine Daten:

Antragsteller:	A. Osaka
Projektleiter:	I. Kanagi
Art der Investition:	Neuinvestition
Bereich:	Haushalt
Land:	J

Kurzbeschreibung Investitionsvorhaben:

Einführung einer neuen Produktlinie (Staubsauger)

Reviews:

Reviewer 1:	U. Takimoto, Produktionscontroller
Reviewer 2:	H. Miller, Investitionscontroller
Reviewer 3:	I. Jonas, Geschäftsführer
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	600.000,00 €
Annuität:	187.538,32 €
Interner Zinsfuß:	25,30%
Kapitalwertrate:	1,19
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 3.107.473,81 €
Modifizierter interner Zinsfuß:	19,08%
Amortisationsdauer (Jahre):	3
Durchschnittliche Buchrendite:	26,38%
Anschaffungskosten:	- 3.000.000,00 €
Durchschnittliche Betriebskosten:	- 754.095,11 €
Durchschnittliche Umsatzerlöse:	1.881.792,00 €

Kommentar:

Mit der Einführung der neuen Produktlinie soll verstärkt das Low-Cost-Segment angesprochen werden. Die Produktionsanlage ist darauf ausgelegt, die Produkte besonders ressourcensparend herzustellen und stark standardisierte Produkte zu erzeugen. Aufgrund der hohen Automatisierung kann der Lohnaufwand ebenfalls reduziert werden, was den Absatzpreis der neuen Produkte weiter reduziert.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 3.000.000,00 €						
(2)	Kumulierte Abschreibungen		- 600.000,00 €	- 1.200.000,00 €	- 1.800.000,00 €	- 2.400.000,00 €	- 3.000.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		2.400.000,00 €	1.800.000,00 €	1.200.000,00 €	600.000,00 €	- €	- €
(4)	Opportunitätskosten	- 97.473,81 €	- €	- €	- €	- €	97.473,81 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 3.107.473,81 €**	**- €**	**- €**	**- €**	**- €**	**107.473,81 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		2.031.480,00 €	2.031.480,00 €	1.871.100,00 €	1.764.180,00 €	1.710.720,00 €	- €
(9)	Betriebskosten		- 893.631,90 €	- 705.743,63 €	- 741.520,00 €	- 741.520,00 €	- 688.060,00 €	- €
(10)	Abschreibungen		- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- 600.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		537.848,10 €	725.736,37 €	529.580,00 €	422.660,00 €	422.660,00 €	- €
(12)	Steuern (t=0,25)		- 134.462,02 €	- 181.434,09 €	- 132.395,00 €	- 105.665,00 €	- 105.665,00 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**403.386,07 €**	**544.302,27 €**	**397.185,00 €**	**316.995,00 €**	**316.995,00 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**1.137.848,10 €**	**1.325.736,37 €**	**1.129.580,00 €**	**1.022.660,00 €**	**1.022.660,00 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 3.107.473,81 €**	**1.137.848,10 €**	**1.325.736,37 €**	**1.129.580,00 €**	**1.022.660,00 €**	**1.130.133,81 €**	**- €**

Annahmen:

Diskontierungszinssatz:	17,00%	Marktgröße (Stück):	198.000,00
Durchschn. Stückpreis:	35,20 €	Durchschn. variable Stückkosten:	- 12,00 €
Marktanteil:	27,00%		

Weitere Angaben:

Risikoklasse:	3
Zusammensetzung des Diskontierungszinssatzes:	
WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	5,00%
+ Landesspezifische Anpassung:	0,00%
= verwendeter Diskontierungszinssatz:	**17,00%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	0,00%	-10,00%	0,00%
Optimistisch	0,00%	10,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	1.693.612,80 €	1.881.792,00 €	2.069.971,20 €	376.358,40 €
Durchschnittliche Betriebskosten:	- 689.943,11 €	- 754.095,11 €	- 818.247,11 €	- 128.304,00 €
Durchschnittliche Buchrendite:	20,18%	26,38%	32,59%	12,40%
Kapitalwertrate:	1,06	1,19	1,32	0,26
Interner Zinsfuß:	19,76%	25,30%	30,67%	10,91%

Investitionsantrag C

Antragskennung:

C

Projektname:

Ersatz DVD-Produktion

Allgemeine Daten:

Antragsteller:	H. Julien
Projektleiter:	F. Henry
Art der Investition:	Ersatzinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Ersatz mechanischer Bauteile an der Produktionsanlage für DVD-Player

Reviews:

Reviewer 1:	T. Jacques, Produktionscontroller
Reviewer 2:	I. Martin, Investitionscontroller
Reviewer 3:	O. Marie, Geschäftsführer
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	300.000,00 €
Annuität:	82.194,53 €
Interner Zinsfuß:	19,13%
Kapitalwertrate:	1,19
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 1.597.179,77 €
Modifizierter interner Zinsfuß:	13,44%
Amortisationsdauer (Jahre):	3
Durchschnittliche Buchrendite:	19,37%
Anschaffungskosten:	- 1.500.000,00 €
Durchschnittliche Betriebskosten:	- 418.341,08 €
Durchschnittliche Umsatzerlöse:	912.000,00 €

Kommentar:

Mit dem Ersatz einzelner Bestandteile der Produktionsanlage wird das Ziel verfolgt, den Anteil defekter Produkte zu reduzieren, der von der Überalterung der zu ersetzenden Bestandteile herrührte. Dies führt in der Konsequenz zu geringerem Ausschuss und somit einer Reduktion sowohl der Stückkosten als auch des Aufwands im Hinblick auf die Kundenbetreuung im Falle von Reklamationsfällen. Ebenso erhofft man sich eine Verbesserung der Wahrnehmung der Produktqualität, welche sich in den letzten Jahren leicht verschlechtert hat.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 1.500.000,00 €						
(2)	Kumulierte Abschreibungen		- 300.000,00 €	- 600.000,00 €	- 900.000,00 €	- 1.200.000,00 €	- 1.500.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		1.200.000,00 €	900.000,00 €	600.000,00 €	300.000,00 €	- €	- €
(4)	Opportunitätskosten	- 87.179,77 €	- €	- €	- €	- €	87.179,77 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 1.597.179,77 €**	**- €**	**- €**	**- €**	**- €**	**97.179,77 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		1.000.000,00 €	960.000,00 €	920.000,00 €	880.000,00 €	800.000,00 €	- €
(9)	Betriebskosten		- 411.705,38 €	- 420.000,00 €	- 420.000,00 €	- 420.000,00 €	- 420.000,00 €	- €
(10)	Abschreibungen		- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		288.294,62 €	240.000,00 €	200.000,00 €	160.000,00 €	80.000,00 €	- €
(12)	Steuern (t=0,25)		- 72.073,65 €	- 60.000,00 €	- 50.000,00 €	- 40.000,00 €	- 20.000,00 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**216.220,96 €**	**180.000,00 €**	**150.000,00 €**	**120.000,00 €**	**60.000,00 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**588.294,62 €**	**540.000,00 €**	**500.000,00 €**	**460.000,00 €**	**380.000,00 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 1.597.179,77 €**	**588.294,62 €**	**540.000,00 €**	**500.000,00 €**	**460.000,00 €**	**477.179,77 €**	**- €**

Annahmen:

Diskontierungszinssatz:	11,50%	Marktgröße (Stück):	200.000,00
Durchschn. Stückpreis:	22,80 €	Durchschn. variable Stückkosten:	- 8,00 €
Marktanteil:	20,00%		

Weitere Angaben:

Risikoklasse:	1
Zusammensetzung des Diskontierungszinssatzes:	
WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	0,00%	-10,00%	0,00%
Optimistisch	0,00%	10,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	820.800,00 €	912.000,00 €	1.003.200,00 €	182.400,00 €
Durchschnittliche Betriebskosten:	- 386.341,08 €	- 418.341,08 €	- 450.341,08 €	- 64.000,00 €
Durchschnittliche Buchrendite:	13,45%	19,37%	25,29%	11,84%
Kapitalwertrate:	1,05	1,19	1,33	0,28
Interner Zinsfuß:	13,58%	19,13%	24,51%	10,93%

Investitionsantrag D

Antragskennung:

D

Projektname:

Replacement V

Allgemeine Daten:

Antragsteller:	Y. Bonnet
Projektleiter:	F. Henry
Art der Investition:	Ersatzinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Ersatz der Sortieranlage

Reviews:

Reviewer 1:	T. Jacques, Produktionscontroller
Reviewer 2:	I. Martin, Investitionscontroller
Reviewer 3:	O. Marie, Geschäftsführer
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	- 235.178,09 €
Annuität:	- 64.434,51 €
Interner Zinsfuß:	5,71%
Kapitalwertrate:	0,85
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 1.597.179,77 €
Modifizierter interner Zinsfuß:	9,74%
Amortisationsdauer (Jahre):	5
Durchschnittliche Buchrendite:	6,00%
Anschaffungskosten:	- 1.500.000,00 €
Durchschnittliche Betriebskosten:	- 430.000,00 €
Durchschnittliche Umsatzerlöse:	790.000,00 €

Kommentar:

Mit dem Ersatz eines Teils der Sortieranlage wird sichergestellt, dass in Zukunft auch die verstärkt nachgefragten kleinteiligeren Produkte richtig identifiziert und weiter bearbeitet werden können.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 1.500.000,00 €						
(2)	Kumulierte Abschreibungen		- 300.000,00 €	- 600.000,00 €	- 900.000,00 €	- 1.200.000,00 €	- 1.500.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		1.200.000,00 €	900.000,00 €	600.000,00 €	300.000,00 €	- €	- €
(4)	Opportunitätskosten	- 87.179,77 €	- €	- €	- €	- €	87.179,77 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 1.597.179,77 €**	**- €**	**- €**	**- €**	**- €**	**97.179,77 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		750.000,00 €	800.000,00 €	800.000,00 €	800.000,00 €	800.000,00 €	- €
(9)	Betriebskosten		- 430.000,00 €	- 430.000,00 €	- 430.000,00 €	- 430.000,00 €	- 430.000,00 €	- €
(10)	Abschreibungen		- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		20.000,00 €	70.000,00 €	70.000,00 €	70.000,00 €	70.000,00 €	- €
(12)	Steuern (t=0,25)		- 5.000,00 €	- 17.500,00 €	- 17.500,00 €	- 17.500,00 €	- 17.500,00 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**15.000,00 €**	**52.500,00 €**	**52.500,00 €**	**52.500,00 €**	**52.500,00 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**320.000,00 €**	**370.000,00 €**	**370.000,00 €**	**370.000,00 €**	**370.000,00 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 1.597.179,77 €**	**320.000,00 €**	**370.000,00 €**	**370.000,00 €**	**370.000,00 €**	**467.179,77 €**	**- €**

Annahmen:

Diskontierungszinssatz:	11,50%	Marktgröße (Stück):	250.000,00
Durchschn. Stückpreis:	15,80 €	Durchschn. variable Stückkosten:	- 7,00 €
Marktanteil:	20,00%		

Weitere Angaben:

Risikoklasse: 1

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	0,00%	-5,00%	0,00%
Optimistisch	0,00%	5,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	750.500,00 €	790.000,00 €	829.500,00 €	79.000,00 €
Durchschnittliche Betriebskosten:	- 412.500,00 €	- 430.000,00 €	- 447.500,00 €	- 35.000,00 €
Durchschnittliche Buchrendite:	3,80%	6,00%	8,20%	4,40%
Kapitalwertrate:	0,80	0,85	0,90	0,10
Interner Zinsfuß:	3,66%	5,71%	7,72%	4,05%

Investitionsantrag E

Antragskennung:

E

Projektname:

Fernseher Plus

Allgemeine Daten:

Antragsteller:	J. Frédéric
Projektleiter:	F. Henry
Art der Investition:	Erweiterungsinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Erweiterung der Produktionsanlage für Fernseher

Reviews:

Reviewer 1:	T. Jacques, Produktionscontroller
Reviewer 2:	I. Martin, Investitionscontroller
Reviewer 3:	O. Marie, Geschäftsführer
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	300.000,00 €
Annuität:	82.194,53 €
Interner Zinsfuß:	18,97%
Kapitalwertrate:	1,19
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 1.597.179,77 €
Modifizierter interner Zinsfuß:	13,44%
Amortisationsdauer (Jahre):	3
Durchschnittliche Buchrendite:	19,74%
Anschaffungskosten:	- 1.500.000,00 €
Durchschnittliche Betriebskosten:	- 434.979,77 €
Durchschnittliche Umsatzerlöse:	932.400,00 €

Kommentar:

Mit der Erweiterung der Anlage zur Produktion der Fernseher können größere Mengen als bisher hergestellt werden. Ziel ist es, hiermit die steigende Nachfrage in den relevanten Absatzmärkten zu bedienen. Es wird erwartet, dass sich das starke Wachstum der letzten Jahre fortsetzt und die Nachfrage nach preisgünstigen Fernsehern weiter ansteigt.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 1.500.000,00 €						
(2)	Kumulierte Abschreibungen		- 300.000,00 €	- 600.000,00 €	- 900.000,00 €	- 1.200.000,00 €	- 1.500.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		1.200.000,00 €	900.000,00 €	600.000,00 €	300.000,00 €	- €	- €
(4)	Opportunitätskosten	- 87.179,77 €	- €	- €	- €	- €	87.179,77 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 1.597.179,77 €**	**- €**	**- €**	**- €**	**- €**	**97.179,77 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		1.110.000,00 €	888.000,00 €	888.000,00 €	888.000,00 €	888.000,00 €	- €
(9)	Betriebskosten		- 515.804,67 €	- 384.000,00 €	- 384.000,00 €	- 507.094,20 €	- 384.000,00 €	- €
(10)	Abschreibungen		- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- 300.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		294.195,33 €	204.000,00 €	204.000,00 €	80.905,80 €	204.000,00 €	- €
(12)	Steuern (t=0,25)		- 73.548,83 €	- 51.000,00 €	- 51.000,00 €	- 20.226,45 €	- 51.000,00 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**220.646,49 €**	**153.000,00 €**	**153.000,00 €**	**60.679,35 €**	**153.000,00 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**594.195,33 €**	**504.000,00 €**	**504.000,00 €**	**380.905,80 €**	**504.000,00 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 1.597.179,77 €**	**594.195,33 €**	**504.000,00 €**	**504.000,00 €**	**380.905,80 €**	**601.179,77 €**	**- €**

Annahmen:

Diskontierungszinssatz:	11,50%	Marktgröße (Stück):	370.000,00
Durchschn. Stückpreis:	21,00 €	Durchschn. variable Stückkosten:	- 10,00 €
Marktanteil:	12,00%		

Weitere Angaben:

Risikoklasse: 2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	-15,00%	0,00%	0,00%
Optimistisch	15,00%	0,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	792.540,00 €	932.400,00 €	1.072.260,00 €	279.720,00 €
Durchschnittliche Betriebskosten:	- 368.379,77 €	- 434.979,77 €	- 501.579,77 €	- 133.200,00 €
Durchschnittliche Buchrendite:	12,42%	19,74%	27,07%	14,65%
Kapitalwertrate:	1,02	1,19	1,36	0,34
Interner Zinsfuß:	12,19%	18,97%	25,55%	13,37%

Investitionsantrag F

Antragskennung:

F

Projektname:

Ladegeräte Plus

Allgemeine Daten:

Antragsteller:	J. Müller
Projektleiter:	I. Graf
Art der Investition:	Rationalisierungsinvestition
Bereich:	Telekommunikation
Land:	CH

Kurzbeschreibung Investitionsvorhaben:

Anpassung der Produktionsanlage für Ladegeräte

Reviews:

Reviewer 1:	J. Schneider, Produktionscontroller
Reviewer 2:	I. Bauer, Investitionscontroller
Reviewer 3:	
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	100.000,00 €
Annuität:	28.431,46 €
Interner Zinsfuß:	23,68%
Kapitalwertrate:	1,29
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 339.637,77 €
Modifizierter interner Zinsfuß:	15,95%
Amortisationsdauer (Jahre):	4
Durchschnittliche Buchrendite:	36,33%
Anschaffungskosten:	- 250.000,00 €
Durchschnittliche Betriebskosten:	- 153.456,91 €
Durchschnittliche Umsatzerlöse:	264.000,00 €

Kommentar:

Die Rationalisierungsinvestition erlaubt es, die Produktionskapazitäten besser auszunutzen. Der Produktionsprozess kann zudem stärker standardisiert werden. Hierdurch können die benötigten Materialien in größeren Mengen eingekauft werden und bessere Einkaufspreise ausgehandelt werden. Voraussichtlich kann ebenfalls auf geographisch näher lokalisierte Lieferanten zugegriffen werden, sodass von Einsparungen für Logistikdienstleistungen ausgegangen werden kann.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 250.000,00 €						
(2)	Kumulierte Abschreibungen		- 50.000,00 €	- 100.000,00 €	- 150.000,00 €	- 200.000,00 €	- 250.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		200.000,00 €	150.000,00 €	100.000,00 €	50.000,00 €	- €	- €
(4)	Opportunitätskosten	- 79.637,77 €	- €	- €	- €	- €	79.637,77 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 339.637,77 €**	**- €**	**- €**	**- €**	**- €**	**89.637,77 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		276.000,00 €	270.000,00 €	258.000,00 €	258.000,00 €	258.000,00 €	- €
(9)	Betriebskosten		- 156.000,00 €	- 156.000,00 €	- 156.000,00 €	- 156.000,00 €	- 143.284,56 €	- €
(10)	Abschreibungen		- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		70.000,00 €	64.000,00 €	52.000,00 €	52.000,00 €	64.715,44 €	- €
(12)	Steuern (t=0,25)		- 17.500,00 €	- 16.000,00 €	- 13.000,00 €	- 13.000,00 €	- 16.178,86 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**52.500,00 €**	**48.000,00 €**	**39.000,00 €**	**39.000,00 €**	**48.536,58 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**120.000,00 €**	**114.000,00 €**	**102.000,00 €**	**102.000,00 €**	**114.715,44 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 339.637,77 €**	**120.000,00 €**	**114.000,00 €**	**102.000,00 €**	**102.000,00 €**	**204.353,21 €**	**- €**

Annahmen:

Diskontierungszinssatz:	13,00%	Marktgröße (Stück):	100.000,00
Durchschn. Stückpreis:	22,00 €	Durchschn. variable Stückkosten:	- 8,00 €
Marktanteil:	12,00%		

Weitere Angaben:

Risikoklasse: 2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	0,00%
+ Landesspezifische Anpassung:	1,00%
= verwendeter Diskontierungszinssatz:	**13,00%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	-15,00%	0,00%	0,00%
Optimistisch	15,00%	0,00%	0,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	224.400,00 €	264.000,00 €	303.600,00 €	79.200,00 €
Durchschnittliche Betriebskosten:	- 139.056,91 €	- 153.456,91 €	- 167.856,91 €	- 28.800,00 €
Durchschnittliche Buchrendite:	21,21%	36,33%	51,45%	30,24%
Kapitalwertrate:	1,03	1,29	1,56	0,53
Interner Zinsfuß:	14,17%	23,68%	32,86%	18,69%

Investitionsantrag G

Antragskennung:

G

Projektname:

Verpackung 2.0

Allgemeine Daten:

Antragsteller:	M. Schweitzer
Projektleiter:	I. Graf
Art der Investition:	Erweiterungsinvestition
Bereich:	Telekommunikation
Land:	CH

Kurzbeschreibung Investitionsvorhaben:

Erweiterung der Produktionsanlage für Handys

Reviews:

Reviewer 1:	J. Schneider, Produktionscontroller
Reviewer 2:	I. Bauer, Investitionscontroller
Reviewer 3:	
Reviewer 4:	

Kennzahlenübersicht (erwartetes Szenario):

Nutzungsdauer (Jahre):	5
Nettobarwert (NPV):	100.000,00 €
Annuität:	28.431,46 €
Interner Zinsfuß:	24,47%
Kapitalwertrate:	1,29
Auszahlung in t=0 (AK, Opportunitätskosten, Anfangsausstattung WC):	- 339.637,77 €
Modifizierter interner Zinsfuß:	15,95%
Amortisationsdauer (Jahre):	3
Durchschnittliche Buchrendite:	34,50%
Anschaffungskosten:	- 250.000,00 €
Durchschnittliche Betriebskosten:	- 168.101,06 €
Durchschnittliche Umsatzerlöse:	275.600,00 €

Kommentar:

Die Erweiterungsinvestition zielt darauf ab, durch die direkte Anbindung einer Verpackungsanlage größere Mengen produzieren zu können. Bisher gibt es keine Verpackungsanlage, das Verpacken wird von einem externen Dienstleister vorgenommen, was zu zeitlichen Verzögerungen geführt hat.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
Investition								
(1)	Anschaffungskosten	- 250.000,00 €						
(2)	Kumulierte Abschreibungen		- 50.000,00 €	- 100.000,00 €	- 150.000,00 €	- 200.000,00 €	- 250.000,00 €	- €
(3)	Buchwert (zum Jahresende, nach Abschreibungen)		200.000,00 €	150.000,00 €	100.000,00 €	50.000,00 €	- €	- €
(4)	Opportunitätskosten	- 79.637,77 €	- €	- €	- €	- €	79.637,77 €	- €
(5)	Net Working Capital (zum Jahresende)	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €	- €	- €
(6)	Änderungen im Net Working Capital	- 10.000,00 €	- €	- €	- €	- €	10.000,00 €	- €
(7)	**Summe Cashflows aus Investition [(1)+(4)+(6)]**	**- 339.637,77 €**	**- €**	**- €**	**- €**	**- €**	**89.637,77 €**	**- €**
Aufwendungen / Erträge								
(8)	Umsatzerlöse		305.500,00 €	292.500,00 €	273.000,00 €	273.000,00 €	234.000,00 €	- €
(9)	Betriebskosten		- 174.000,00 €	- 164.000,00 €	- 164.000,00 €	- 174.000,00 €	- 164.505,32 €	- €
(10)	Abschreibungen		- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- 50.000,00 €	- €
(11)	Ergebnis vor Steuern [(8)+(9)+(10)]		81.500,00 €	78.500,00 €	59.000,00 €	49.000,00 €	19.494,69 €	- €
(12)	Steuern (t=0,25)		- 20.375,00 €	- 19.625,00 €	- 14.750,00 €	- 12.250,00 €	- 4.873,67 €	- €
(13)	Ergebnis nach Steuern [(11)+(12)]		**61.125,00 €**	**58.875,00 €**	**44.250,00 €**	**36.750,00 €**	**14.621,01 €**	**- €**
Zusammenfassung Cashflows								
(14)	**Operativer Cashflow vor Steuern [(8)+(9)]**	**- €**	**131.500,00 €**	**128.500,00 €**	**109.000,00 €**	**99.000,00 €**	**69.494,69 €**	**- €**
(15)	**Cashflow-Effekt des Projekts vor Steuern [(7)+(14)]**	**- 339.637,77 €**	**131.500,00 €**	**128.500,00 €**	**109.000,00 €**	**99.000,00 €**	**159.132,46 €**	**- €**

Annahmen:

Diskontierungszinssatz:	13,00%	Marktgröße (Stück):	100.000,00
Durchschn. Stückpreis:	21,20 €	Durchschn. variable Stückkosten:	- 8,00 €
Marktanteil:	13,00%		

Weitere Angaben:

Risikoklasse: 2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	0,00%
+ Landesspezifische Anpassung:	1,00%
= verwendeter Diskontierungszinssatz:	**13,00%**

Annahmen Sensitivitätsanalyse - Abweichung vom erwarteten Szenario in %:

	Marktanteil	Marktgröße	Anschaffungs-kosten
Pessimistisch	0,00%	0,00%	20,00%
Optimistisch	0,00%	0,00%	-20,00%

Sensitivitätsanalyse:

	Pessimistisch	Erwartet	Optimistisch	Range Pessimistisch - Optimistisch
Durchschnittliche Umsatzerlöse:	275.600,00 €	275.600,00 €	275.600,00 €	- €
Durchschnittliche Betriebskosten:	- 168.101,06 €	- 168.101,06 €	- 168.101,06 €	- €
Durchschnittliche Buchrendite:	23,75%	34,50%	50,62%	26,87%
Kapitalwertrate:	1,13	1,29	1,52	0,39
Interner Zinsfuß:	18,12%	24,47%	32,64%	14,52%

Hinweis: Die Investitionsanträge sind bereits nach Bereichen sortiert.

ZA

Investitionsantrag A

Antragskennung:

A

Projektname:

OkoDesign

Allgemeine Daten:

Art der Investition:	Neuinvestition
Bereich:	Haushalt
Land:	DE

Kurzbeschreibung Investitionsvorhaben:

Einführung einer neuen Produktlinie (Spülmaschinen)

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	600.000,00 €
Amortisationsdauer (Jahre):	3
Anschaffungskosten:	- 3.000.000,00 €

Kommentar:

Die Einführung der neuen Produktlinie ist ein Bestandteil der definierten Unternehmensstrategie, vermehrt Kunden im Segment "designbewusst und ökologisch verantwortungsvoll" anzusprechen. Die Einführung erlaubt es, die Produkte klar von den bisher existierenden Angeboten im Markt abzugrenzen. Schwerpunkt der neuen Produktlinie ist eine Konstruktion, welche sowohl den Wasser- als auch den Stromverbrauch wesentlich reduziert.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	**Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)**	- 3.107.473,81 €	- €	- €	- €	- €	107.473,81 €	- €
(2)	**Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)**	- €	1.317.508,10 €	1.363.540,00 €	1.226.640,00 €	800.220,00 €	752.840,00 €	- €
(3)	**Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]**	- 3.107.473,81 €	1.317.508,10 €	1.363.540,00 €	1.226.640,00 €	800.220,00 €	860.313,81 €	- €

Annahmen:

Diskontierungszinssatz:	17,00%

Weitere Angaben:

Risikoklasse:	3

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	5,00%
+ Landesspezifische Anpassung:	0,00%
= verwendeter Diskontierungszinssatz:	**17,00%**

Investitionsantrag B

Antragskennung:

B

Projektname:

StandardClean

Allgemeine Daten:

Art der Investition:	Neuinvestition
Bereich:	Haushalt
Land:	J

Kurzbeschreibung Investitionsvorhaben:

Einführung einer neuen Produktlinie (Staubsauger)

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	600.000,00 €
Amortisationsdauer (Jahre):	3
Anschaffungskosten:	- 3.000.000,00 €

Kommentar:

Mit der Einführung der neuen Produktlinie soll verstärkt das Low-Cost-Segment angesprochen werden. Die Produktionsanlage ist darauf ausgelegt, die Produkte besonders ressourcensparend herzustellen und stark standardisierte Produkte zu erzeugen. Aufgrund der hohen Automatisierung kann der Lohnaufwand ebenfalls reduziert werden, was den Absatzpreis der neuen Produkte weiter reduziert.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)	- 3.107.473,81 €	- €	- €	- €	- €	107.473,81 €	- €
(2)	Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)	- €	1.137.848,10 €	1.325.736,37 €	1.129.580,00 €	1.022.660,00 €	1.022.660,00 €	- €
(3)	Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]	- 3.107.473,81 €	1.137.848,10 €	1.325.736,37 €	1.129.580,00 €	1.022.660,00 €	1.130.133,81 €	- €

Annahmen:

Diskontierungszinssatz:	17,00%

Weitere Angaben:

Risikoklasse:	3

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	5,00%
+ Landesspezifische Anpassung:	0,00%
= verwendeter Diskontierungszinssatz:	**17,00%**

Investitionsantrag C

Antragskennung:

C

Projektname:

Ersatz DVD-Produktion

Allgemeine Daten:

Art der Investition:	Ersatzinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Ersatz mechanischer Bauteile an der Produktionsanlage für DVD-Player

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	300.000,00 €
Amortisationsdauer (Jahre):	3
Anschaffungskosten:	- 1.500.000,00 €

Kommentar:

Mit dem Ersatz einzelner Bestandteile der Produktionsanlage wird das Ziel verfolgt, den Anteil defekter Produkte zu reduzieren, der von der Überalterung der zu ersetzenden Bestandteile herrührte. Dies führt in der Konsequenz zu geringerem Ausschuss und somit einer Reduktion sowohl der Stückkosten als auch des Aufwands im Hinblick auf die Kundenbetreuung im Falle von Reklamationsfällen. Ebenso erhofft man sich eine Verbesserung der Wahrnehmung der Produktqualität, welche sich in den letzten Jahren leicht verschlechtert hat.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)	- 1.597.179,77 €	- €	- €	- €	- €	97.179,77 €	- €
(2)	Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)	- €	588.294,62 €	540.000,00 €	500.000,00 €	460.000,00 €	380.000,00 €	- €
(3)	Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]	- 1.597.179,77 €	588.294,62 €	540.000,00 €	500.000,00 €	460.000,00 €	477.179,77 €	- €

Annahmen:

Diskontierungszinssatz:	11,50%

Weitere Angaben:

Risikoklasse:	1

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Investitionsantrag D

Antragskennung:

D

Projektname:

Replacement V

Allgemeine Daten:

Art der Investition:	Ersatzinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Ersatz der Sortieranlage

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	- 235.178,09 €
Amortisationsdauer (Jahre):	5
Anschaffungskosten:	- 1.500.000,00 €

Kommentar:

Mit dem Ersatz eines Teils der Sortieranlage wird sichergestellt, dass in Zukunft auch die verstärkt nachgefragten kleinteiligeren Produkte richtig identifiziert und weiter bearbeitet werden können.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)	- 1.597.179,77 €	- €	- €	- €	- €	97.179,77 €	- €
(2)	Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)	- €	320.000,00 €	370.000,00 €	370.000,00 €	370.000,00 €	370.000,00 €	- €
(3)	Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]	- 1.597.179,77 €	320.000,00 €	370.000,00 €	370.000,00 €	370.000,00 €	467.179,77 €	- €

Annahmen:

Diskontierungszinssatz:	11,50%

Weitere Angaben:

Risikoklasse:	1

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Investitionsantrag E

Antragskennung:

E

Projektname:

Fernseher Plus

Allgemeine Daten:

Art der Investition:	Erweiterungsinvestition
Bereich:	Unterhaltung
Land:	F

Kurzbeschreibung Investitionsvorhaben:

Erweiterung der Produktionsanlage für Fernseher

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	300.000,00 €
Amortisationsdauer (Jahre):	3
Anschaffungskosten:	- 1.500.000,00 €

Kommentar:

Mit der Erweiterung der Anlage zur Produktion der Fernseher können größere Mengen als bisher hergestellt werden. Ziel ist es, hiermit die steigende Nachfrage in den relevanten Absatzmärkten zu bedienen. Es wird erwartet, dass sich das starke Wachstum der letzten Jahre fortsetzt und die Nachfrage nach preisgünstigen Fernsehern weiter ansteigt.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	**Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)**	- 1.597.179,77 €	- €	- €	- €	- €	97.179,77 €	- €
(2)	**Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)**	- €	594.195,33 €	504.000,00 €	504.000,00 €	380.905,80 €	504.000,00 €	- €
(3)	**Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]**	- 1.597.179,77 €	594.195,33 €	504.000,00 €	504.000,00 €	380.905,80 €	601.179,77 €	- €

Annahmen:

Diskontierungszinssatz:	11,50%

Weitere Angaben:

Risikoklasse:	2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	-1,00%
+ Landesspezifische Anpassung:	0,50%
= verwendeter Diskontierungszinssatz:	**11,50%**

Investitionsantrag F

Antragskennung:

F

Projektname:

Ladegeräte Plus

Allgemeine Daten:

Art der Investition:	Rationalisierungsinvestition
Bereich:	Telekommunikation
Land:	CH

Kurzbeschreibung Investitionsvorhaben:

Anpassung der Produktionsanlage für Ladegeräte

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	100.000,00 €
Amortisationsdauer (Jahre):	4
Anschaffungskosten:	- 250.000,00 €

Kommentar:

Die Rationalisierungsinvestition erlaubt es, die Produktionskapazitäten besser auszunutzen. Der Produktionsprozess kann zudem stärker standardisiert werden. Hierdurch können die benötigten Materialien in größeren Mengen eingekauft werden und bessere Einkaufspreise ausgehandelt werden. Voraussichtlich kann ebenfalls auf geographisch näher lokalisierte Lieferanten zugegriffen werden, sodass von Einsparungen für Logistikdienstleistungen ausgegangen werden kann.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)	- 339.637,77 €	- €	- €	- €	- €	89.637,77 €	- €
(2)	Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)	- €	120.000,00 €	114.000,00 €	102.000,00 €	102.000,00 €	114.715,44 €	- €
(3)	Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]	- 339.637,77 €	120.000,00 €	114.000,00 €	102.000,00 €	102.000,00 €	204.353,21 €	- €

Annahmen:

Diskontierungszinssatz:	13,00%

Weitere Angaben:

Risikoklasse:	2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	0,00%
+ Landesspezifische Anpassung:	1,00%
= verwendeter Diskontierungszinssatz:	**13,00%**

Investitionsantrag G

Antragskennung:

G

Projektname:

Verpackung 2.0

Allgemeine Daten:

Art der Investition:	Erweiterungsinvestition
Bereich:	Telekommunikation
Land:	CH

Kurzbeschreibung Investitionsvorhaben:

Erweiterung der Produktionsanlage für Handys

Kennzahlenübersicht (erwartetes Szenario):

Nettobarwert (NPV):	100.000,00 €
Amortisationsdauer (Jahre):	3
Anschaffungskosten:	- 250.000,00 €

Kommentar:

Die Erweiterungsinvestition zielt darauf ab, durch die direkte Anbindung einer Verpackungsanlage größere Mengen produzieren zu können. Bisher gibt es keine Verpackungsanlage, das Verpacken wird von einem externen Dienstleister vorgenommen, was zu zeitlichen Verzögerungen geführt hat.

Investitionsrechnung:

	Jahr	0	1	2	3	4	5	6
(1)	Summe Cashflows aus Investition (Anschaffungskosten + Opportunitätskosten + Änderungen im Net Working Capital)	- 339.637,77 €	- €	- €	- €	- €	89.637,77 €	- €
(2)	Operativer Cashflow vor Steuern (Umsatzerlöse + Betriebskosten)	- €	131.500,00 €	128.500,00 €	109.000,00 €	99.000,00 €	69.494,69 €	- €
(3)	Cashflow-Effekt des Projekts vor Steuern [(1) + (2)]	- 339.637,77 €	131.500,00 €	128.500,00 €	109.000,00 €	99.000,00 €	159.132,46 €	- €

Annahmen:

Diskontierungszinssatz:	13,00%

Weitere Angaben:

Risikoklasse:	2

Zusammensetzung des Diskontierungszinssatzes:

WACC:	12,00%
+ Risikoanpassung (basierend auf der Risikoklasse):	0,00%
+ Landesspezifische Anpassung:	1,00%
= verwendeter Diskontierungszinssatz:	**13,00%**

D Information Overload Effects in Sequential Information Acquisition for Investment Decision-Making

Authors:

Maren Hartmann

Heinrich Heine University Düsseldorf

Prof. Dr. Barbara E. Weißenberger

Chair of Management Control and Accounting

Heinrich Heine University Düsseldorf

Information Overload Effects in Sequential Information Acquisition for Investment Decision-Making

ABSTRACT

This paper experimentally investigates structured investment decision-making with sequential information provision. Subjects were asked to rank investment alternatives using a scoring model. A mixed design with information provision as the within-subject variable and initial information load as the between-subjects variable was employed. A computer-based process tracing technology provided insights into the underlying information acquisition process – information cues were covered by boxes for the second step of the decision. Moving the cursor over a box uncovered the information. Duration and frequency of uncovering the different information cues was recorded in a database. The main variables of interest were decision accuracy, decision confidence, and measures characterizing the information acquisition process. The main findings were the following: the amount of information provided in the first step significantly impacted decision accuracy and decision confidence, which decreased for the high initial information load group. In addition, receiving a high number of information cues in the first step led to a reduction in the attention devoted to the information received in the second step. Confirmatory information search behavior could not be observed. Findings help further our understanding on how the amount and timing of information provision impact decision quality and confidence.

Keywords: information overload, decision-making, process tracing, information use, investment decisions

JEL Classification: M41; D83; C91; D91

1. Introduction

Decision-makers in corporations face ever-increasing amounts of information (e.g., Luft & Shields, 2010). This makes the role of management accountants as decision facilitators (Sprinkle, 2003; referring to Demski & Feltham, 1976) i.e., information providers, even more important – selecting the right information and the right amount of information is critical to ensure managerial decision quality and thus organizational performance. To do so, management accountants need to understand how decision-makers acquire and process information (e.g., Ackoff, 1967).

Based on the model by Schroder, Driver, and Streufert (1967), it has been shown in a variety of settings that an increase in information load beyond a certain level can impair decision quality. Both on a conceptual level, focusing mostly on external reporting (e.g., Fertakis, 1969; Miller, 1972), and empirically (e.g., Iselin, 1993; Stocks & Harrell, 1995; Shields, 1980, 1983; Swain & Haka, 2000), effects of increases in information load have been investigated in the accounting domain.

Often, information, for example on investment projects, is provided successively to decision-makers as additional information becomes available (e.g., Saunders & Jones, 1990). However, to the authors' knowledge, there is no investigation to date into the effects of increases in information load when information is provided sequentially. Therefore, in a computerized experiment, we investigated how decision accuracy and decision confidence are affected by increases in information load in a structured investment decision when information is provided successively to decision-makers. In addition, as called for by Luft and Shields (2010) and Weber and Johnson (2009), we employed a process tracing methodology to further understand the way individuals used the information provided, which can provide insights into the reasons for decision outcomes.

We extended the experimental task described in Hirsch and Volnhals (2012), based on Volnhals (2010), which places subjects in the role of a manager required to make a recommendation for an acquisition decision based on a report containing information on six potential target companies. Decisions were made in two steps: subjects received performance indicators and ranked the investment alternatives (first step / initial decision). They were then informed that additional information had become available and asked to update their ranking if necessary (second step / final decision).

Information load was manipulated between subjects by varying the number of attributes (performance indicators) presented for each investment alternative. In the first step, one group received 14 performance indicators per investment alternative (group "high initial information load"), whereas the other group received only four performance indicators per investment alternative (group "low initial information load"). Subjects were then asked to rank the investment alternatives according to their economic favorability. Six additional performance indicators for each investment alternative were then presented, together with the information presented in step one, so that the "high initial information

load" group received 20 performance indicators in total, whereas the "low initial information load" group received ten performance indicators in step two. Provision of the six additional performance indicators can thus be considered a within-subjects factor, resulting in a mixed experimental design. Employing a simple scoring model with equal weights, a correct solution to the task could be derived (the scoring model is described in greater detail in section 4.2). Time in each step was restricted to 15 minutes for both experimental groups. Thus, the concept of information load employed here is that of information cues per time (e.g., Schick, Gordon, & Haka, 1990). In addition to a show-up fee, participants received a performance-based bonus.

The findings from the experiment further our understanding of how decision performance is impacted by information load when information is provided sequentially, how increases in information load impact information use, and how this translates into decision performance. This enables us to derive implications for practice as to which factors to consider when providing information to decision-makers.

2. Literature Review

As indicated by Hirsch and Volnhals (2012), few empirical studies have explicitly investigated information overload effects in the management accounting domain. Some exceptions are Shields (1980) and Shields (1983), who investigated analyses of performance reports; Swain and Haka (2000), who tracked information use in a capital budgeting task; Barefield (1972), who employed a cost variance analysis task; and Iselin (1988), who investigated net present value (NPV) calculations. In addition, effects of increases in the number of information cues have been investigated in further accounting-related settings, in which most studies address financial distress prediction (e.g., Casey, 1980; Chewning & Harrell, 1990; Iselin, 1993; Stocks & Harrell, 1995; and others).

As described above, to understand the information acquisition process in the second stage of the experiment, we used a computerized process tracing methodology. Payne and Venkatraman (2011) explain the benefits of process tracing methodologies: tracing the decision process allows researchers to observe changes in decisions and decision strategies, to gain an understanding of which information cues individuals attend to and to analyze individual differences in both decision behavior and processes. The underlying assumption is that judgments are constructed during the decision process. Thus, tracing the decision process is one way to understand how judgments are formed, a prerequisite for improving decisions (Payne & Venkatraman, 2011). The tracing of pre-decisional processes has a long history in psychological research (see Shields, 1983, for an overview).

In the accounting context, process tracing methodologies have previously been used by Swain and Haka (2000), who investigated the effects of information load on information processing in a capital budgeting task. They found that an increase in information load leads to a decrease in the proportion of

information searched, an increased variability in the search pattern, and adjustment in the direction of search patterns. Bogan and Just (2009) found that students and executives are prone to confirmation bias in information searches for merger decisions. They also found that there are significant differences in the search behavior of students and executives. Shields (1980) used an information board to analyze the effect of increases in information load on the search patterns used to gather information from performance reports. Shields (1983) used an information board to analyze the link between information demand, information supply and judgment accuracy when analyzing performance reports. Other applications include general judgment and decision-making research (e.g., Glöckner & Herbold, 2011; Huber, Wider, & Huber, 1997), consumer research (e.g., Reisen & Hoffrage, 2008; Zellman, Kaye-Blake, & Abell, 2010), or credit decisions (Andersson, 2004). A review of earlier process tracing studies can be found in Ford, Schmitt, Schechtman, Hults, and Doherty (1989).

As described above, in the experimental task, information cues were provided in two steps, with a ranking of investment alternatives occurring after each step.

In the accounting context, the belief-adjustment model by Hogarth and Einhorn (1992) has been a prominent theory to predict how judgments change with the provision of new information. This is especially relevant in the auditing context, in which information is analyzed step by step in the audit process (e.g., Asare, 1992; referring to Gibbins, 1984). Ashton and Ashton (1988) provide a concise summary of the Hogarth and Einhorn (1992) belief-adjustment model: the effect of evidence is usually determined by its direction (confirming vs. disconfirming the belief currently held); strength (how strongly/weakly the additional evidence confirms or disconfirms a belief); and type (consistent vs. mixed). Hogarth and Einhorn (1992)'s belief adjustment model focuses explicitly on two more factors – order and presentation mode – making predictions as to when the order and presentation mode (simultaneous vs. sequential) affect judgment. The model's predictions include a recency effect for mixed evidence and describe the circumstances under which evidence can have a diluting effect. The model has been investigated experimentally in auditing, for example by McMillan and White (1993); Asare (1992); Bamber, Ramsay, and Tubbs (1997); and in management accounting, for example by Dillard, Kauffman, and Spires (1991). Kahle, Pinsker, and Pennington (2005) provide a broader literature review of the model's application in accounting.

Ashton and Ashton (1988) highlight that the order of presentation should not influence judgment in auditing in an ideal world. Similarly, this should also not be the case in the experimental task described here. The fact that a group of subjects received a different amount of information in the first step should not influence the way they deal with the information received in the second step. As described in the hypotheses section (3), we assume that this is not the case, similar to the general prediction of the Hogarth and Einhorn (1992) model. We assume that information received in the first step does influence decision-making in the second step. However, judgment of evidence in auditing is

an unstructured task, while the task employed here was highly structured. To arrive at the optimal solution, every information cue must be considered. In a highly structured task which clearly indicates relevance, the belief revision effects previously described are unlikely to appear. Sub-optimal processing of information in the second step would rather be due to limited information processing capacities.

3. Hypotheses Development

3.1. Decision Accuracy

There are different mechanisms through which increases in information load affect decision-making performance. Luft and Shields (2010) summarize how information load above a certain level is likely to impair decision quality: if the absolute quantity of information increases, this might decrease the relative amount of information considered (Payne, Bettman, & Johnson, 1993). Furthermore, information integration is likely to decline once information quantity surpasses a certain point, leading to the famous inverted-U relationship (Schroder et al., 1967).

Research in psychology on self-control adds a further explanation, especially for the decision made in the second stage: ego depletion assumes that performance on a task does not only depend on motivation and effort expended, but also on the amount of resources available for self-regulation. Baumeister and Vohs (2007) define self-regulation as a function that controls unwanted impulses, changing a response. The assumption when discussing ego depletion is that self-regulation requires a limited resource which is used up when exerting choice. A depleted ego thus temporarily lacks these resources (Baumeister & Vohs, 2007).

In this context, Schmeichel, Vohs, and Baumeister (2003) demonstrated that exerting self-control in a first task led to a decrease in performance in a second task for tasks that required higher-order intellectual capacity, but not for simple tasks (e.g., a simple recall task). The task employed here requires higher-order information processing; performance is thus likely to be worse in the second step of the task.

As subjects in the “high initial information load” condition viewed the initial information again in the second step of the task, it is not purely the effort for self-regulation expended in the first part of the task, the second part is also likely to be more difficult in the high information load condition, as it is more difficult to integrate the additional information into the first set of information cues. This leads to the first hypothesis:

Hypothesis 1: Decision accuracy will be lower for the “high initial information load” group than for the “low initial information load” group.

3.2. Decision Confidence

Decision-makers who are more confident are more likely to turn judgments into actions (Chung & Monroe, 2000; referring to Norman, 1975). A positive correlation between decision confidence and decision accuracy is therefore beneficial in order for high confidence to not lead to sub-optimal actions (Chung & Monroe, 2000). The effects of increases in information load on decision confidence are not clear. Most studies have not found any significant effects (Agnew & Szykman, 2005; Hirsch & Volnhals, 2012; Simnett, 1996; Snowball, 1980). The exception are Chervany and Dickson (1974), who found an increase in decision confidence when providing subjects with disaggregated data. However, this setting is quite different from the one employed in this experiment. Increases in information load can be linked to increases in task complexity (Wood, 1986). Chung and Monroe (2000) experimentally investigated the relationship between task difficulty and confidence in the context of control evaluations in an audit setting and found a negative relationship. Kelley and Lindsay (1993, p. 2) highlight that the "fluency" with which an answer is found positively effects confidence. This was investigated for general knowledge questions. With increasing information load, task difficulty is likely to be higher, which should negatively affect decision confidence. The fluency of the decisions taken could also decline with higher task difficulty:

Hypothesis 2: Decision confidence will be lower for the "high initial information load" group than for the "low initial information load" group.

3.3. Information Use and Decision-Making

Tracing the information acquisition process in the second step, after additional information has become available, allows the analysis of which information cues (i.e., which performance indicator for which investment alternative) subjects looked at. A perfectly rational decision-maker with the ability to process all available information should not be affected by the information load present in the first stage of the decision. However, several findings suggest that this might not be the case, and that decision-makers are likely to pay less attention to the new information cues in the high initial information load condition than they do in the low initial information load condition.

In their synthesis of potential negative effects of redundant information, Einhorn, Kleinmuntz, and Kleinmuntz (1979), citing Shepard (1964), summarize that the presence of additional information might lead decision-makers to believe that they have already considered a large amount of information. Einhorn et al. (1979) refer to redundant information. However, this effect should also be present with additional relevant, non-redundant information cues. Furthermore, restrictions in information processing capacity will likely impair the information acquisition process for the additional information cues. As described above with regards to decision accuracy, ego-depletion (Baumeister & Vohs, 2007) from the effort expanded in the first step of the experimental task might

also lead subjects in the "high initial information load" condition to attend less to the additional information provided. Based on these findings, we propose hypotheses 3 and 4:

Hypothesis 3: Subjects in the "high initial information load" condition will spend less time viewing additional information.

Hypothesis 4: The number of information acquisitions (opening a box with information) will be lower for subjects in the "high initial information load" condition.

When presented with additional information after a tentative first decision has been made, people tend to engage in confirmatory information search. The psychological theory typically proposed to explain this phenomenon is cognitive dissonance theory (Festinger, 1957). To reduce post-decisional conflict, people prefer supporting over non-supporting information. Although this phenomenon is more pronounced in non-routine decision-making (unlike our task; Jonas, Schulz-Hardt, Frey, & Thelen, 2001), we argue that confirmatory information search might also occur in our task. This leads to the fifth hypothesis:

Hypothesis 5: Subjects in both conditions will exhibit confirmatory search behavior.

As described above, ego depletion due to effort expended in the first step of the task can lead to reduced performance in the second step of a task (Baumeister & Vohs, 2007). In the context of confirmation bias, Fischer, Frey, and Greitemeyer (2008) found that ego depletion leads to increases in confirmatory information processing behavior in a number of decision-making tasks. In particular, if subjects are already experiencing a feeling of information overload triggered by a higher number of information cues in the "high initial information load" group, they might be less capable of following a balanced information acquisition strategy:

Hypothesis 6: Confirmatory search behavior will be more pronounced in the "high initial information load" group than in the "low initial information load" group.

4. Research Design

4.1. Overview of the Experimental Procedure

To test the above propositions, we conducted an experiment with 66 participants in an experimental laboratory at a large German university. Recruitment for the experiment was done via the online recruitment system for economic experiments (ORSEE) of the experimental lab. Invitations were sent to potential candidates in the database who had stated that they studied either business, economics, or a related subject (business and IT or business and chemistry). In addition, the invitation specified that

people were eligible to participate in the experiment if they studied either business, economics or a related subject.[1]

Five experimental sessions were conducted in January and February 2015. Subjects were paid a show-up fee of €4 and a bonus of up to €10 based on their performance in the task.

At the beginning of the experiment, the experimenter welcomed everyone to the study, saying that they were about to participate in a study addressing investment decision-making. They were told that all information they needed would appear in the instructions on their screen once they started the task. Subjects were instructed not to take any notes, not to talk during the experiment, and to raise their hand if they encountered a technical problem. They were also told to raise their hand when they reached the webpage that stated their payment for the experiment. The experimenter then came to their desk and handed them the receipt, which they filled out, and noted on a sheet of paper the respective payment. Subjects were then told to click on the link that was named "start study" on their computer desktop. The link then opened a browser window containing the first webpage of the experiment. Subjects were paid in cash immediately after the respective experimental session.

Figure 1 provides an overview of the experiment (for the complete set of instructions, see appendix).

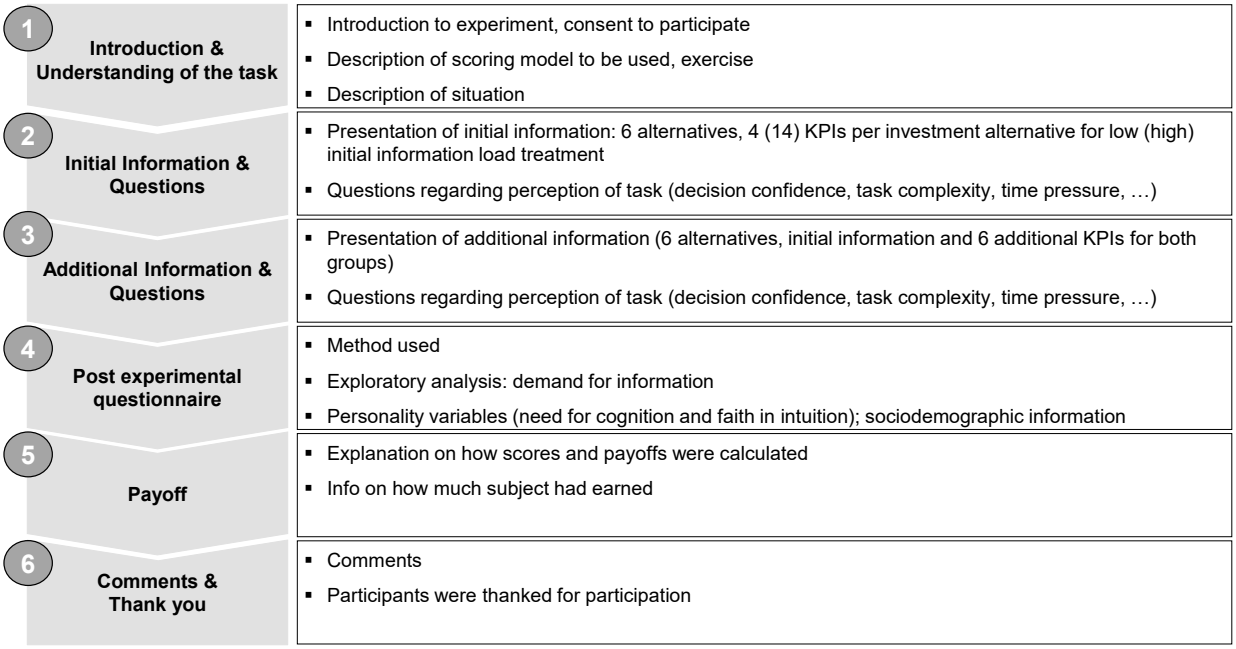


Figure 1: Experiment Overview

1) Introduction and understanding of the task: After receiving some general information on the experiment, subjects could choose to either consent to participating or leave the lab. The next step was

[1] One participant stated in the post-experimental questionnaire that they were studying German. As the database data for this participant stated that they had at studied business or economics at some point, we kept the data in the analysis.

a brief description of the scoring model to be employed when making the investment decision, supplemented by a numerical example. The scoring model is explained in more detail later; the description in the experiment is based on Riedl (2006). As indicated by Willemsen and Johnson (2011), it is important to familiarize subjects with the process tracing technology. We therefore included an exercise before the start of the actual experimental task that allowed subjects to familiarize themselves with the way information was presented, how to uncover information by moving the cursor over the respective boxes, and the scoring model to be employed. To avoid anchoring effects, we used a decision different from the one in the real experimental task: the exercise let subjects choose between three different cameras based on three attributes. Participants then needed to answer three multiple-choice questions – two referring to the information covered by the MouselabWeb boxes, and one question referring to the optimal ranking based on the scoring model to be used. Instructions and an example for the scoring model could be re-accessed by clicking on a link on the screen. Subjects could only continue with the task if they answered all three test questions correctly. They were then given background information on the hypothetical situation and asked to imagine they were a manager in a multinational corporation that needed to rank investment alternatives according to their economic attractiveness. They were told that all information cues had to be weighed equally and that their additional payoff of up to €10 would be based on whether they provided the economically most advantageous ranking – stating that the rank and the order were going to be taken into account. They were also told that the time they had to complete the task would be restricted, the remaining time would be shown on the top of the screen, and the information cues and the notes they would take would not be visible anymore when the time had run out. For the correct application of the scoring model, it was critical to weigh all information cues equally. Pretests had shown that some subjects attended to selected information cues (e.g., only financial indicators). We therefore included another question before the start of the experimental task that asked subjects how the information provided should be taken into account (answering options were “only financial performance indicators,” “only non-financial performance indicators,” “all performance indicators weighed equally,” and “only the most important performance indicators”). Again, subjects could only continue with the experiment once they had answered this question correctly.

2) Initial information and questions: The next screen reminded participants that they now had 15 minutes to make their decision and explained the layout of the following page (information, text field to take notes, and buttons for the decision regarding the ranking of the investment alternatives). Subjects then continued to the page that presented the performance indicators in tabular format (see appendix). According to the experimental group, either 4 or 14 performance indicators were presented.

After the initial decision, participants answered a set of questions regarding the perception of the task they had just completed. We used a set of questions similar to Hirsch and Volnhals (2012): perceived

information load, decision confidence, and feeling of overload (we slightly adapted some of the questions, e.g., to fit with the overall layout of 7-point-Likert scales). In addition, we asked how many performance indicators had been presented, and we included questions on perceived time pressure (Glover, 1997); perceived task complexity (Fessler, 2003; Scott & Erskine, 1980); and effort intensity (Yeo & Neal, 2008). As in Yeo and Neal (2008), measures of effort intensity were not only taken at the end of the experiment, but also during the experimental task for each decision stage. The information set and scoring model to be employed is presented in detail in section "Information Presented, Scoring Model Employed, and Optimal Solution."

3) Additional information and questions: On the next screen, participants were told that additional information had become available, they were to update or revise their ranking if necessary, and they would have 15 minutes to do so. The following page was identical to the page presenting the information for the first step decision, except for the fact that now (for both groups) six additional performance indicators were included, appended to the original information set. These were covered by grey boxes (the MouselabWeb functionality that allows the tracking of the information acquisition process). Thus, the information set now consisted of 20 performance indicators per alternative for the "high initial information load" group and of 10 performance indicators for the "low initial information load" group. Each performance indicator/alternative combination would open separately when hovering over the respective box (screenshots are included in the appendix). The notes taken in step one reappeared on the screen, along with the ranking subjects had chosen in the first step. After the final decision, the same questions regarding perceived task characteristics (see 2) were asked.

4) Post-experimental questionnaire: In the post-experimental questionnaire, we first asked subjects their expectations regarding the achieved percentage on the final decision (to later calculate a measure of overconfidence); how they had weighed the information cues for the first and second (final) decision (if not equally, what other method they had employed); and the method they had used to make their decision, similar to Hirsch and Volnhals (2012). As we were interested in what information individuals would ask for when being able to choose the performance indicators themselves, we asked them which performance indicators they would select for a standard reporting from the list of all 20 performance indicators. They could add additional performance indicators they would like to receive in the text field.

The next page contained a short version of a need for cognition (NFC) and faith in intuition (FI) scale (Epstein, Pacini, Denes-Raj, & Heier, 1996; five items for each scale). The two scales were included to account for a potential impact of subjects' cognitive style on how they work on the experimental task. In short, need for cognition refers to a rational thinking style, while faith in intuition refers to a more experiential thinking style, based on intuition rather than on detailed analyses (e.g., Epstein et al., 1996; Witteman, Van den Bercken, Claes, & Godoy, 2009). As the task required a purely analytical

approach, subjects with high need for cognition might perform better on the task. Keller, Bohner, and Erb (2000) have developed a German version of the NFC and FI scales. We used their translation where available.[2]

After completing the NFC and FI scales, subjects were asked to provide some information on their experience working with performance indicators ("how secure do you feel when dealing with performance indicators," "Do you have any practical experience with performance indicators, if yes, how many months"), their field of study, current semester, age, sex, and mother tongue.

5) Payoff: Participants were then given an example of how the score was calculated and informed of their payment.

6) Comments and thank you: Subjects were asked to provide any comments they might have, thanked for their participation, and asked to remain silently seated at their desks until the end of the study was announced by the experimenter.

If not stated otherwise, we used 7-point Likert scales.

4.2. Information Presented, Scoring Model Employed, and Optimal Solution

It was indicated in the experimental instructions that all information cues should be weighed equally. Subjects thus had to rank investment alternatives for each attribute (i.e. performance indicator). Then the overall rank for each investment alternative was determined by summing the ranks across all attributes.

Table 1 illustrates the information available to each of the experimental groups (based on Hirsch & Volnhals, 2012) and the resulting ranks. The ranks for attributes that represent "negative" performance indicators (such as costs) are reversed, such that a low rank is always positive.[3] Whether low or high values are positive is marked with "l" or "h" in the "Pos/neg."

[2] One of the items used in Epstein et al. (1996) was not used in Keller et al. (2000) ("I prefer complex to simple problems") which we translated to "Ich mag komplexe Problemstellungen lieber als einfache Problemstellungen."

[3] We slightly changed the original wording used in Hirsch and Volnhals (2012) for two of the performance indicators after some pretesters commented that it might not be clear whether an increase in the respective indicator should be considered as positive or negative. The wording we applied was "Ø yearly state support in k €" instead of "Ø yearly subsidies in k €" and "Ø effectiveness of sales channels in %" instead of "Ø extent of development of existing sales channels in %."

Table 1: Information Set, Based on Hirsch and Volnhals (2012)

			Company							Rank					
Time of information presentation	**High vs. low Info. load condition**	**Information**	**A**	**B**	**C**	**D**	**E**	**F**	**Pos /neg**	**A**	**B**	**C**	**D**	**E**	**F**
Step 1	High / Low	1) Ø Return on Investment (ROI) in %	9.20	7.40	8.30	7.85	9.65	8.75	h	2	6	4	5	1	3
Step 1	High / Low	2) Ø Revenues in k €	173,100	160,400	154,000	147,600	166,700	134,900	h	1	3	4	5	2	6
Step 1	High / Low	3) Ø Percentage of satisfied customers	40.82	33.58	55.30	69.78	48.06	62.54	h	5	6	3	1	4	2
Step 1	High / Low	4) Ø brand awareness in %	38.21	19.07	12.69	31.83	25.45	6.31	h	1	4	5	2	3	6
Step 2	High / Low	5) Ø market share in %	17.35	21.47	9.11	0.87	13.23	4.99	h	2	1	4	6	3	5
Step 2	High / Low	6) Ø revenue growth in %	13.72	16.29	8.58	21.43	11.15	18.86	h	4	3	6	1	5	2
Step 2	High / Low	7) Ø percentage of satisfied employees	68.81	63.83	83.75	73.79	88.73	78.77	h	5	6	2	4	1	3
Step 2	High / Low	8) Ø yearly state support in k €	640.00	655.00	670.00	685.00	625.00	700.00	h	5	4	3	2	6	1
Step 2	High / Low	9) Necessary one-time investment in infrastructure in k €	377.00	296.00	242.00	350.00	269.00	323.00	l	6	3	1	5	2	4
Step 2	High / Low	10) One-time qualification expenses for employees in k €	909.00	1,845.00	1,533.00	1,221.00	597.00	285.00	l	3	6	5	4	2	1
Step 1	High	11) Ø production reject rate in %	12.70	15.48	18.26	7.14	9.92	21.04	l	3	4	5	1	2	6
Step 1	High	12) Ø first time buyer growth in %	8.11	11.51	14.91	1.31	4.71	18.31	h	4	3	2	6	5	1
Step 1	High	13) Ø innovation growth rate in %	13.89	18.20	22.51	5.27	9.58	26.82	h	4	3	2	6	5	1
Step 1	High	14) Ø attractiveness for potential employees in %	60.20	53.98	47.76	72.64	66.42	41.54	h	3	4	5	1	2	6
Step 1	High	15) Ø competition growth in %	7.93	9.03	10.13	5.73	6.83	11.23	l	3	4	5	1	2	6
Step 1	High	16) Ø profit margin in %	20.00	21.50	23.00	17.00	18.50	24.50	h	4	3	2	6	5	1
Step 1	High	17) Ø profit growth in %	12.84	10.09	7.34	18.34	15.59	4.59	h	3	4	5	1	2	6
Step 1	High	18) Ø degree of dependence from 10 biggest investors in %	62.22	57.10	51.98	72.46	67.34	46.86	l	4	3	2	6	5	1
Step 1	High	19) Ø dependence on political and judicial parameters in %	61.27	68.41	75.55	46.99	54.13	82.69	l	3	4	5	1	2	6
Step 1	High	20) Ø effectiveness of sales channels in %	50.21	54.98	59.75	40.67	45.44	64.52	h	4	3	2	6	5	1

To investigate the effect of a variation in initial information load in sequential decision-making, we split the information set shown above into three parts: attributes 1–4, attributes 5–10, attributes 11–20.

1) Information sets in step one (preliminary decision): Subjects in the "low initial information load" condition received an information set consisting of attributes 1–4. Subjects in the "high initial information load" condition received an information set consisting of attributes 1–4 plus attributes 11–20.
2) Adding performance indicators 11–20 to performance indicators 1–4, the information set provided to the "low initial information load" group in the first step (resulting in the information set presented to the "high initial information load" group in the first step) did not change the correct ranking, as illustrated in Table 2. Both groups should thus come to the same ranking in the first step if they applied the scoring model correctly.
3) Information set in step two (final decision): both groups received an additional information set consisting of attributes 5–10. Table 2 illustrates the information available in steps one and two for the two groups, the respective sum of ranks, and the resulting ranking for each alternative.

Table 2: Information Sets in Sequential Decisions

		A	B	C	D	E	F
Step 1:	1) Initial Info-Set "low": Sum of attribute ranks 1-4	9	19	16	13	10	17
	2) Initial Info-Set "high": Sum of attribute ranks 1-4 and 10-20	44	54	51	48	45	52
	Resulting ranking (for (1) or (2))	**1**	**6**	**4**	**3**	**2**	**5**
Step 2:	3) Incl. additional info "low": Sum of attribute ranks 1-10	34	42	37	35	29	33
	4) Incl. additional info "high": Sum of attribute ranks 1-20	69	77	72	70	64	68
	Resulting ranking (for (3) or (4))	**3**	**6**	**5**	**4**	**1**	**2**

This design allows the determination of whether subjects integrated the new information presented in step two into their judgment. If they did, the ranking of alternatives should change after considering the additional information in step two.

In step 2, subjects viewed the initial information set from step 1, plus the additional information set (attributes 5–10 for all alternatives).

As in Hirsch and Volnhals (2012), decision accuracy was measured by comparing the resulting ranking to the optimal ranking, considering both the absolute rank and the deviation from the correct rank (larger deviations leading to a lower score), as well as the order of alternatives. The exact calculation of the score is described in the experimental materials in the appendix (payoff).

To control for order effects, we used two orders for the additional attributes (as presented above in Table 1 or inversed). In the section of the post-experimental questionnaire where we asked about the information that subjects would ask for in a standard reporting, the performance indicators were also presented in two different orders.

4.3. Process Tracing and Technical Realization

There are several options for tracing information acquisition or decision processes. Reisen and Hoffrage (2008) give an overview of the most important technologies, namely Mouselab, eye tracking, active information search, or verbal protocols. We used MouselabWeb (www.mouselabweb.org, for an overview also see Willemsen & Johnson, 2011), an open-source computerized process-tracing methodology that is based on information boards as, for example, used by Shields (1980, 1983).

Information cues are initially covered on screen and can be viewed by moving the mouse cursor over the respective box (the functionality employed in this experiment, a box represented a performance indicator/alternative combination) or clicking on it. For a detailed description, see Willemsen and Johnson (2011). Times for mouseover (moving the cursor over an element) and mouseout (moving the cursor away from an element) are recorded in a database during the experiment. This provides researchers with a vast amount of process data on which information is retrieved for how long at which point of the decision process (Reisen & Hoffrage, 2008). However, one drawback compared to verbal protocols is that purely understanding the information acquisition process does not enable the inference of whether the respective information cues are truly integrated into the decision by the decision-maker (Reisen & Hoffrage, 2008). By construction of our experimental task, however, it is possible to analyze whether the information viewed was integrated into the final decision – successful integration of the information in the second stage of the experiment should lead to a change in the ranking of investment alternatives. The MouselabWeb website provides researchers with a tool (the "designer") to program the experiment pages (www.mouselabweg.org). The output from the designer was then modified by additional HTML and JavaScript code. The experiment was run in the browser installed on the experimental lab's PCs (Mozilla Firefox). Subjects were prevented from accessing the next page of the experiment if they had not answered all required questions. If required input had not been given, a warning alert popped up, reminding participants to answer all required questions before clicking on "continue."

5. Results

5.1. Descriptives and Manipulation Checks

Two of the 66 subjects were excluded from the analysis.[4] As there were no significant effects of the order in which the additional attributes were presented, results are reported without differentiating between the two versions. Table 17 in the appendix contains the number of subjects per experimental session; Table 18 in the appendix shows the number of subjects per order of the additional attributes.

Table 3 shows the resulting number of subjects for each cell, indicating that the ratio of female and male subjects was approximately equal for both experimental groups, which was also true for field of study (Table 4) and mother tongue (Table 5).

Table 3: Number of Subjects by Group and Gender

Number of Subjects by Group and Gender

		Group		
		High initial information load	Low initial information load	Total
Gender	Male	20	19	39
	Female	12	13	25
	Total	32	32	64

Table 4: Number of Subjects by Group and Field of Study

Number of Subjects by Group and Field of Study

		Group		
		High initial information load	Low initial information load	Total
Field of study	Business administration	12	15	27
	Economics	17	14	31
	Other	3	3	6
	Total	32	32	64

[4] One participant arrived later at the experimental session and loaded the first page of the experiment ca. 4–6 minutes later than the other participants. Another participant's notes disappeared in the first decision step (thus leading to a reduced chance to apply the correct ranking). These two subjects were excluded from further analysis.

Table 5: Number of Subjects by Group and Mother Tongue

Number of Subjects by Group and Mother Tongue

		Group		
		High initial information load	Low initial information load	Total
Mother tongue	German	25	26	51
	Other	7	6	13
	Total	32	32	64

Conducting *t*-tests on the variables "understanding of the task," "age," "current semester," "perceived security when dealing with KPIs," "practical KPI experience in months," and the need for cognition (NFC)[5] and faith in intuition (FI) scores (see Table 6), we did not find any significant differences between the two experimental groups for most variables.[6] An exception was the question of how confident subjects felt when dealing with performance indicators. The mean was significantly higher for the "low initial information load" group. As the differences between means for all other variables described above are not statistically significant, the reason for the difference is most likely that subjects were primed by the task they had completed before, perceiving the high information load task as more difficult and thus rating the question lower than subjects in the "low initial information load" condition. It could be hypothesized that there would not have been any significant difference between the answers had the questions been asked before the start of the experimental task.

[5] To improve reliability, the NFC score was calculated based on two items only. See section 5.2 for details.
[6] Levene's Test for equality of variances was significant for "perceived security when dealing with KPIs;" robust significance values are reported for this item.

Table 6: Tests for Equality Between Experimental Groups

Group		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	
Understanding of the task	High initial information load	32	6.47	1.02	0.18	.285	
	Low initial information load	32	6.69	0.54	0.09		
Age	High initial information load	32	23.13	2.86	0.51	.393	
	Low initial information load	32	24.16	6.15	1.09		
Current semester	High initial information load	31	4.81	2.91	0.52	.092	
	Low initial information load	31	6.13	3.16	0.57		
Perceived security when dealing with KPIs	High initial information load	32	4.53	1.22	0.22	.000	***
	Low initial information load	32	5.50	0.80	0.14		
Practical KPI experience in months	High initial information load	32	1.03	2.60	0.46	.295	
	Low initial information load	32	10.91	52.82	9.34		
Score NFC	High initial information load	32	8.91	3.22	0.57	.313	
	Low initial information load	32	9.66	2.66	0.47		
Score FI	High initial information load	32	22.91	5.18	0.92	.527	
	Low initial information load	32	23.63	3.74	0.66		

Overall, the above results show that the two experimental groups were sufficiently equal to allow for a meaningful interpretation of the results.

The mean payoff across both groups was €11.23 (Table 7); the experiment lasted on average roughly 40 minutes (Table 8).[7]

[7] One subject did not press "next" on the last page of the experiment, so there is one missing value for total time.

Table 7: Mean Payoffs by Group and Gender

Mean Payoff by Group and Gender

			Group		
			High initial information load	Low initial information load	Total
			Mean	Mean	Mean
Gender	Male	Total payoff	10.26	12.61	11.41
	Female	Total payoff	9.49	12.31	10.95
	Total	Total payoff	9.97	12.49	11.23

Table 8: Total Time by Group in Min

Total Time by Group in Min

		Total time				
		Mean	Standard Error of Mean	Median	Count	Missing
Group	High initial information load	45.22	1.07	45.69	32	0
	Low initial information load	35.45	1.07	35.75	32	1
	Total	40.41	0.97	39.51	64	1

As indicated above, subjects were asked how they had perceived the amount of information presented and how many performance indicators they had received. Table 9 shows the means and significance values for a *t*-test conducted on the two groups for the initial (1) and final decision (2) for the variables "perceived information load" and "number of KPIs".[8] For the initial decision, there was a significant difference for the two variables, with higher mean values for the "high initial information load" group, indicating that the information load manipulation was effective. For the final decision, however, the means for "perceived information load" were not significantly different for the two groups. Apparently, there was already a ceiling effect attained with the maximum effect on perceived information load in this task when 10 attributes are presented (as was the case for the "low initial information load" group in the second step decision).

[8] When Levene's Test for equality of variances was significant, robust test values are reported. One subject did not enter a number into the field for "number of KPIs" but wrote "all". The analysis is therefore based on n=63 for this variable.

Table 9: T-Test Perceived Information Load and Number of KPIs

Group Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	
Perceived information load: initial decision	High initial information load	32	5.31	1.03	0.18	.000	***
	Low initial information load	32	3.25	0.98	0.17		
Number of KPIs: initial decision	High initial information load	31	10.94	2.73	0.49	.000	***
	Low initial information load	32	4.06	0.25	0.04		
Perceived information load: final decision	High initial information load	32	5.16	1.22	0.22	.830	
	Low initial information load	32	5.09	1.09	0.19		
Number of KPIs: final decision	High initial information load	31	17.03	4.18	0.75	.000	***
	Low initial information load	32	9.38	1.24	0.22		

5.2. Decision Accuracy and Decision Confidence

The score for decision accuracy was measured as in Hirsch and Volnhals (2012). However, for the analysis reported here, we analyzed decision accuracy with reference to the information that was available to the participants at the specific point in time. As described above, applying the scoring model correctly, the rankings in step 1 and step 2 should differ. Whereas Hirsch and Volnhals (2012) analyzed decision quality with reference to the full information set (subjects in the low information load group could thus not obtain a 100% score for decision quality as they lacked relevant information), in our case, obtaining a 100% score in the decision in the first step was possible when the scoring model was correctly applied. As mentioned above, we hypothesized decision accuracy and decision confidence to be higher in the "low initial information load" group (hypotheses 1 and 2).

To analyze the effects of an increase in information load on decision accuracy and decision confidence, we used a repeated-measures MANCOVA with decision accuracy and decision confidence as the dependent variables. Provision of six additional attributes was the within-subjects factor; initial information load was the between-subjects factor. The scores for need for cognition and faith in intuition were included as covariates in the model.[9] The faith-in-intuition score included all five items (Cronbach's Alpha was .673), whereas the need-for-cognition score was calculated based on the two items "I prefer to do something that challenges my thinking abilities rather than something that requires little thought" and "I prefer complex to simple problems." Deleting the three remaining (reverse-scored) items resulted in an improved reliability – Cronbach's Alpha increased from .636 to .787.

Using Pillai's Trace,[10] there was a significant main effect of initial information load, $V = 0.53$, $F(2, 59) = 32.71$, $p < .001$. This supports hypotheses 1 and 2.

The main effect of providing six additional performance indicators (within-subjects factor) was not significant, Pillai's Trace: $V = 0.01$, $F(2, 59) = 0.19$, $p = .824$, indicating that across the two groups of low initial information load and high initial information load, the provision of the additional information cues did not significantly impact decision accuracy or decision confidence (there was no change in the variables across groups between the initial decision in step 1 and the final decision in step 2).

There was, however, an interaction effect between the level of initial information load and the provision of the six additional performance indicators, which is depicted in Figures 2 and 3. Values for Pillai's Trace are $V = 0.167$, $F(2, 59) = 5.90$, $p = .005$. The significant interaction effect shows that subjects react differently to a further increase in information load depending on the initial information load already received. Decision confidence and decision accuracy improved for those in the "high initial information load" group in the second step decision, whereas they declined for subjects in the low initial information load group when the six additional attributes were added. Follow-up univariate tests show that this interaction effect was statistically significant for decision confidence, $F(1, 60) = 10.83$, $p = .002$, but only marginally significant for decision accuracy, $F(1, 60) = 3.92$, $p = .052$. More detailed results for the repeated measures MANCOVA can be found in the appendix (Tables 19–24).

[9] Levene's test was significant for the decision confidence measures in steps 1 and 2. A model including reverse-scored log-transformed values for these variables, eliminating the problem of non-homogeneity of error variances, comes to the same conclusions (not reported here). In addition, violations of the homoscedasticity assumption should have little effect with equal group sizes, as is the case here: Blanca, Alarcón, Arnau, Bono, and Bendayan (2018) found ANOVA to be robust for equal group sizes even in the presence of heteroscedasticity.

[10] Pillai's trace is a test statistic used in the context of multivariate analyses based on the eigenvalues of the matrices used in the analysis. On a conceptual level, it is similar to the F-statistic in ANOVA (Field, 2013).

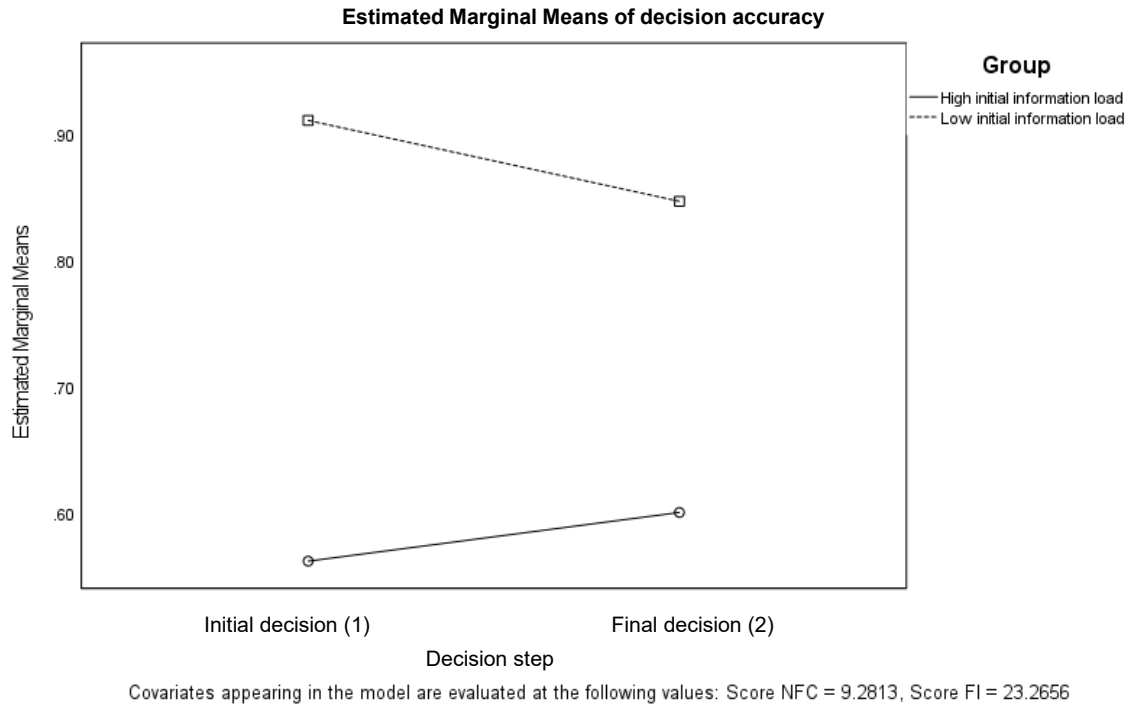


Figure 2: Estimated Marginal Means of Decision Accuracy

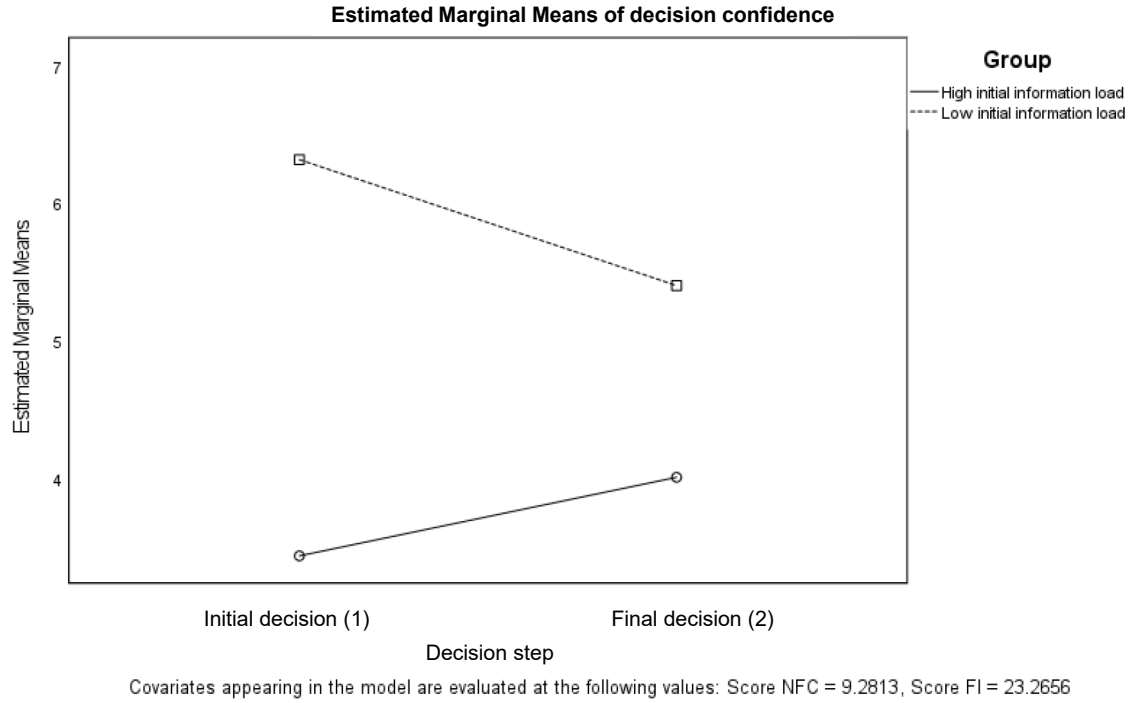


Figure 3: Estimated Marginal Means of Decision Confidence

Non-parametric tests show similar results: comparing the effect of initial information load (the between-subjects factor) separately for each decision stage using a Mann-Whitney test, in the first step of the decision, the median for decision confidence for the "low initial information load" group (*Mdn* = 7.00) was significantly higher than in the "high initial information load" group (*Mdn* = 3.00); $U = 77.00$, $z = -5.97$, $p < .001$, $r = -.75$. The same was the case for decision accuracy (*Mdn* = 100.00% for the "low initial information load" group; *Mdn* = 48.33% for the "high initial information load" group, $U = 163.00$, $z = -4.98$, $p < .001$, $r = -.62$). Results for the second step of the decision were similar, but differences were less pronounced: the medians for decision confidence in the second step were higher for the low initial information load group (*Mdn* = 6.00) than for the "high initial information load" group (*Mdn* = 4.00); $U = 277.00$, $z = -3.23$; $p = .001$, $r = -.40$. Similarly, the median for decision accuracy was higher for the "low initial information load" group (*Mdn* = 100.00%) than for the "high initial information load" group (55.00%); $U = 246.50$, $z = -3.73$, $p < .001$, $r = -.47$. Additional details can be found in the appendix (Tables 25–27).

Investigating the effect of providing six additional information cues (within subjects factor) separately for each group using a Wilcoxon Signed Ranks test, shows that the effect was significant only for the "low initial information load group," and only for decision confidence (first step decision: *Mdn* = 7.00, second step decision, *Mdn* = 6.00, $z = -3.60$, $p < .001$, $r = .-45$), but not for decision accuracy (first step decision: *Mdn* = 100.00%, second step decision: *Mdn* = 100.00%, $z = -1.81$, $p = .071$, $r = -.23$). Details can be found in the appendix (Tables 28–30).

Process data collected from the experiment allow us to analyze how often subjects changed their ranking (by recording how often clicks on the respective buttons occurred). This data can be used as an additional indicator for decision confidence. On average, in the first step, participants in the "high initial information load" group changed their ranking more often ($M = 9.53$, $SE = 0.70$) than participants in the "low initial information load" group ($M = 6.91$, $SE = 0.36$). This difference was significant; $t(45.93) = 3.35$, $p = .002$;[11] indicating that in the first-step decision, subjects in the "high initial information load" condition felt more insecure with the rating they provided.[12] For the decision in the second step, the mean number of clicks was also higher for the "high initial information load" group ($M = 8.09$, $SE = 0.46$) than for the "low initial information load" group ($M = 7.13$, $SE = 0.37$). However, the difference was not statistically significant; $t(62) = 1.65$, $p = .103$.

[11] Robust *t*-test

[12] Not every rating change is necessarily reflected in clicks on the respective buttons. There is, however, no reason to suspect that subjects in the two groups should behave differently when making their choices.

5.3. Information Use and Decision-Making

Hypothesis 3 predicts that subjects in the "high initial information load" condition would spend less time viewing additional information; hypothesis 4 predicts that the number of information acquisitions would be lower for the "high initial information load" condition.

To analyze the process data obtained from the experiment, we first cleaned the data as proposed in Willemsen and Johnson (2011), eliminating information acquisitions that lasted less than 200 milliseconds.

The mean time spent viewing additional information and the number of information acquisitions was significantly higher for subjects in the "low initial information load" group. Subjects in the "high initial information load" condition also spent a significantly smaller percentage of the total time available looking at information. The additional number of information cues to be considered in step two of the decision was the same for the "high initial information load" condition and the "low initial information load" condition – they both received six additional performance indicators. As the information from the first step was also displayed, it might be that subjects who did not completely finish the task from the first step spent some additional time re-considering the information from the first step (see appendix with experimental materials for details on how the information was presented in the second step). Overall, these results support hypotheses 3 and 4 (see Table 10).

Table 10: Means and T-Test Process Data

Group Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	
Sum viewing time	High initial information load	32	163869.38	70364.10	12438.73	.002	**
	Low initial information load	32	216604.28	62367.70	11025.16		
No. of acquisitions	High initial information load	32	197.91	77.54	13.71	.009	**
	Low initial information load	32	251.13	79.23	14.01		
Ratio information viewing time to effort duration 2	High initial information load	32	0.23	0.10	0.02	.000	***
	Low initial information load	32	0.34	0.11	0.02		

To investigate hypotheses 5 and 6, we calculated an index to analyze confirmatory search behavior. This index considered the ranking subjects provided in step 1 and then classified each information acquisition as either confirmatory or non-confirmatory, based on the initial ranking. Depending on the decision in step 1, information cues could thus be classified as confirmatory for one subject and non-confirmatory for another subject. As described in the details for the scoring model to be applied, for each investment alternative, a ranking on each performance indicator could be derived (e.g., when company A was the 4th best company with regards to sales, it would receive rank "4"). Depending on the ranking in step 1, the absolute difference between the rank for the respective performance indicator and the initial ranking was calculated (e.g., when company A was placed on rank 1 in the second step, the difference would be 3). We then classified a difference of 0–2 as confirming and a difference of 3–5 as non-confirming. Two dummy variables were then computed to classify each information acquisition as either confirming or non-confirming. Aggregating the data for these dummy variables per subject, we calculated a ratio of confirming information acquisitions to total number of information acquisitions for each participant. As an individual benchmark for each subject, we used the ratio of confirming to total number of cells, which again depended on the initial ranking. A ratio for the duration each subject looked at confirming to total information cells was also calculated. Comparing the "balanced" benchmark ratio to the actual ratio (number of acquisitions and duration), it is possible to judge whether subjects exhibited confirmatory search behavior and, if they did, if this behavior differed between the two groups.[13]

Hypothesis 5 predicted that subjects would exhibit confirmatory search behavior, independent of the condition they were assigned to. However, the difference between the ratio of confirming to total information acquired and a balanced information acquisition was negative on average, both for the duration of viewing additional information (confirmation bias duration) and for the number of information acquisitions (confirmation bias acquisitions). The hypothesis that subjects prefer viewing confirming information can thus not be supported by the data from the task used in the experiment (see Table 11 for the results of a one-sample *t*-test).

[13] An alternative measure to test confirmatory information acquisition was additionally used that did not use dummy variables, but the absolute deviations. Also, this measure did not differ significantly between the two groups.

Table 11: T-Test Confirmation Bias

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Confirmation bias duration dummy	64	-0.02	0.07	0.01	.050 *
Confirmation bias acquisitions dummy	64	-0.01	0.04	0.00	.141

Hypothesis 6 predicted that confirmatory search behavior would be more pronounced in the "high initial information load" condition. An independent samples *t*-test showed no significant differences between the two groups (see Table 12). Equally to hypothesis 5, hypothesis 6 is therefore not supported.

Table 12: T-Test Group Differences Confirmation Bias

Group Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Confirmation bias duration dummy	High initial information load	32	-0.02	0.09	0.02	.750
	Low initial information load	32	-0.02	0.06	0.01	
Confirmation bias acquisitions dummy	High initial information load	32	-0.01	0.05	0.01	.493
	Low initial information load	32	0.00	0.03	0.00	

5.4. Additional Analyses

Based on the ranking that subjects provided in each of the two decision steps, a measure for decision consensus was derived. Calculating Kendall's coefficient of concordance for each step indicated a significant measure for the two groups in each step. In both decision steps, consensus for the "low initial information" group was higher. The difference between experimental groups was more

pronounced in the initial decision (Table 13; $W = .26$, $p < .001$ for "high initial information load" vs. $W = .75$, $p < .001$ for "low initial information load") than in the final decision (Table 14; $W = .43$, $p < .001$ for "high initial information load" vs. $W = .61$, $p < .001$ for "low initial information load"). Similar to the pattern observed when analyzing decision confidence and decision accuracy, the difference between experimental groups decreased from the first to the second decision.

Table 13: Decision Consensus – Step 1

Test Statistics

High initial information load	N	32
	Kendall's W[a]	.26
	Chi-Square	40.89
	df	5
	Asymp. Sig.	.000
Low initial information load	N	32
	Kendall's W[a]	.75
	Chi-Square	120.57
	df	5
	Asymp. Sig.	.000

a. Kendall's Coefficient of Concordance

Table 14: Decision Consensus – Step 2

Test Statistics

High initial information load	N	32
	Kendall's W[a]	.43
	Chi-Square	68.34
	df	5
	Asymp. Sig.	.000
Low initial information load	N	32
	Kendall's W[a]	.61
	Chi-Square	97.00
	df	5
	Asymp. Sig.	.000

a. Kendall's Coefficient of Concordance

In addition to the main variables of interest described above, we gathered data on time pressure, effort intensity, effort duration, task complexity, feeling of overload, and estimated performance (to investigate whether subjects exhibited overconfidence). Table 15 shows the means for the above

variables and the results of a two-sided *t*-test for differences between the "high initial information load" and the "low initial information load" groups, where "1" refers to the initial decision in step 1 and "2" refers to the final decision (step 2). For step 1, effort intensity and effort duration (in mins),[14] the feeling of overload, and time pressure were significantly higher for the "high initial information load" group. Perceived task complexity was slightly higher for the "high initial information load" group, but the difference between means was only marginally significant. The task complexity score was calculated as the sum of the three items.[15] Although Cronbach's Alpha would have been improved from .765 to .799 by deleting the third item for the task complexity scale for the second step of the decision, it would have deteriorated from .681 to .676 for the scale in the first step. We therefore included all items for both steps.

For the decision in the second step, the distance between the two groups for the ratings of the variables shrank. Differences between the means for effort duration and the feeling of overload were only marginally significant. There was no statistically significant difference between the two experimental groups for effort intensity, time pressure, and perceived task complexity.

Subjects also provided a relatively realistic estimate ("estimated percentage") of their performance in the second step of the task. Subjects in the "high initial information load" group estimated their performance to be significantly lower than did subjects in the "low initial information load" group. Overconfidence, calculated as the difference between estimated performance and actual performance, was not different from 0 (results not tabulated here), and did not differ between groups (see Table 15).[16]

[14] For both decision steps, few subjects used more than the allocated 15 mins, mostly between 15–17 mins. One subject took 18.6 mins. As neither notes nor information set were visible after 15 mins had passed, subjects could not significantly improve decision accuracy with using slightly more time. Analysis was therefore done including all 64 subjects.

[15] Task complexity was measured on a 7-point Likert scale with items anchored by "difficult–easy," "complex–simple," and "varied–routine" (Scott & Erskine, 1980).

[16] Where Levene's test for equality of variances was significant, robust values are reported.

Table 15: Additional Analyses

Group Statistics

Group		N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	
Effort intensity 1	High initial information load	32	5.31	0.93	0.16	.007	**
	Low initial information load	32	4.44	1.48	0.26		
Effort duration 1	High initial information load	32	14.84	1.74	0.31	.000	***
	Low initial information load	32	7.35	1.88	0.33		
Overload 1	High initial information load	32	4.22	1.50	0.26	.000	***
	Low initial information load	32	2.16	1.11	0.20		
Time pressure 1	High initial information load	32	5.91	1.15	0.20	.000	***
	Low initial information load	32	3.03	1.58	0.28		
Score task complexity 1	High initial information load	32	9.84	3.47	0.61	.082	
	Low initial information load	32	8.28	3.59	0.64		
Effort intensity 2	High initial information load	32	5.06	1.05	0.18	1.000	
	Low initial information load	32	5.06	1.39	0.25		
Effort duration 2	High initial information load	32	12.40	3.44	0.61	.093	
	Low initial information load	32	11.08	2.74	0.48		
Overload 2	High initial information load	32	4.50	1.46	0.26	.083	
	Low initial information load	32	3.91	1.23	0.22		
Time pressure 2	High initial information load	32	4.69	1.87	0.33	.528	
	Low initial information load	32	4.41	1.66	0.29		
Score task complexity 2	High initial information load	32	10.28	4.28	0.76	.315	
	Low initial information load	32	11.31	3.86	0.68		
Overconfidence	High initial information load	32	0.81	28.66	5.07	.533	
	Low initial information load	32	4.92	23.43	4.14		
Estimated percentage	High initial information load	32	60.50	24.72	4.37	.000	***
	Low initial information load	32	89.81	10.59	1.87		

Final decision accuracy was likely to have been impacted by the decision accuracy in step 1. An additional factor influencing final decision accuracy might have been the attention subjects paid to the additional information available. The total viewing time and the number of information acquisitions can be considered a measure of attention to the information provided (Willemsen & Johnson, 2011). Looking at partial correlations between the score for decision accuracy in step 2 and the variables for information acquisition (viewing time and number of acquisitions), while controlling for the score for decision accuracy in step 1, we found the following pattern (see Table 16): as expected, decision accuracy in step 1 significantly correlated with decision accuracy in step 2. However, the number of information acquisitions correlated positively with final decision accuracy even after controlling for the decision accuracy in step 1, indicating that the more often subjects looked at the information cues presented, the higher the final decision accuracy. There was no significant correlation between total viewing time and final decision accuracy.

Table 16: Partial Correlations Across Both Experimental Groups

Correlations

Control Variables			Score decision quality 2	Sum viewing time	No. of acquisitions	Score decision quality 1
-none-[a]	Score decision quality 2	Correlation	1.00	.40	.56	.72
		Significance (2-tailed)		.001	.000	.000
		df	0	62	62	62
	Sum viewing time	Correlation	.40	1.00	.74	.47
		Significance (2-tailed)	.001		.000	.000
		df	62	0	62	62
	No. of acquisitions	Correlation	.56	.74	1.00	.56
		Significance (2-tailed)	.000	.000		.000
		df	62	62	0	62
	Score decision quality 1	Correlation	.72	.47	.56	1.00
		Significance (2-tailed)	.000	.000	.000	
		df	62	62	62	0
Score decision quality 1	Score decision quality 2	Correlation	1.00	.11	.27	
		Significance (2-tailed)		.406	.032	
		df	0	61	61	
	Sum viewing time	Correlation	.11	1.00	.65	
		Significance (2-tailed)	.406		.000	
		df	61	0	61	
	No. of acquisitions	Correlation	.27	.65	1.00	
		Significance (2-tailed)	.032	.000		
		df	61	61	0	

a. Cells contain zero-order (Pearson) correlations.

Repeating this analysis separately for the "low initial information load" group and the "high initial information load" group, we see that the effect of the number of acquisitions on decision accuracy stemmed mainly from the "low initial information load" group (see appendix, Table 31). Controlling for the effect of the decision accuracy in step 1, we see that for the "high initial information load" group, the correlation between number of acquisitions and final decision accuracy was non-significant

and low (r = .05, p = .806). For the "low initial information load" group, the correlation was positive and significant (r = .45, p = .011).

As described above, in the post-experimental questionnaire, we asked participants to select the performance indicators they would demand for a standard reporting. There was no significant difference between the number of performance indicators selected between the two groups (results not tabulated). This indicates that, in our setting, working with many versus few performance indicators during the task did not translate into a general tendency to demand more information.

6. Discussion

The results provide insights into the effects of increases in information load in sequential investment decision-making. Process data suggest how an increased information load influences information acquisition in subsequent stages of the decision at hand.

Overall, the results support hypotheses 1 and 2, which predicted decision accuracy and decision confidence to be higher in the "low initial information load" group. The results also support hypotheses 3 and 4, which predicted that subjects in the "high initial information load" group would spend less time viewing additional information and that the number of information acquisitions (uncovering a box to view the performance indicator) would be lower. The hypotheses relating to confirmatory search behavior (5 and 6) are not supported by the data. Decision consensus, as a supplementary indicator for decision quality, was shown to decline with increased information load.

Regarding the effects on decision accuracy, we confirm the findings of Hirsch and Volnhals (2012): increased information load resulted in a decrease in decision accuracy. Even after familiarization with the scoring model to be employed (which was not the case in the original experiment by Hirsch & Volnhals, 2012), subjects were prone to information overload effects, resulting in a deterioration in decision accuracy.

In our experimental task, we used a structured decision with a clear right or wrong answer, which provided us with an unambiguous measure for decision accuracy that could be used as a basis for the performance-based payment subjects received. In practice, however, most decision problems are likely to be unstructured (Iselin, 1993). Unstructured tasks can be considered more complex (e.g., Bonner & Sprinkle, 2002; Wood, 1986). The results reported above would likely be more extreme in an unstructured task and thus constitute a lower bound for the effects observed.

The results show that additional information was processed differently depending on the information that was already available – subjects receiving a high number of information cues in the first step devoted less attention to additional information.

In addition to the effect on the way information was used and the resulting effect on decision accuracy, subjects' decision confidence was impacted differently by the provision of the additional information. Whereas the measure declined for the "low initial information load" group, it increased for the "high initial information load group." Subjects in the "low initial information load" group needed to consider four different attributes in the first step and ten different attributes in the second step (increase by six attributes), while subjects in the "high initial information load" group dealt with 14 attributes in the first step and 20 attributes in the second step (also an increase by six attributes). As such, the increase in information load was relatively higher for the "low initial information load" group than for the "high initial information load" group. Therefore, the development of the two groups' mean decision confidence in opposite directions could be due to some sort of contrast effect. Another possible explanation could be a learning effect occurring between the first and second rating of investment alternatives, assuming that subjects in the high initial information load group were better trained due to the higher information load in the first step of the decision. Training effects have been observed by Iselin (1988, 1989, 1990). Miller and Gordon (1975) highlight Schroder et al. (1967)'s findings, indicating that individuals' conceptual levels (and thus their ability to integrate information) are not fixed, but can develop over time. Whether this can occur in such a short time frame warrants further investigation.

The hypotheses regarding confirmatory search behavior were not supported. A possible explanation is the type of task that was employed. The structured task used required subjects to follow a clearly defined calculation rule that was based on including every information cue available. Subjects were therefore likely to have followed a more mechanical information acquisition approach, not evaluating which cues confirmed or disconfirmed the rating in the first step.

Additional analysis showed decision consensus to be higher for the "low initial information load" group. Extant research investigating the effects of increases in information load on consensus has also found negative effects when information load increases (Abdel-Khalik, 1973; Stocks & Harrell, 1995) or has not found consensus to be related to information load (Chewning & Harrell, 1990; Shields, 1983; Stocks & Tuttle, 1998).

Some caution must be exercised – the experimental task was designed to investigate the research questions at hand, analyzing individual decision-making for a structured task with a presentation format allowing for use of the MouselabWEB functionalities. Investment decision-making in an organizational context is likely to involve interactions in the organization and different presentation formats of the relevant performance indicators. Nevertheless, the effects on individual decision-making observed here provide some valuable indicators as to how increases in information load influence decision accuracy, confidence and information use. When translating the results into practice, management accountants should continue to be aware of how supplying too much

information negatively affects decision accuracy, especially when the time for analysis is limited. When information is provided sequentially to decision-makers, one should bear in mind that the attention devoted to new information might differ depending on the information already analyzed in a first step of the decision. Decision-makers react differently to new information input and might not pay sufficient attention to new performance indicators that become available after a substantial amount of information has already been analyzed.

References

Abdel-Khalik, A. R. (1973). The effect of aggregating accounting reports on the quality of the lending decision: An empirical investigation. *Journal of Accounting Research*, *11*, 104.

Ackoff, R. L. (1967). Management Misinformation Systems. *Management Science*, *14*(4), B147-B156.

Agnew, J. R., & Szykman, L. R. (2005). Asset allocation and information overload: The influence of information display, asset choice, and investor experience. *Journal of Behavioral Finance*, *6*(2), 57–70.

Andersson, P. (2004). Does experience matter in lending? A process-tracing study on experienced loan officers' and novices' decision behavior. *Journal of Economic Psychology*, *25*(4), 471–492.

Asare, S. K. (1992). The auditor's going-concern decision: Interaction of task variables and the sequential processing of evidence. *The Accounting Review*, *67*(2), 379–393.

Ashton, A. H., & Ashton, R. H. (1988). Sequential belief revision in auditing. *The Accounting Review*, *63*(4), 623–641.

Bamber, E. M., Ramsay, R. J., & Tubbs, R. M. (1997). An examination of the descriptive validity of the belief-adjustment model and alternative attitudes to evidence in auditing. *Accounting, Organizations and Society*, *22*(3–4), 249–268.

Barefield, R. M. (1972). The effect of aggregation on decision making success: A laboratory study. *Journal of Accounting Research*, *10*(2), 229-242.

Baumeister, R. F., & Vohs, K. D. (2007). Self-regulation, ego depletion, and motivation. *Social and Personality Psychology Compass*, *1*(1), 115–128.

Blanca, M. J., Alarcón, R., Arnau, J., Bono, R., & Bendayan, R. (2018). Effect of variance ratio on ANOVA robustness: Might 1.5 be the limit? *Behavior research methods*, *50*(3), 937–962.

Bogan, V., & Just, D. (2009). What drives merger decision making behavior? Don't seek, don't find, and don't change your mind. *Journal of Economic Behavior & Organization*, *72*(3), 930–943.

Bonner, S. E., & Sprinkle, G. B. (2002). The effects of monetary incentives on effort and task performance: theories, evidence, and a framework for research. *Accounting, Organizations and Society*, *27*(4-5), 303–345.

Casey, C. J. (1980). Variation in accounting information load: The effect on loan officers' predictions of bankruptcy. *The Accounting Review*, *55*(1), 36–49.

Chervany, N. L., & Dickson, G. W. (1974). An experimental evaluation of information overload in a production environment. *Management Science*, *20*(10), 1335–1344.

Chewning, E. G., & Harrell, A. M. (1990). The effect of information load on decision makers' cue utilization levels and decision quality in a financial distress decision task. *Accounting, Organizations and Society*, *15*(6), 527–542.

Chung, J., & Monroe, G. (2000). The effects of experience and task difficulty on accuracy and confidence assessments of auditors. *Accounting and Finance*, *40*(2), 135–151.

Demski, J., & Feltham, G. (1976). *Cost determination: a conceptual approach*. Ames, Iowa: Iowa State University Press.

Dillard, J. F., Kauffman, N. L., & Spires, E. E. (1991). Evidence order and belief revision in management accounting decisions. *Accounting, Organizations and Society*, *16*(7), 619–633.

Einhorn, H. J., Kleinmuntz, D. N., & Kleinmuntz, B. (1979). Linear regression and process-tracing models of judgment. *Psychological Review*, *86*(5), 465–485.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive–experiential and analytical–rational thinking styles. *Journal of Personality and Social Psychology*, *71*(2), 390–405.

Fertakis, J. P. (1969). On communication, understanding, and relevance in accounting reporting. *The Accounting Review*, *44*(4), 680–691.

Fessler, N. J. (2003). Experimental evidence on the links among monetary incentives, task attractiveness, and task performance. *Journal of Management Accounting Research*, *15*(1), 161–176.

Festinger, L. (1957). *A theory of cognitive dissonance*: *Mass communication series* (Vol. 2). Stanford, Calif: Stanford University Press.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics: And sex and drugs and rock 'n' roll* (4th ed.). Thousand Oaks, California: Sage Publications.

Fischer, P., Frey, D., & Greitemeyer, T. (2008). Self-regulation and selective exposure: The impact of depleted self-regulation resources on confirmatory information processing. *Journal of Personality & Social Psychology*, *94*(3), 382–395.

Ford, J. K., Schmitt, N., Schechtman, S. L., Hults, B. M., & Doherty, M. L. (1989). Process tracing methods: Contributions, problems, and neglected research questions. *Organizational Behavior and Human Decision Processes*, *43*(1), 75–117.

Gibbins, M. (1984). Propositions about the psychology of professional judgment in public accounting. *Journal of Accounting Research*, *22*(1), 103.

Glöckner, A., & Herbold, A.-K. (2011). An eye-tracking study on information processing in risky decisions: Evidence for compensatory strategies based on automatic processes. *Journal of Behavioral Decision Making*, *24*(1), 71–98.

Glover, S. M. (1997). The influence of time pressure and accountability on auditors' processing of nondiagnostic information. *Journal of Accounting Research*, *35*(2), 213–226.

Hirsch, B., & Volnhals, M. (2012). Information Overload im betrieblichen Berichtswesen – ein unterschätztes Phänomen. *Die Betriebswirtschaft*, *72*(1), 23–55.

Hogarth, R. M., & Einhorn, H. J. (1992). Order effects in belief updating: The belief-adjustment model. *Cognitive Psychology*, *24*(1), 1–55.

Huber, O., Wider, R., & Huber, O. W. (1997). Active information search and complete information presentation in naturalistic risky decision tasks. *Acta Psychologica*, *95*(1), 15–29.

Iselin, E. R. (1988). The effects of information load and information diversity on decision quality in a structured decision task. *Accounting, Organizations and Society*, *13*(2), 147–164.

Iselin, E. R. (1989). The impact of information diversity on information overload effects in unstructured managerial decision making. *Journal of Information Science*, *15*(3), 163–173.

Iselin, E. R. (1990). Information, uncertainty and managerial decision quality: an experimental investigation. *Journal of Information Science*, *16*(4), 239–248.

Iselin, E. R. (1993). The effects of the information and data properties of financial ratios and statements on managerial decision quality. *Journal of Business Finance & Accounting*, *20*(2), 249–266.

Jonas, E., Schulz-Hardt, S., Frey, D., & Thelen, N. (2001). Confirmation bias in sequential information search after preliminary decisions: An expansion of dissonance theoretical research on selective exposure to information. *Journal of Personality and Social Psychology*, *80*(4), 557–571.

Kahle, J., Pinsker, R., & Pennington, R. (2005). Belief revision in accounting: A literature review of the belief-adjustment Model. In *Advances in Accounting Behavioral Research* (Vol. 8, pp. 1–40). Bingley, UK: Emerald Group Publishing Limited.

Keller, J., Bohner, G., & Erb, H.-P. (2000). Intuitive und heuristische Urteilsbildung – verschiedene Prozesse? *Zeitschrift für Sozialpsychologie*, *31*(2), 87–101.

Kelley, C. M., & Lindsay, D. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language*, *32*(1), 1–24.

Luft, J., & Shields, M. D. (2010). Psychology models of management accounting. *Foundations and Trends in Accounting*, *4*(3–4), 199–345.

McMillan, J. J., & White, R. A. (1993). Auditors' belief revisions and evidence search: The effect of hypothesis frame, confirmation bias, and professional skepticism. *The Accounting Review*, *68*(3), 443–465.

Miller, D., & Gordon, L. A. (1975). Conceptual levels and the design of accounting information systems. *Decision Sciences*, *6*(2), 259–269.

Miller, H. (1972). Environmental complexity and financial reports. *The Accounting Review*, *47*(1), 31–37.

Norman, R. (1975). Affective-cognitive consistency, attitudes, conformity, and behavior. *Journal of Personality and Social Psychology*, *32*(1), 83–91.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. New York, NY: Cambridge University Press.

Payne, J. W., & Venkatraman, V. (2011). Opening the black box: Conclusions to a handbook of process tracing methods for decision research. In M. Schulte-Mecklenbeck, A. Kühberger & J. G. Johnson (Eds.), *A handbook of process tracing methods for decision research. A critical review and user's guide* (pp. 223–249). New York, NY: Psychology Press.

Reisen, N., & Hoffrage, U. M. F. W. (2008). Identifying decision strategies in a consumer choice situation. *Judgment and Decision Making*, *3*(8), 641–658.

Riedl, R. (2006). Analytischer Hierarchieprozess vs. Nutzwertanalyse: Eine vergleichende Gegenüberstellung zweier multiattributiver Auswahlverfahren am Beispiel Application Service Providing. In K. Fink & C. Ploder (Eds.), *Wirtschaftsinformatik als Schlüssel zum Unternehmenserfolg* (pp. 99–127). Wiesbaden, Germany: DUV.

Saunders, C., & Jones, J. W. (1990). Temporal sequences in information acquisition for decision making: A focus on source and medium. *The Academy of Management Review*, *15*(1), 29–46.

Schick, A. G., Gordon, L. A., & Haka, S. (1990). Information overload: A temporal approach. *Accounting, Organizations and Society*, *15*(3), 199–220.

Schmeichel, B. J., Vohs, K. D., & Baumeister, R. F. (2003). Intellectual performance and ego depletion: Role of the self in logical reasoning and other information processing. *Journal of Personality and Social Psychology*, *85*(1), 33–46.

Schroder, H., Driver, M., & Streufert, S. (1967). *Human Information Processing*. New York, NY: Holt, Rinehard & Winston.

Shepard, R.N. (1964). On subjectively optimum selection among multi-attribute alternatives. In M.W. Shelley & G. L. Bryan (Eds.), *Human judgments and optimality* (pp. 257–281). New York, NY: Wiley.

Scott, W., & Erskine, J. (1980). The effects of variations in task design and monetary reinforcers on task behavior. *Organizational Behavior and Human Performance*, *25*(3), 311–335.

Shields, M. D. (1980). Some effects on information load on search patterns used to analyze performance reports. *Accounting, Organizations and Society*, *5*(4), 429–442.

Shields, M. D. (1983). Effects of information supply and demand on judgment accuracy: Evidence from corporate managers. *The Accounting Review*, *58*(2), 284–303.

Simnett, R. (1996). The effect of information selection, information processing and task complexity on predictive accuracy of auditors. *Accounting, Organizations and Society*, *21*(7-8), 699–719.

Snowball, D. (1980). Some effects of accounting expertise and information load: An empirical study. *Accounting, Organizations and Society*, *5*(3), 323–338.

Sprinkle, G. B. (2003). Perspectives on experimental research in managerial accounting. *Accounting, Organizations and Society*, *28*(2-3), 287–318.

Stocks, M. H., & Harrell, A. (1995). The impact of an increase in accounting information level on the judgment quality of individuals and groups. *Accounting, Organizations and Society*, *20*(7–8), 685–700.

Stocks, M. H., & Tuttle, B. (1998). An examination of information presentation effects on financial distress predictions. In S. G. Sutton (Ed.), *Advances in accounting information systems* (Vol. 6.) (pp. 107–128). Stamford, Conn.: JAI Press.

Swain, M. R., & Haka, S. F. (2000). Effects of information load on capital budgeting decisions. *Behavioral Research in Accounting*, *12*, 171–198.

Volnhals, M. (2010). *Information Overload und Controlling: Analyse kognitiver Restriktionen bei der Wahrnehmung von Berichtsinformationen*.Hamburg, Germany: Kovač.

Weber, E. U., & Johnson, E. J. (2009). Mindful judgment and decision making. *Annual Review of Psychology*, *60*(1), 53–85.

Willemsen, M. C., & Johnson, E. J. (2011). Visiting the decision factory: observing cognition with MouselabWEB and other information acquisition methods. In M. Schulte-Mecklenbeck, A. Kuehberger & J. G. Johnson (Eds.), *A handbook of process tracing methods for decision research. A critical review and user's guide.* New York, NY: Psychology Press.

Witteman, C., Van den Bercken, J., Claes, L., & Godoy, A. (2009). Assessing rational and intuitive thinking styles. *European Journal of Psychological Assessment*, *25*(1), 39–47.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes*, *37*(1), 60–82.

Yeo, G., & Neal, A. (2008). Subjective cognitive effort: A model of states, traits, and time. *Journal of Applied Psychology*, *93*(3), 617–631.

Zellman, E., Kaye-Blake, W., & Abell, W. (2010). Identifying consumer decision-making strategies using alternative methods. *Qualitative Market Research: An International Journal*, *13*(3), 271–286.

Appendix 1: Additional Tables and Figures

Abbreviations for variables used in the following tables:

- Score decision quality 1(2): decision accuracy in step 1(2) of the decision
- dec_conf: decision confidence
- dec_acc: decision accuracy
- NFC_Score: score for "need for cognition"
- FI_Score: score for "faith in intuition"
- condnum_keep: between subjects factor: initial information load (high vs. low)
- add_info: within subjects factor, provision of additional information cues in the second step of the decision

Table 17: Number of Subjects by Group and Session

Number of Subjects by Group and Session

		Group		
		High initial information load	Low initial information load	Total
Session	1 - 07 January 2015 13:00-14:00	9	12	21
	2 - 12 January 2015 11:00-12:00	4	2	6
	3 - 12 January 2015 13:00-14:00	10	9	19
	4 - 13 January 2015 11:00-12:00	7	6	13
	5 - 04 February 2015 13:00-14:00	2	3	5
	Total	32	32	64

Table 18: Number of Subjects by Group and Order

Number of Subjects by Group and Order

		Group		
		High initial information load	Low initial information load	Total
Order	Normal	16	16	32
	Reversed	16	16	32
	Total	32	32	64

Table 19: Repeated measures MANCOVA – Descriptives

Descriptive Statistics

Group		Mean	Std. Deviation	N
Decision confidence 1	High initial information load	3.41	1.68	32
	Low initial information load	6.34	1.23	32
	Total	4.88	2.08	64
Decision confidence 2	High initial information load	4.00	1.74	32
	Low initial information load	5.41	1.24	32
	Total	4.70	1.66	64
Score decision quality 1	High initial information load	0.56	0.24	32
	Low initial information load	0.91	0.21	32
	Total	0.74	0.28	64
Score decision quality 2	High initial information load	0.60	0.24	32
	Low initial information load	0.85	0.25	32
	Total	0.72	0.27	64

Table 20: Repeated Measures MANCOVA – Box's Test

Box's Test of Equality of Covariance Matrices[a]

Box's M	12.07
F	1.12
df1	10
df2	18377.69
Sig.	.340

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + NFC_Score + FI_Score + condnum_keep
Within Subjects Design: add_info

Table 21: Repeated Measures MANCOVA – Bartlett's Test

Bartlett's Test of Sphericity[a]

Effect		Likelihood Ratio	Approx. Chi-Square	df	Sig.
Between Subjects		.000	127.77	2	.000
Within Subjects	add_info	.000	180.11	2	.000

Tests the null hypothesis that the residual covariance matrix is proportional to an identity matrix.

a. Design: Intercept + NFC_Score + FI_Score + condnum_keep
Within Subjects Design: add_info

Table 22: Repeated measures MANCOVA – Multivariate Tests

Multivariate Tests[a]

Effect			Value	F	Hypo-thesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Between Subjects	Intercept	Pillai's Trace	.46	24.90[b]	2	59	.000	.46	49.77	100.00%
		Wilks' Lambda	.54	24.90[b]	2	59	.000	.46	49.77	100.00%
		Hotelling's Trace	.84	24.90[b]	2	59	.000	.46	49.77	100.00%
		Roy's Largest Root	.84	24.90[b]	2	59	.000	.46	49.77	100.00%
	NFC_ Score	Pillai's Trace	.06	1.91[b]	2	59	.157	.06	3.82	38.13%
		Wilks' Lambda	.94	1.91[b]	2	59	.157	.06	3.82	38.13%
		Hotelling's Trace	.06	1.91[b]	2	59	.157	.06	3.82	38.13%
		Roy's Largest Root	.06	1.91[b]	2	59	.157	.06	3.82	38.13%
	FI_Score	Pillai's Trace	.04	1.20[b]	2	59	.309	.04	2.39	25.20%
		Wilks' Lambda	.96	1.20[b]	2	59	.309	.04	2.39	25.20%
		Hotelling's Trace	.04	1.20[b]	2	59	.309	.04	2.39	25.20%
		Roy's Largest Root	.04	1.20[b]	2	59	.309	.04	2.39	25.20%
	condnum_ keep	Pillai's Trace	.53	32.71[b]	2	59	.000	.53	65.41	100.00%
		Wilks' Lambda	.47	32.71[b]	2	59	.000	.53	65.41	100.00%
		Hotelling's Trace	1.11	32.71[b]	2	59	.000	.53	65.41	100.00%
		Roy's Largest Root	1.11	32.71[b]	2	59	.000	.53	65.41	100.00%

- continued on next page -

Multivariate Tests[a]

Effect			Value	F	Hypo-thesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Within Subjects	add_info	Pillai's Trace	.01	.19[b]	2	59	.824	.01	.39	7.89%
		Wilks' Lambda	.99	.19[b]	2	59	.824	.01	.39	7.89%
		Hotelling's Trace	.01	.19[b]	2	59	.824	.01	.39	7.89%
		Roy's Largest Root	.01	.19[b]	2	59	.824	.01	.39	7.89%
	add_info * NFC_ Score	Pillai's Trace	.04	1.15[b]	2	59	.323	.04	2.30	24.38%
		Wilks' Lambda	.96	1.15[b]	2	59	.323	.04	2.30	24.38%
		Hotelling's Trace	.04	1.15[b]	2	59	.323	.04	2.30	24.38%
		Roy's Largest Root	.04	1.15[b]	2	59	.323	.04	2.30	24.38%
	add_info * FI_Score	Pillai's Trace	.01	.32[b]	2	59	.731	.01	.63	9.78%
		Wilks' Lambda	.99	.32[b]	2	59	.731	.01	.63	9.78%
		Hotelling's Trace	.01	.32[b]	2	59	.731	.01	.63	9.78%
		Roy's Largest Root	.01	.32[b]	2	59	.731	.01	.63	9.78%
	add_info * condnum_keep	Pillai's Trace	.17	5.90[b]	2	59	.005	.17	11.80	85.95%
		Wilks' Lambda	.83	5.90[b]	2	59	.005	.17	11.80	85.95%
		Hotelling's Trace	.20	5.90[b]	2	59	.005	.17	11.80	85.95%
		Roy's Largest Root	.20	5.90[b]	2	59	.005	.17	11.80	85.95%

a. Design: Intercept + NFC_Score + FI_Score + condnum_keep
Within Subjects Design: add_info
b. Exact statistic

c. Computed using alpha = .05

Table 23: Repeated measures MANCOVA – Mauchly's Test

Mauchly's Test of Sphericity[a]

Within Subjects Effect		Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
add_info	decision_conf	1.00	0.00	0		1.00	1.00	1.00
	decision_acc	1.00	0.00	0		1.00	1.00	1.00

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.
a. Design: Intercept + NFC_Score + FI_Score + condnum_keep
Within Subjects Design: add_info
b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Table 24: Repeated measures MANCOVA – Univariate Tests

Univariate Tests

Source			Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
add_info	decision_conf	Sphericity Assumed	.04	1	.04	.02	.879	.00	.02	5.26%
		Greenhouse-Geisser	.04	1	.04	.02	.879	.00	.02	5.26%
		Huynh-Feldt	.04	1	.04	.02	.879	.00	.02	5.26%
		Lower-bound	.04	1	.04	.02	.879	.00	.02	5.26%
	decision_acc	Sphericity Assumed	.01	1	.01	.39	.532	.01	.39	9.48%
		Greenhouse-Geisser	.01	1	.01	.39	.532	.01	.39	9.48%
		Huynh-Feldt	.01	1	.01	.39	.532	.01	.39	9.48%
		Lower-bound	.01	1	.01	.39	.532	.01	.39	9.48%
add_info * NFC_Score	decision_conf	Sphericity Assumed	2.61	1	2.61	1.64	.206	.03	1.64	24.23%
		Greenhouse-Geisser	2.61	1	2.61	1.64	.206	.03	1.64	24.23%
		Huynh-Feldt	2.61	1	2.61	1.64	.206	.03	1.64	24.23%
		Lower-bound	2.61	1	2.61	1.64	.206	.03	1.64	24.23%
	decision_acc	Sphericity Assumed	.00	1	.00	.19	.663	.00	.19	7.15%
		Greenhouse-Geisser	.00	1	.00	.19	.663	.00	.19	7.15%
		Huynh-Feldt	.00	1	.00	.19	.663	.00	.19	7.15%
		Lower-bound	.00	1	.00	.19	.663	.00	.19	7.15%
add_info * FI_Score	decision_conf	Sphericity Assumed	1.02	1	1.02	.64	.428	.01	.64	12.31%
		Greenhouse-Geisser	1.02	1	1.02	.64	.428	.01	.64	12.31%
		Huynh-Feldt	1.02	1	1.02	.64	.428	.01	.64	12.31%
		Lower-bound	1.02	1	1.02	.64	.428	.01	.64	12.31%
	decision_acc	Sphericity Assumed	.00	1	.00	.08	.775	.00	.08	5.92%
		Greenhouse-Geisser	.00	1	.00	.08	.775	.00	.08	5.92%
		Huynh-Feldt	.00	1	.00	.08	.775	.00	.08	5.92%
		Lower-bound	.00	1	.00	.08	.775	.00	.08	5.92%

- continued on next page -

Univariate Tests

Source			Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
add_info * condnum_keep	decision_conf	Sphericity Assumed	17.30	1	17.30	10.83	.002	.15	10.83	89.93%
		Greenhouse-Geisser	17.30	1	17.30	10.83	.002	.15	10.83	89.93%
		Huynh-Feldt	17.30	1	17.30	10.83	.002	.15	10.83	89.93%
		Lower-bound	17.30	1	17.30	10.83	.002	.15	10.83	89.93%
	decision_acc	Sphericity Assumed	0.08	1	0.08	3.92	.052	.06	3.92	49.58%
		Greenhouse-Geisser	0.08	1	0.08	3.92	.052	.06	3.92	49.58%
		Huynh-Feldt	0.08	1	0.08	3.92	.052	.06	3.92	49.58%
		Lower-bound	0.08	1	0.08	3.92	.052	.06	3.92	49.58%
Error (add_info)	decision_conf	Sphericity Assumed	95.86	60	1.60					
		Greenhouse-Geisser	95.86	60	1.60					
		Huynh-Feldt	95.86	60	1.60					
		Lower-bound	95.86	60	1.60					
	decision_acc	Sphericity Assumed	1.27	60	0.02					
		Greenhouse-Geisser	1.27	60	0.02					
		Huynh-Feldt	1.27	60	0.02					
		Lower-bound	1.27	60	0.02					

a. Computed using alpha = .05

Table 25: Mann-Whitney Test – Descriptives

Descriptive Statistics

		N	Mean	Std. Deviation	Minimum	Maximum	Median
High initial information load	Decision confidence 1	32	3.41	1.68	1.00	6.00	3.00
	Decision confidence 2	32	4.00	1.74	1.00	7.00	4.00
	Score decision quality 1	32	0.56	0.24	0.23	1.00	0.48
	Score decision quality 2	32	0.60	0.24	0.27	1.00	0.55
Low initial information load	Decision confidence 1	32	6.34	1.23	1.00	7.00	7.00
	Decision confidence 2	32	5.41	1.24	3.00	7.00	6.00
	Score decision quality 1	32	0.91	0.21	0.20	1.00	1.00
	Score decision quality 2	32	0.85	0.25	0.20	1.00	1.00

Table 26: Mann-Whitney Test – Ranks

Ranks

Group		N	Mean Rank	Sum of Ranks
Decision confidence 1	High initial information load	32	18.91	605.00
	Low initial information load	32	46.09	1475.00
	Total	64		
Decision confidence 2	High initial information load	32	25.16	805.00
	Low initial information load	32	39.84	1275.00
	Total	64		
Score decision quality 1	High initial information load	32	21.59	691.00
	Low initial information load	32	43.41	1389.00
	Total	64		
Score decision quality 2	High initial information load	32	24.20	774.50
	Low initial information load	32	40.80	1305.50
	Total	64		

Table 27: Mann-Whitney Test – Test Statistics

Test Statistics[a]

	Decision confidence 1	Decision confidence 2	Score decision quality 1	Score decision quality 2
Mann-Whitney U	77.00	277.00	163.00	246.50
Wilcoxon W	605.00	805.00	691.00	774.50
Z	-5.97	-3.23	-4.98	-3.73
Asymp. Sig. (2-tailed)	.000	.001	.000	.000

a. Grouping Variable: Group

Table 28: Wilcoxon Signed Ranks Test – Descriptives

Descriptive Statistics

		N	Mean	Std. Deviation	Minimum	Maximum	Median
High initial information load	Decision confidence 1	32	3.41	1.68	1.00	6.00	3.00
	Score decision quality 1	32	0.56	0.24	0.23	1.00	0.48
	Decision confidence 2	32	4.00	1.74	1.00	7.00	4.00
	Score decision quality 2	32	0.60	0.24	0.27	1.00	0.55
Low initial information load	Decision confidence 1	32	6.34	1.23	1.00	7.00	7.00
	Score decision quality 1	32	0.91	0.21	0.20	1.00	1.00
	Decision confidence 2	32	5.41	1.24	3.00	7.00	6.00
	Score decision quality 2	32	0.85	0.25	0.20	1.00	1.00

Table 29: Wilcoxon Signed Ranks Test – Ranks

Ranks

Group			N	Mean Rank	Sum of Ranks
High initial information load	Decision confidence 2 - Decision confidence 1	Negative Ranks	5[a]	11.00	55.00
		Positive Ranks	14[b]	9.64	135.00
		Ties	13[c]		
		Total	32		
	Score decision quality 2 - Score decision quality 1	Negative Ranks	13[d]	12.12	157.50
		Positive Ranks	14[e]	15.75	220.50
		Ties	5[f]		
		Total	32		
Low initial information load	Decision confidence 2 - Decision confidence 1	Negative Ranks	22[a]	11.50	253.00
		Positive Ranks	1[b]	23.00	23.00
		Ties	9[c]		
		Total	32		
	Score decision quality 2 - Score decision quality 1	Negative Ranks	7[d]	8.86	62.00
		Positive Ranks	5[e]	3.20	16.00
		Ties	20[f]		
		Total	32		

a. Decision confidence 2 < Decision confidence 1

b. Decision confidence 2 > Decision confidence 1

c. Decision confidence 2 = Decision confidence 1

d. Score decision quality 2 < Score decision quality 1

e. Score decision quality 2 > Score decision quality 1

f. Score decision quality 2 = Score decision quality 1

Table 30: Wilcoxon Signed Ranks Test – Test Statistics

Test Statistics[a]

Group		Decision confidence 2 - Decision confidence 1	Score decision quality 2 - Score decision quality 1
High initial information load	Z	-1.63[b]	-.76[b]
	Asymp. Sig. (2-tailed)	.103	.449
Low initial information load	Z	-3.60[c]	-1.81[c]
	Asymp. Sig. (2-tailed)	.000	.071

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

Table 31: Partial Correlations Split by Experimental Groups

Correlations

Group				Score decision quality 2	Sum viewing time	No. of acquisi-tions	Score decision quality 1
High initial information load	-none-[a]	Score decision quality 2	Correlation	1.00	.12	.40	.67
			Significance (2-tailed)		.502	.023	.000
			df	0	30	30	30
		Sum viewing time	Correlation	.12	1.00	.78	.24
			Significance (2-tailed)	.502		.000	.181
			df	30	0	30	30
		No. of acquisitions	Correlation	.40	.78	1.00	.56
			Significance (2-tailed)	.023	.000		.001
			df	30	30	0	30
		Score decision quality 1	Correlation	.67	.24	.56	1.00
			Significance (2-tailed)	.000	.181	.001	
			df	30	30	30	0
	Score decision quality 1	Score decision quality 2	Correlation	1.00	-.05	.05	
			Significance (2-tailed)		.778	.806	
			df	0	29	29	
		Sum viewing time	Correlation	-.05	1.00	.80	
			Significance (2-tailed)	.778		.000	
			df	29	0	29	
		No. of acquisitions	Correlation	.05	.80	1.00	
			Significance (2-tailed)	.806	.000		
			df	29	29	0	

- continued on next page -

Correlations

Group				Score decision quality 2	Sum viewing time	No. of acquisi-tions	Score decision quality 1
Low initial information load	-none-[a]	Score decision quality 2	Correlation	1.00	.45	.57	.59
			Significance (2-tailed)		.010	.001	.000
			df	0	30	30	30
		Sum viewing time	Correlation	.45	1.00	.63	.42
			Significance (2-tailed)	.010		.000	.015
			df	30	0	30	30
		No. of acquisitions	Correlation	.57	.63	1.00	.39
			Significance (2-tailed)	.001	.000		.026
			df	30	30	0	30
		Score decision quality 1	Correlation	.59	.42	.39	1.00
			Significance (2-tailed)	.000	.015	.026	
			df	30	30	30	0
	Score decision quality 1	Score decision quality 2	Correlation	1.00	.28	.45	
			Significance (2-tailed)		.134	.011	
			df	0	29	29	
		Sum viewing time	Correlation	.28	1.00	.56	
			Significance (2-tailed)	.134		.001	
			df	29	0	29	
		No. of acquisitions	Correlation	.45	.56	1.00	
			Significance (2-tailed)	.011	.001		
			df	29	29	0	

a. Cells contain zero-order (Pearson) correlations.

Appendix 2: Experimental Materials

On the following pages, the original materials (in German, screenshots) are presented. Images have been resized to fit the layout of this dissertation.

1) Introduction and understanding of the task:

Sie nehmen heute an einer Studie zur Untersuchung des Entscheidungsverhaltens bei einer Investitionsentscheidung teil.
Aufbau der Studie: Sie erhalten eine Situationsbeschreibung und werden gebeten, die Vorteilhaftigkeit mehrerer vorgestellter Alternativen zu bewerten und anschließend gemäß Ihrer Bewertung eine Prioritäten-Reihenfolge zu erstellen. Im Anschluss muss ein Fragebogen ausgefüllt werden. Die Studie dauert insgesamt ungefähr 45-60 min.

Bitte stellen Sie während der Studie keine Fragen und verwenden Sie keine Hilfsmittel (z.B. Taschenrechner). Lesen Sie die Angaben aufmerksam durch und bearbeiten Sie die Aufgabe nach Ihrem besten Verständnis. Sie erhalten eine prozentual von der Vorteilhaftigkeit Ihres Investitionsrankings abhängige Prämie von bis zu 10 EUR (zusätzlich zu den 4 EUR, die Sie fix erhalten). Ihr Ergebnis sowie Ihre Auszahlung erhalten Sie am Ende der Studie.

Ihre Teilnahme an dieser Studie ist rein freiwillig und Sie können Ihre Teilnahme jederzeit abbrechen. Die Daten dieser Studie werden ausschließlich zum Zweck wissenschaftlicher Publikationen ausgewertet. Sämtliche Angaben werden streng vertraulich behandelt, vollständig anonym ausgewertet und nur in aggregierter Form wiedergegeben, sodass keinerlei Rückschlüsse auf individuelle Antworten möglich sind.

Mit der Teilnahme an dieser Studie erklären Sie sich bereit, dass die in dieser Studie erhobenen Daten in eine wissenschaftliche Analyse und in Publikationen mit eingehen.

Hinweise:

- Für das Treffen der Investitionsentscheidung soll das Verfahren der "Nutzwertanalyse" herangezogen werden, dieses wird auf der folgenden Seite kurz erläutert.
- In einem Teil der Studie sind Informationen auf dem Bildschirm hinter grauen "Boxen" verdeckt. Indem Sie den Mauszeiger über die Box führen, können Sie die verdeckte Information einsehen. Wenn Sie den Mauszeiger wieder wegbewegen, wird die Information wieder verdeckt.
- Um Sie mit dieser Funktionalität sowie der Bewertungsmethodik vertraut zu machen, finden Sie vor Beginn der eigentlichen Aufgabe zuerst eine kurze Übung.

Mit Klick auf "Ich bin einverstanden - Übung starten" gelangen Sie zur Beschreibung des Bewertungsverfahrens und im Anschluss zur Übung.

Ich bin einverstanden - Übung starten

Ich bin nicht einverstanden - Teilnahme abbrechen

Message for those deciding not to participate in the experiment:

Sie haben sich entschieden, nicht teilzunehmen.

Herzlichen Dank, dass Sie zum Labor gekommen sind. Sie können das Labor nun verlassen.

Explanation of the scoring model to be applied:

Erläuterung des Bewertungsverfahrens: Im Rahmen der Bewertung der Investitionsalternativen soll die sogenannte "Nutzwertanalyse" zum Einsatz kommen (im Englischen: "Scoring Model"). Die Nutzwertanalyse ist ein Verfahren zur Lösung eines Entscheidungsproblems, in dem mehrere Kriterien berücksichtigt werden müssen:

- Hierzu werden typischerweise pro Kriterium den einzelnen Alternativen Werte zugeordnet. Eine Möglichkeit ist es, hierfür eine ordinale Skala zu verwenden, sprich eine Rangfolge der Alternativen für jedes Kriterium zu bilden.
- Im Anschluss wird für jede Alternative ein Gesamtwert über alle Kriterien ermittelt. Sofern alle Kriterien gleichgewichtet werden sollen, kann auf die Zuordnung von Gewichten pro Kriterium verzichtet werden.

Das folgende **Beispiel** verdeutlicht das Vorgehen. Angenommen, Sie haben die Wahl zwischen 3 gebrauchten Automodellen ("Alternativen"). Ihnen liegen pro Modell 3 Informationen ("Kriterien") vor:

	Modell A	Modell B	Modell C
Preis	10.000 EUR	5.000 EUR	3.000 EUR
CO2-Ausstoß	132 g/km	90 g/km	140 g/km
Gefahrene km	80.000 km	100.000 km	150.000 km

Als erstes werden den unterschiedlichen Modellen Werte pro Kriterium gemäß der Rangfolge zugeordnet:

- Für das Kriterium "Preis" entsteht folgende Rangfolge:
  Platz 1 - Modell C (Wert=1), Platz 2 - Modell B (Wert=2), Platz 3 - Modell A (Wert=3)
- Für das Kriterium "CO2-Ausstoß" entsteht folgende Rangfolge:
  Platz 1 - Modell B (Wert=1), Platz 2 - Modell A (Wert=2), Platz 3 - Modell C (Wert=3)
- Für das Kriterium "Gefahrene km" entsteht folgende Rangfolge:
  Platz 1 - Modell A (Wert=1), Platz 2 - Modell B (Wert=2), Platz 3 - Modell C (Wert=3)

Zur **Ermittlung der optimalen Entscheidung** ergibt sich in diesem Beispiel mit Gleichgewichtung der Kriterien über ein Aufsummieren der Werte folgendes Ergebnis:

- Für das Modell A ein Wert von 3+2+1=**6**
- Für das Modell B ein Wert von 2+1+2=**5**
- Für das Modell C ein Wert von 1+3+3=**7**

Das beste Modell ist die Alternative mit der geringsten Summe. Die resultierende Rangfolge ist somit B>A>C.

Mit Klick auf "Weiter" gelangen Sie zu einer kurzen Übung.

Weiter

Exercise to verify understanding of scoring model:

Dies ist eine **Übungsseite**. Indem Sie den Mauszeiger über die Felder der Tabelle bewegen, können Sie die verdeckten Informationen einsehen.

Bitte beantworten Sie im Anschluss die unten aufgeführten Fragen. Wenn Sie alle Übungsfragen korrekt beantwortet haben, können Sie mit der eigentlichen Aufgabe starten.

	Kamera A	Kamera B	Kamera C
Preis			
Testurteil			
Auflösung			

Frage 1: Wie ist der Preis für Kamera A?

- 75 €
- 105 €
- 60 €

Frage 2: Welche Kamera hat die höchste Auflösung?

- Kamera A
- Kamera B
- Kamera C

Frage 3: Welche Rangfolge ergibt sich unter Anwendung der Nutzwertanalyse bei Gleichgewichtung aller Kriterien?

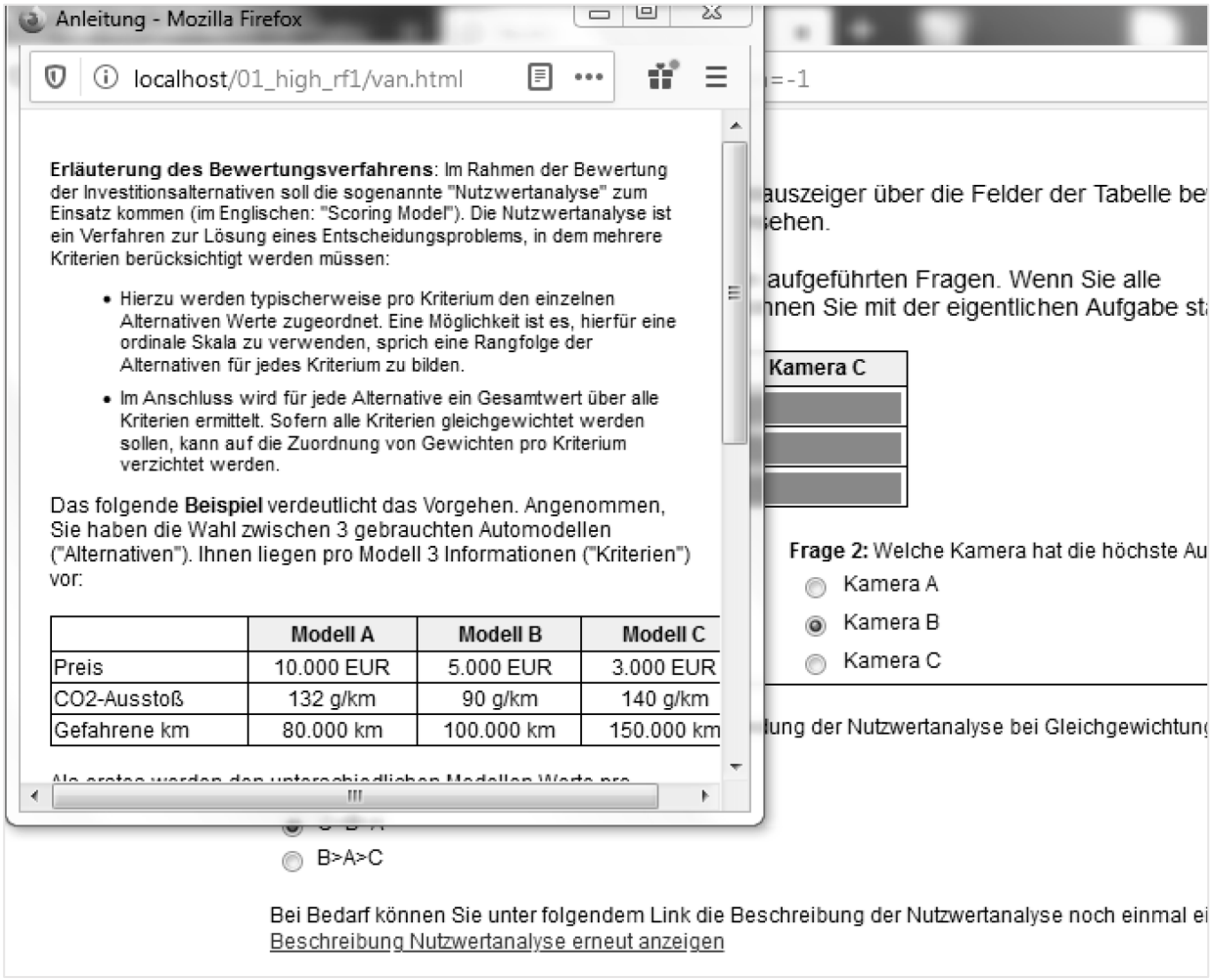
- A>B>C
- C>B>A
- B>A>C

Bei Bedarf können Sie unter folgendem Link die Beschreibung der Nutzwertanalyse noch einmal einsehen:
Beschreibung Nutzwertanalyse erneut anzeigen

Im folgenden Textfeld können Sie sich Notizen für die Ermittlung der Rangfolge (Frage 3) machen:

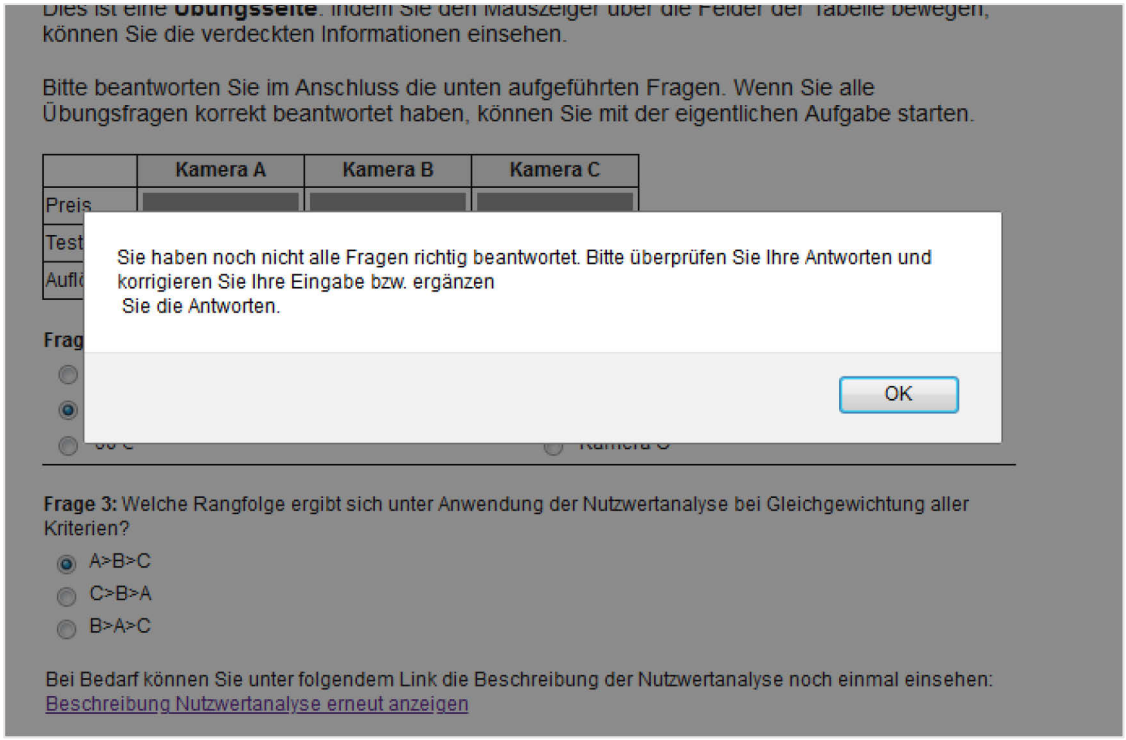
Weiter

Possibility of viewing explanation of scoring model when clicking on the link "Beschreibung Nutzwertanalyse erneut anzeigen":

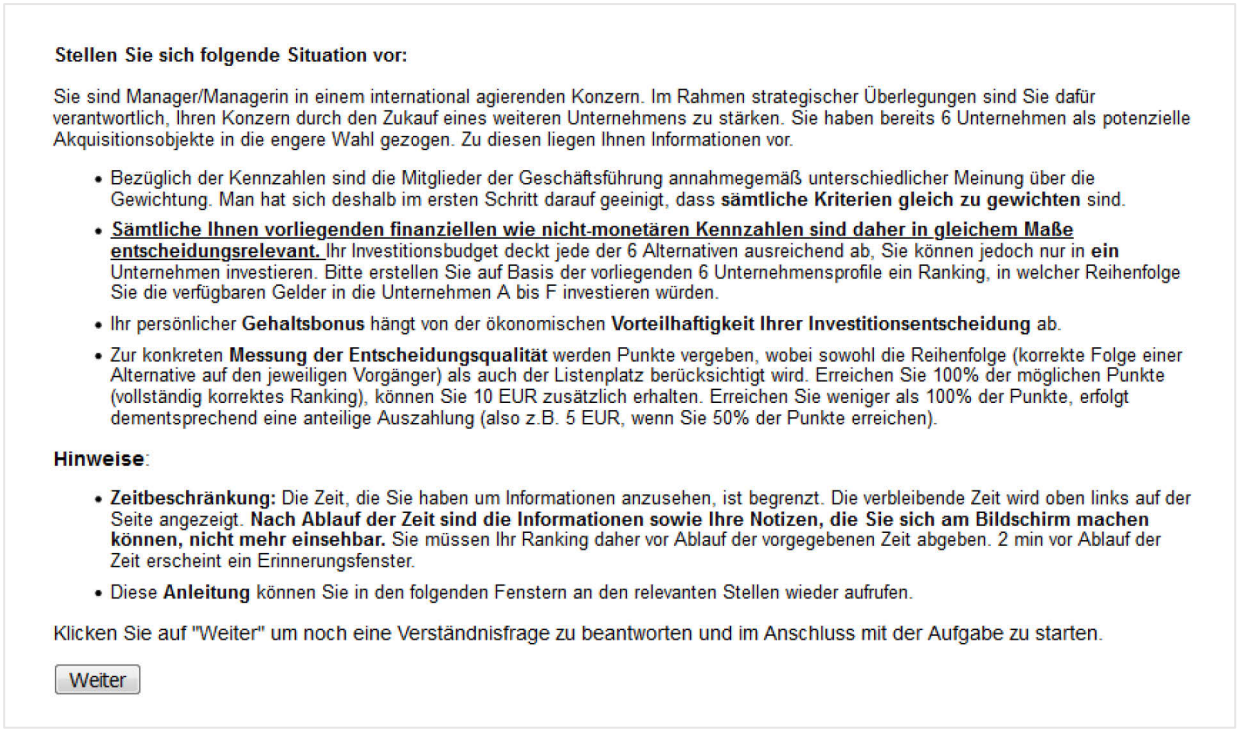


Message that task would start by clicking on "Starten" after exercise had been successfully completed:

Message window appearing if not all exercise questions had been answered correctly:



Description of decision situation and task instructions:



Stellen Sie sich folgende Situation vor:

Sie sind Manager/Managerin in einem international agierenden Konzern. Im Rahmen strategischer Überlegungen sind Sie dafür verantwortlich, Ihren Konzern durch den Zukauf eines weiteren Unternehmens zu stärken. Sie haben bereits 6 Unternehmen als potenzielle Akquisitionsobjekte in die engere Wahl gezogen. Zu diesen liegen Ihnen Informationen vor.

- Bezüglich der Kennzahlen sind die Mitglieder der Geschäftsführung annahmegemäß unterschiedlicher Meinung über die Gewichtung. Man hat sich deshalb im ersten Schritt darauf geeinigt, dass **sämtliche Kriterien gleich zu gewichten** sind.
- **Sämtliche Ihnen vorliegenden finanziellen wie nicht-monetären Kennzahlen sind daher in gleichem Maße entscheidungsrelevant.** Ihr Investitionsbudget deckt jede der 6 Alternativen ausreichend ab, Sie können jedoch nur in **ein** Unternehmen investieren. Bitte erstellen Sie auf Basis der vorliegenden 6 Unternehmensprofile ein Ranking, in welcher Reihenfolge Sie die verfügbaren Gelder in die Unternehmen A bis F investieren würden.
- Ihr persönlicher **Gehaltsbonus** hängt von der ökonomischen **Vorteilhaftigkeit Ihrer Investitionsentscheidung** ab.
- Zur konkreten **Messung der Entscheidungsqualität** werden Punkte vergeben, wobei sowohl die Reihenfolge (korrekte Folge einer Alternative auf den jeweiligen Vorgänger) als auch der Listenplatz berücksichtigt wird. Erreichen Sie 100% der möglichen Punkte (vollständig korrektes Ranking), können Sie 10 EUR zusätzlich erhalten. Erreichen Sie weniger als 100% der Punkte, erfolgt dementsprechend eine anteilige Auszahlung (also z.B. 5 EUR, wenn Sie 50% der Punkte erreichen).

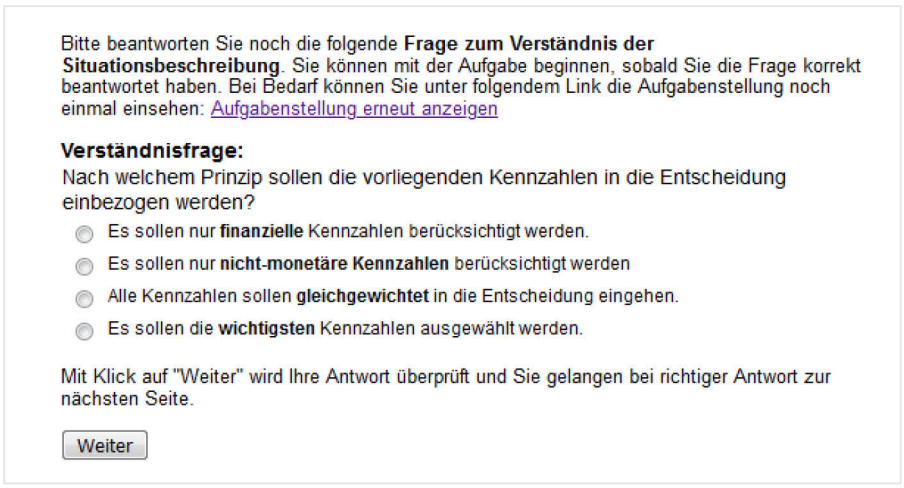
Hinweise:

- **Zeitbeschränkung:** Die Zeit, die Sie haben um Informationen anzusehen, ist begrenzt. Die verbleibende Zeit wird oben links auf der Seite angezeigt. **Nach Ablauf der Zeit sind die Informationen sowie Ihre Notizen, die Sie sich am Bildschirm machen können, nicht mehr einsehbar.** Sie müssen Ihr Ranking daher vor Ablauf der vorgegebenen Zeit abgeben. 2 min vor Ablauf der Zeit erscheint ein Erinnerungsfenster.
- Diese **Anleitung** können Sie in den folgenden Fenstern an den relevanten Stellen wieder aufrufen.

Klicken Sie auf "Weiter" um noch eine Verständnisfrage zu beantworten und im Anschluss mit der Aufgabe zu starten.

Weiter

Questions regarding understanding of the task (to be answered before start of actual task):



Bitte beantworten Sie noch die folgende **Frage zum Verständnis der Situationsbeschreibung**. Sie können mit der Aufgabe beginnen, sobald Sie die Frage korrekt beantwortet haben. Bei Bedarf können Sie unter folgendem Link die Aufgabenstellung noch einmal einsehen: Aufgabenstellung erneut anzeigen

Verständnisfrage:

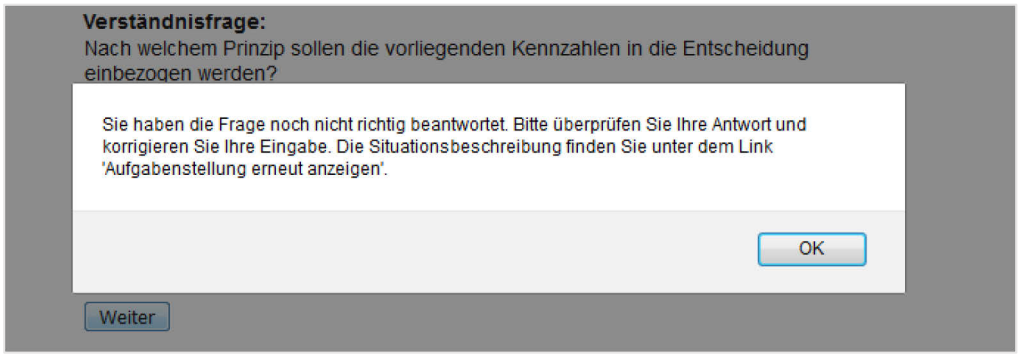
Nach welchem Prinzip sollen die vorliegenden Kennzahlen in die Entscheidung einbezogen werden?

- Es sollen nur **finanzielle** Kennzahlen berücksichtigt werden.
- Es sollen nur **nicht-monetäre Kennzahlen** berücksichtigt werden
- Alle Kennzahlen sollen **gleichgewichtet** in die Entscheidung eingehen.
- Es sollen die **wichtigsten** Kennzahlen ausgewählt werden.

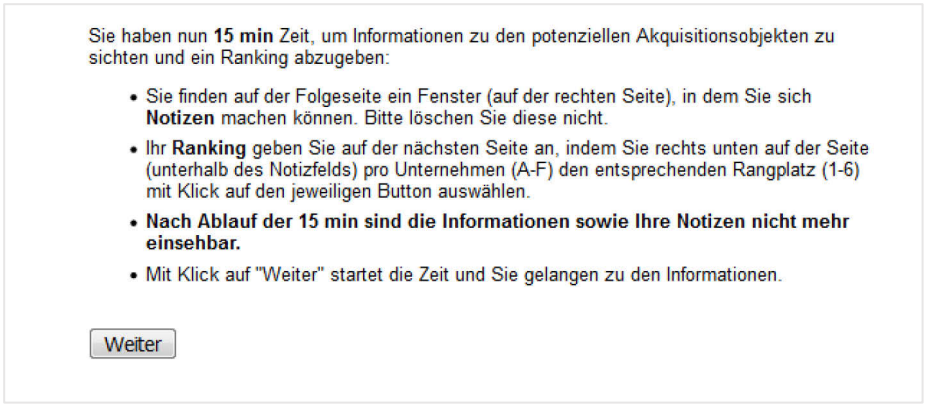
Mit Klick auf "Weiter" wird Ihre Antwort überprüft und Sie gelangen bei richtiger Antwort zur nächsten Seite.

Weiter

Message window appearing if questions regarding understanding of task had not been correctly answered:

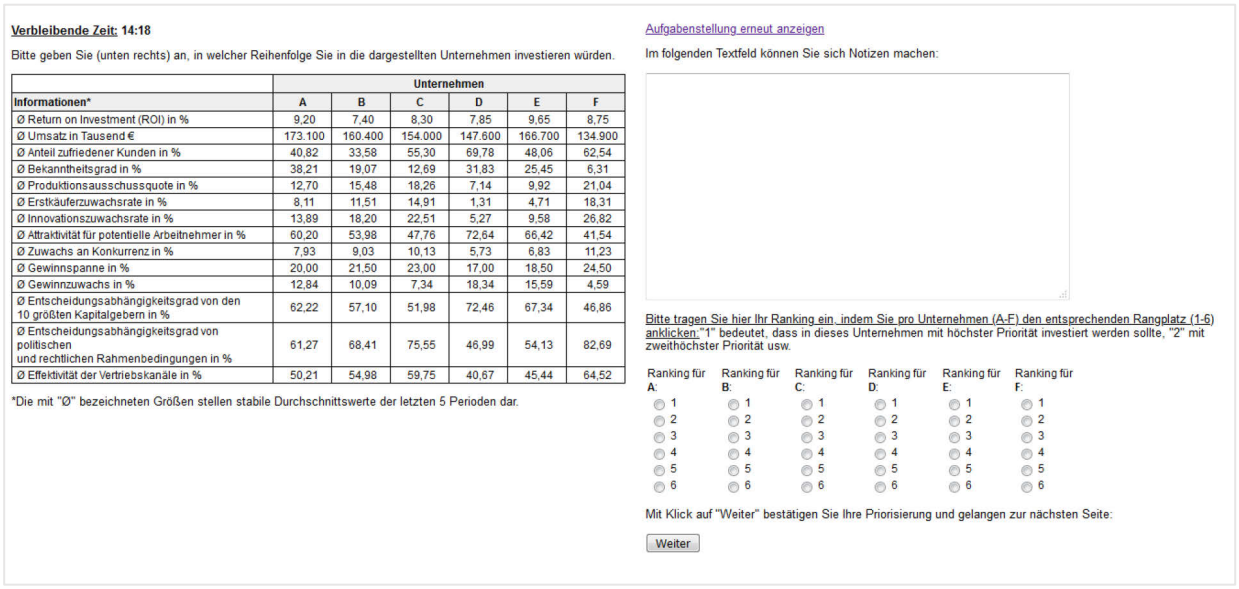


Description of screen layout and reminder of time limit:



2) Initial information and questions

Information for "high initial information load" condition:



Verbleibende Zeit: 14:18

Bitte geben Sie (unten rechts) an, in welcher Reihenfolge Sie in die dargestellten Unternehmen investieren würden.

	Unternehmen					
Informationen*	**A**	**B**	**C**	**D**	**E**	**F**
Ø Return on Investment (ROI) in %	9,20	7,40	8,30	7,85	9,65	8,75
Ø Umsatz in Tausend €	173.100	160.400	154.000	147.600	166.700	134.900
Ø Anteil zufriedener Kunden in %	40,82	33,58	55,30	69,78	48,06	62,54
Ø Bekanntheitsgrad in %	38,21	19,07	12,69	31,83	25,45	6,31
Ø Produktionsausschussquote in %	12,70	15,48	18,26	7,14	9,92	21,04
Ø Erstkäuferzuwachsrate in %	8,11	11,51	14,91	1,31	4,71	18,31
Ø Innovationszuwachsrate in %	13,89	18,20	22,51	5,27	9,58	26,82
Ø Attraktivität für potentielle Arbeitnehmer in %	60,20	53,98	47,76	72,64	66,42	41,54
Ø Zuwachs an Konkurrenz in %	7,93	9,03	10,13	5,73	6,83	11,23
Ø Gewinnspanne in %	20,00	21,50	23,00	17,00	18,50	24,50
Ø Gewinnzuwachs in %	12,84	10,09	7,34	18,34	15,59	4,59
Ø Entscheidungsabhängigkeitsgrad von den 10 größten Kapitalgebern in %	62,22	57,10	51,98	72,46	67,34	46,86
Ø Entscheidungsabhängigkeitsgrad von politischen und rechtlichen Rahmenbedingungen in %	61,27	68,41	75,55	46,99	54,13	82,69
Ø Effektivität der Vertriebskanäle in %	50,21	54,98	59,75	40,67	45,44	64,52

*Die mit "Ø" bezeichneten Größen stellen stabile Durchschnittswerte der letzten 5 Perioden dar.

Aufgabenstellung erneut anzeigen

Im folgenden Textfeld können Sie sich Notizen machen:

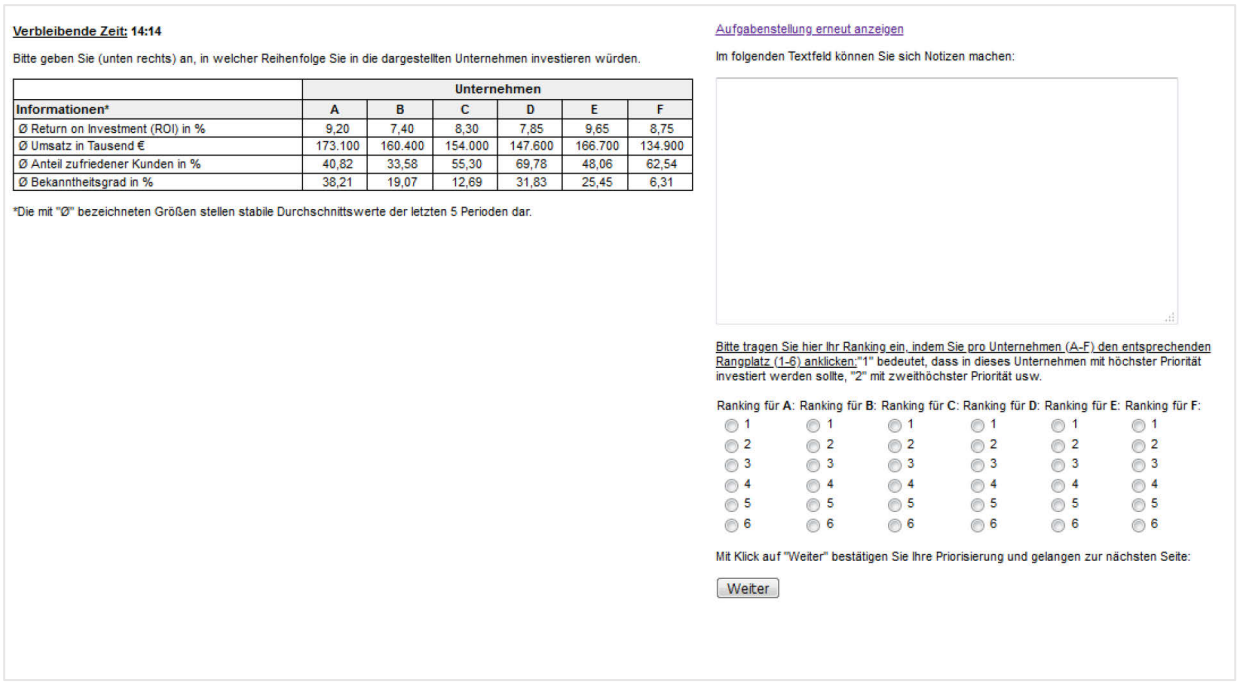
Bitte tragen Sie hier Ihr Ranking ein, indem Sie pro Unternehmen (A-F) den entsprechenden Rangplatz (1-6) anklicken: "1" bedeutet, dass in dieses Unternehmen mit höchster Priorität investiert werden sollte, "2" mit zweithöchster Priorität usw.

Ranking für A:	Ranking für B:	Ranking für C:	Ranking für D:	Ranking für E:	Ranking für F:
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6

Mit Klick auf "Weiter" bestätigen Sie Ihre Priorisierung und gelangen zur nächsten Seite:

Weiter

Information for "low initial information load" condition:



Verbleibende Zeit: 14:14

Bitte geben Sie (unten rechts) an, in welcher Reihenfolge Sie in die dargestellten Unternehmen investieren würden.

	Unternehmen					
Informationen*	**A**	**B**	**C**	**D**	**E**	**F**
Ø Return on Investment (ROI) in %	9,20	7,40	8,30	7,85	9,65	8,75
Ø Umsatz in Tausend €	173.100	160.400	154.000	147.600	166.700	134.900
Ø Anteil zufriedener Kunden in %	40,82	33,58	55,30	69,78	48,06	62,54
Ø Bekanntheitsgrad in %	38,21	19,07	12,69	31,83	25,45	6,31

*Die mit "Ø" bezeichneten Größen stellen stabile Durchschnittswerte der letzten 5 Perioden dar.

Aufgabenstellung erneut anzeigen

Im folgenden Textfeld können Sie sich Notizen machen:

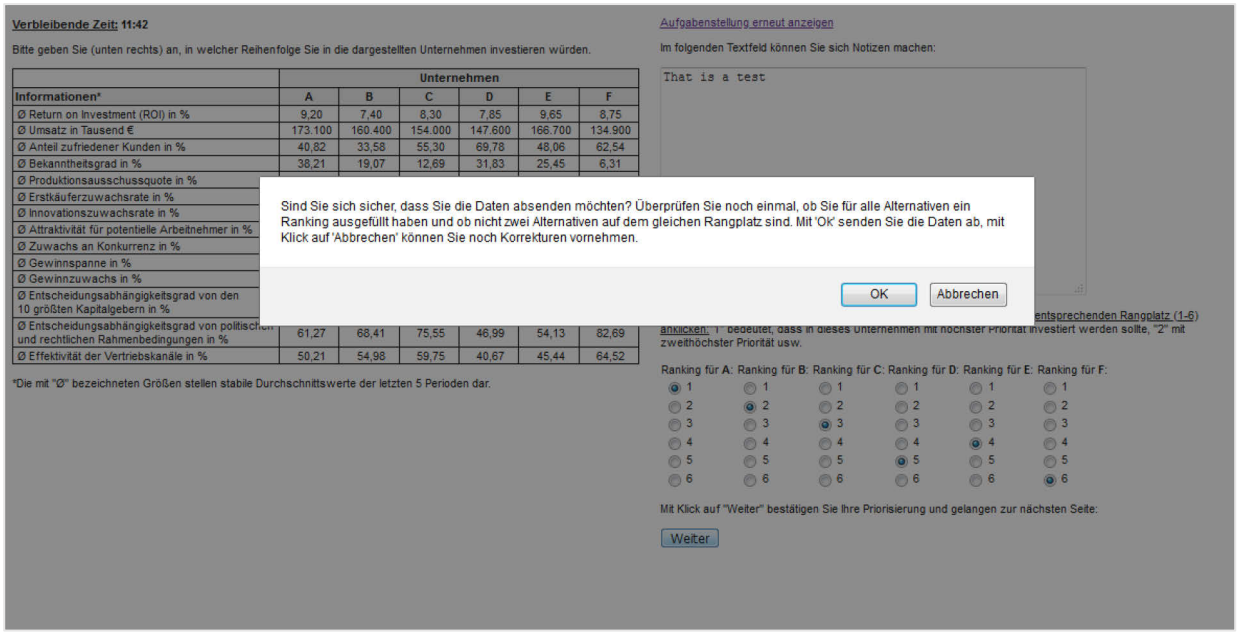
Bitte tragen Sie hier Ihr Ranking ein, indem Sie pro Unternehmen (A-F) den entsprechenden Rangplatz (1-6) anklicken: "1" bedeutet, dass in dieses Unternehmen mit höchster Priorität investiert werden sollte, "2" mit zweithöchster Priorität usw.

Ranking für A:	Ranking für B:	Ranking für C:	Ranking für D:	Ranking für E:	Ranking für F:
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6

Mit Klick auf "Weiter" bestätigen Sie Ihre Priorisierung und gelangen zur nächsten Seite:

Weiter

Message to verify whether final rating should be submitted:



Questions regarding decision in first step:

Bitte beantworten Sie folgende Fragen zur **eben getroffenen** Entscheidung:

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	○	○	○	○	○	○	○	Sehr sicher

Wie viele Informationen/Kennzahlen hatten Sie **pro Unternehmen** vorliegen? Bitte geben Sie die Zahl hier an. Wenn Sie sich nicht sicher sind, geben Sie bitte eine Schätzung ab: _____

Wie stark haben Sie sich bei der Bearbeitung der Aufgabe angestrengt?

	1	2	3	4	5	6	7	
Überhaupt nicht	○	○	○	○	○	○	○	Extrem stark

Wie haben Sie die Menge der Informationen wahrgenommen?

	1	2	3	4	5	6	7	
Sehr wenige Informationen	○	○	○	○	○	○	○	Sehr viele Informationen

Haben Sie sich durch die Menge der zur Verfügung gestellten Informationen überlastet gefühlt?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	○	○	○	○	○	○	○	Ja, extrem stark

Haben Sie sich während der Bearbeitung der Aufgabe unter Zeitdruck gefühlt?

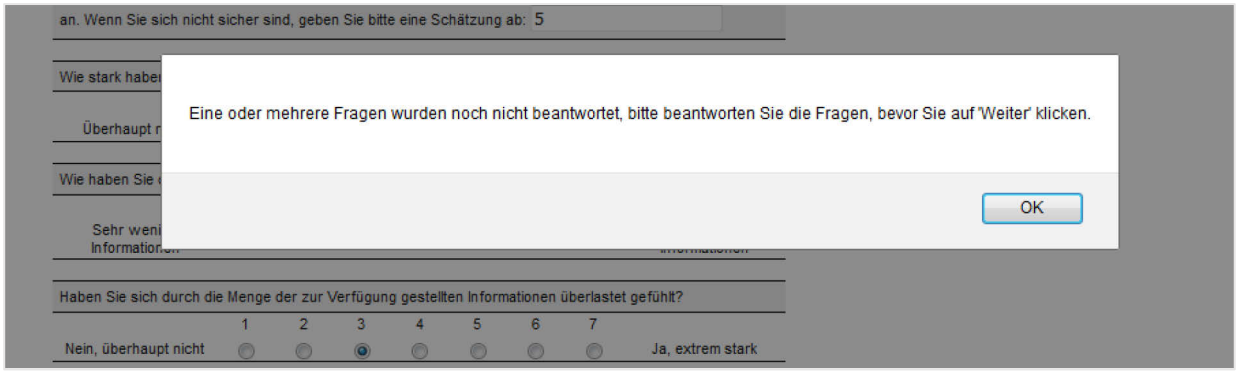
	1	2	3	4	5	6	7	
Nein, überhaupt nicht	○	○	○	○	○	○	○	Ja, extrem stark

Wie beurteilen Sie die durchgeführte Aufgabe?

	1	2	3	4	5	6	7	
Schwierig	○	○	○	○	○	○	○	Leicht
Komplex	○	○	○	○	○	○	○	Einfach
Variierend	○	○	○	○	○	○	○	Gleichbleibend

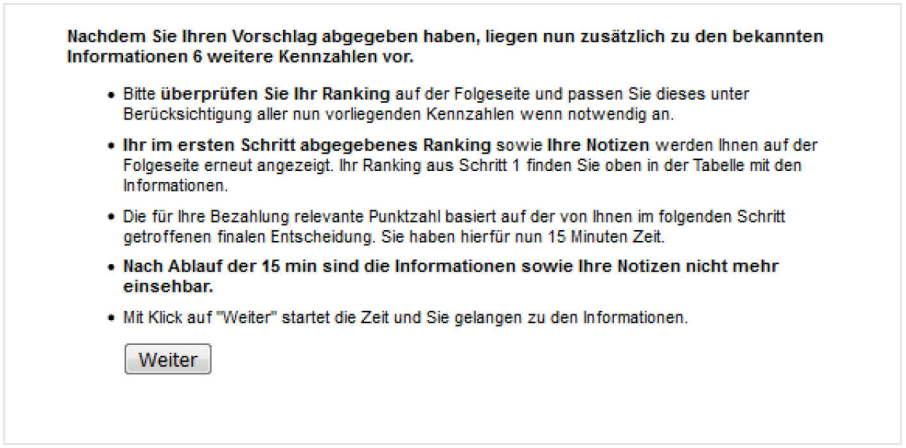
Weiter

Message window if not all questions had been answered:



3) Additional information and questions

Description of screen layout and reminder of time limit:

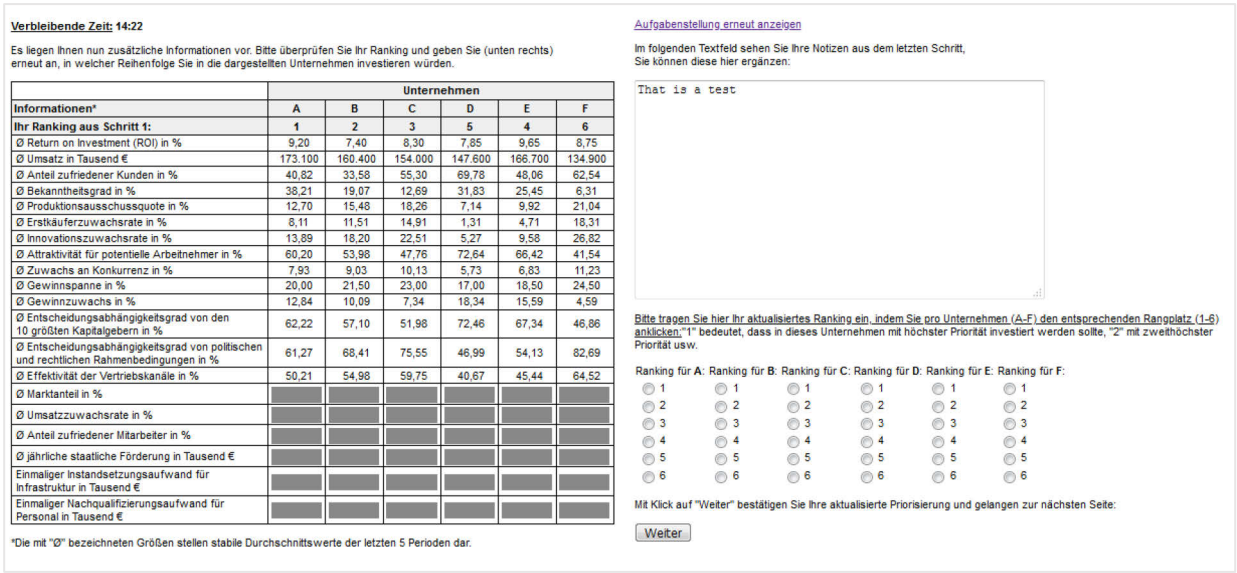


Nachdem Sie Ihren Vorschlag abgegeben haben, liegen nun zusätzlich zu den bekannten Informationen 6 weitere Kennzahlen vor.

- Bitte **überprüfen Sie Ihr Ranking** auf der Folgeseite und passen Sie dieses unter Berücksichtigung aller nun vorliegenden Kennzahlen wenn notwendig an.
- **Ihr im ersten Schritt abgegebenes Ranking** sowie **Ihre Notizen** werden Ihnen auf der Folgeseite erneut angezeigt. Ihr Ranking aus Schritt 1 finden Sie oben in der Tabelle mit den Informationen.
- Die für Ihre Bezahlung relevante Punktzahl basiert auf der von Ihnen im folgenden Schritt getroffenen finalen Entscheidung. Sie haben hierfür nun 15 Minuten Zeit.
- **Nach Ablauf der 15 min sind die Informationen sowie Ihre Notizen nicht mehr einsehbar.**
- Mit Klick auf "Weiter" startet die Zeit und Sie gelangen zu den Informationen.

Weiter

Additional information for "high initial information load" condition. Notes from first step reappeared in the window on the right:



Verbleibende Zeit: 14:22

Es liegen Ihnen nun zusätzliche Informationen vor. Bitte überprüfen Sie Ihr Ranking und geben Sie (unten rechts) erneut an, in welcher Reihenfolge Sie in die dargestellten Unternehmen investieren würden.

	Unternehmen					
Informationen*	**A**	**B**	**C**	**D**	**E**	**F**
Ihr Ranking aus Schritt 1:	**1**	**2**	**3**	**5**	**4**	**6**
Ø Return on Investment (ROI) in %	9,20	7,40	8,30	7,85	9,65	8,75
Ø Umsatz in Tausend €	173.100	160.400	154.000	147.600	166.700	134.900
Ø Anteil zufriedener Kunden in %	40,82	33,58	55,30	69,78	48,06	62,54
Ø Bekanntheitsgrad in %	38,21	19,07	12,69	31,83	25,45	6,31
Ø Produktionsausschussquote in %	12,70	15,48	18,26	7,14	9,92	21,04
Ø Erstkäuferzuwachsrate in %	8,11	11,51	14,91	1,31	4,71	18,31
Ø Innovationszuwachsrate in %	13,89	18,20	22,51	5,27	9,58	26,82
Ø Attraktivität für potentielle Arbeitnehmer in %	60,20	53,98	47,76	72,64	66,42	41,54
Ø Zuwachs an Konkurrenz in %	7,93	9,03	10,13	5,73	6,83	11,23
Ø Gewinnspanne in %	20,00	21,50	23,00	17,00	18,50	24,50
Ø Gewinnzuwachs in %	12,84	10,09	7,34	18,34	15,59	4,59
Ø Entscheidungsabhängigkeitsgrad von den 10 größten Kapitalgebern in %	62,22	57,10	51,98	72,46	67,34	46,86
Ø Entscheidungsabhängigkeitsgrad von politischen und rechtlichen Rahmenbedingungen in %	61,27	68,41	75,55	46,99	54,13	82,69
Ø Effektivität der Vertriebskanäle in %	50,21	54,98	59,75	40,67	45,44	64,52
Ø Marktanteil in %						
Ø Umsatzzuwachsrate in %						
Ø Anteil zufriedener Mitarbeiter in %						
Ø jährliche staatliche Förderung in Tausend €						
Einmaliger Instandsetzungsaufwand für Infrastruktur in Tausend €						
Einmaliger Nachqualifizierungsaufwand für Personal in Tausend €						

*Die mit "Ø" bezeichneten Größen stellen stabile Durchschnittswerte der letzten 5 Perioden dar.

Aufgabenstellung erneut anzeigen

Im folgenden Textfeld sehen Sie Ihre Notizen aus dem letzten Schritt, Sie können diese hier ergänzen:

That is a test

Bitte tragen Sie hier Ihr aktualisiertes Ranking ein, indem Sie pro Unternehmen (A-F) den entsprechenden Rangplatz (1-6) anklicken: "1" bedeutet, dass in dieses Unternehmen mit höchster Priorität investiert werden sollte, "2" mit zweithöchster Priorität usw.

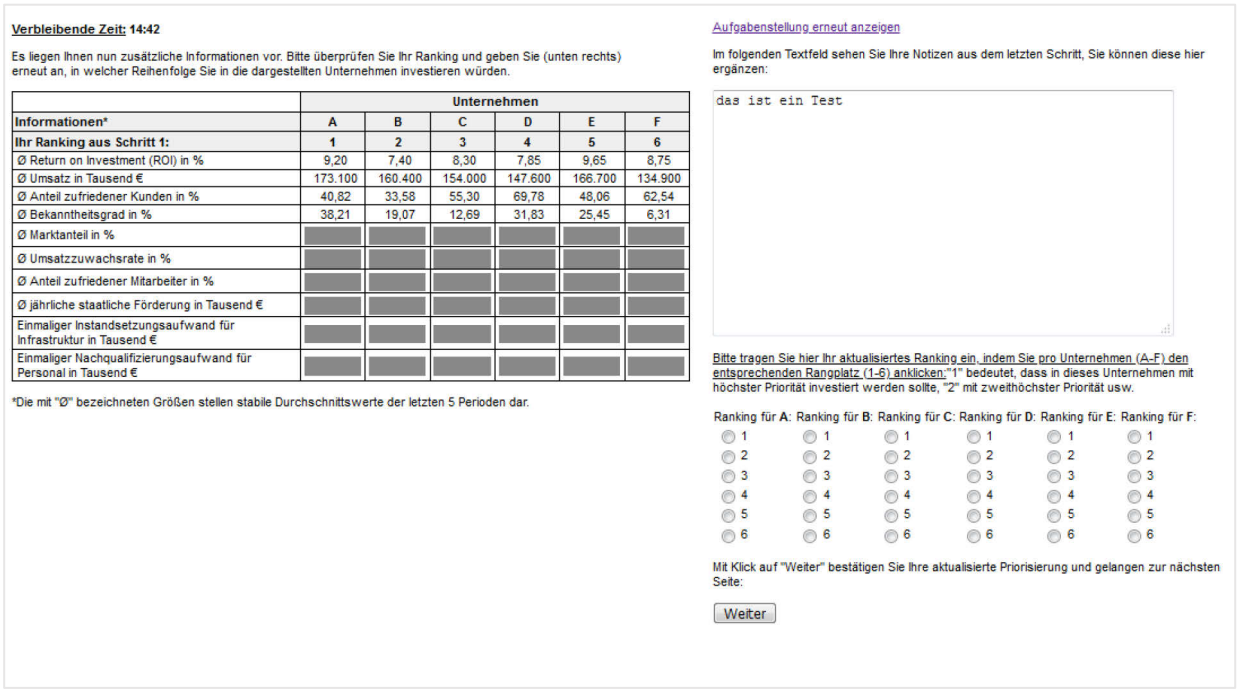
Ranking für **A**: Ranking für **B**: Ranking für **C**: Ranking für **D**: Ranking für **E**: Ranking für **F**:

1 2 3 4 5 6

Mit Klick auf "Weiter" bestätigen Sie Ihre aktualisierte Priorisierung und gelangen zur nächsten Seite:

Weiter

Additional information for "low initial information load" condition. Notes from first step reappeared in the window on the right:



Verbleibende Zeit: 14:42

Es liegen Ihnen nun zusätzliche Informationen vor. Bitte überprüfen Sie Ihr Ranking und geben Sie (unten rechts) erneut an, in welcher Reihenfolge Sie in die dargestellten Unternehmen investieren würden.

	Unternehmen					
Informationen*	**A**	**B**	**C**	**D**	**E**	**F**
Ihr Ranking aus Schritt 1:	**1**	**2**	**3**	**4**	**5**	**6**
Ø Return on Investment (ROI) in %	9,20	7,40	8,30	7,85	9,65	8,75
Ø Umsatz in Tausend €	173.100	160.400	154.000	147.600	166.700	134.900
Ø Anteil zufriedener Kunden in %	40,82	33,58	55,30	69,78	48,06	62,54
Ø Bekanntheitsgrad in %	38,21	19,07	12,69	31,83	25,45	6,31
Ø Marktanteil in %						
Ø Umsatzzuwachsrate in %						
Ø Anteil zufriedener Mitarbeiter in %						
Ø jährliche staatliche Förderung in Tausend €						
Einmaliger Instandsetzungsaufwand für Infrastruktur in Tausend €						
Einmaliger Nachqualifizierungsaufwand für Personal in Tausend €						

*Die mit "Ø" bezeichneten Größen stellen stabile Durchschnittswerte der letzten 5 Perioden dar.

Aufgabenstellung erneut anzeigen

Im folgenden Textfeld sehen Sie Ihre Notizen aus dem letzten Schritt, Sie können diese hier ergänzen:

das ist ein Test

Bitte tragen Sie hier Ihr aktualisiertes Ranking ein, indem Sie pro Unternehmen (A-F) den entsprechenden Rangplatz (1-6) anklicken:"1" bedeutet, dass in dieses Unternehmen mit höchster Priorität investiert werden sollte, "2" mit zweithöchster Priorität usw.

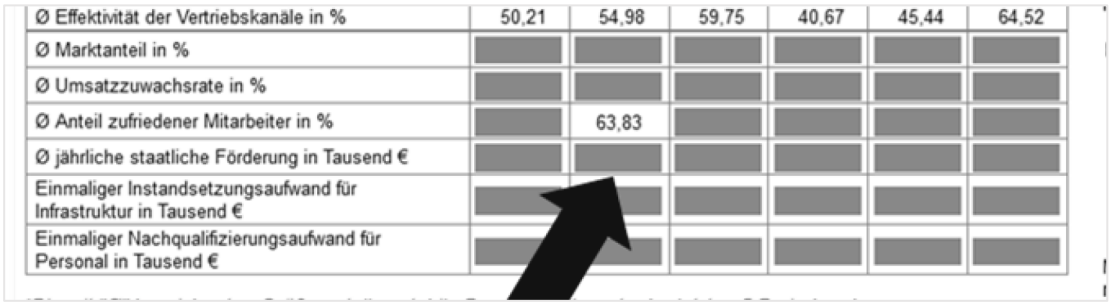
Ranking für **A**: Ranking für **B**: Ranking für **C**: Ranking für **D**: Ranking für **E**: Ranking für **F**:

1 2 3 4 5 6 | 1 2 3 4 5 6 | 1 2 3 4 5 6 | 1 2 3 4 5 6 | 1 2 3 4 5 6 | 1 2 3 4 5 6

Mit Klick auf "Weiter" bestätigen Sie Ihre aktualisierte Priorisierung und gelangen zur nächsten Seite:

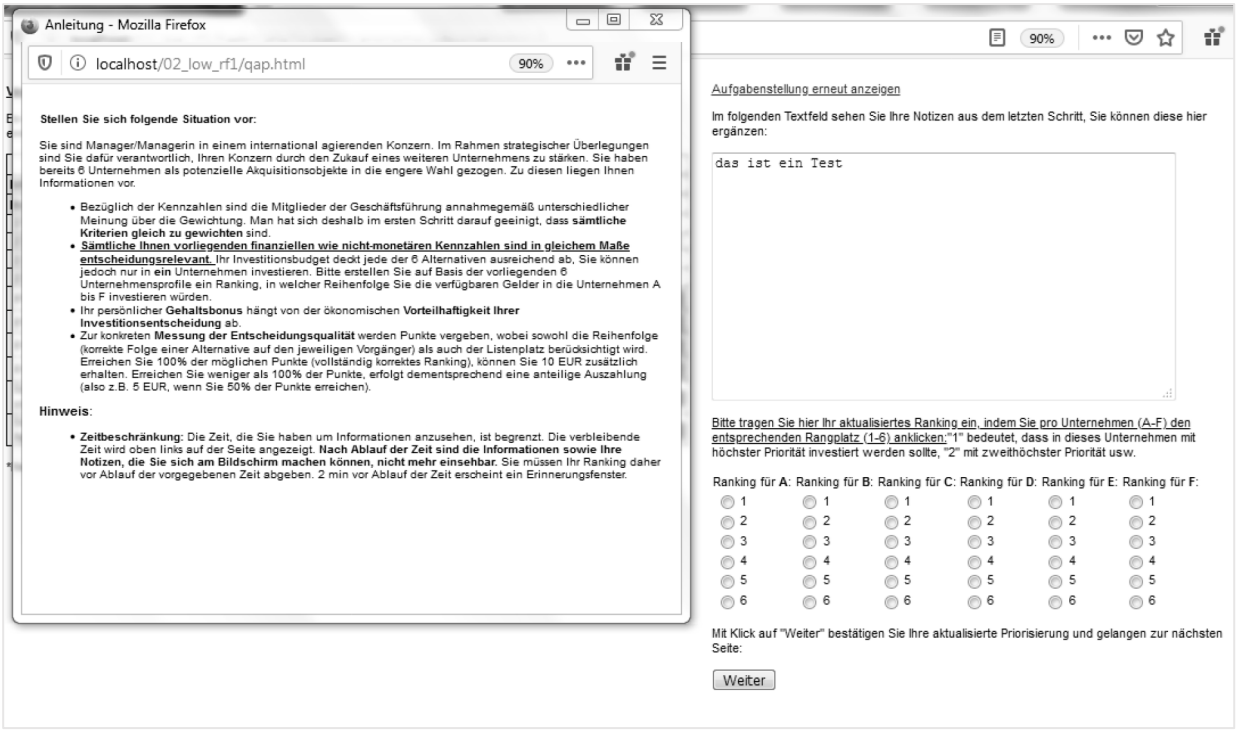
Weiter

MouselabWEB-functionality: numbers could be uncovered by moving the cursor over the boxes:

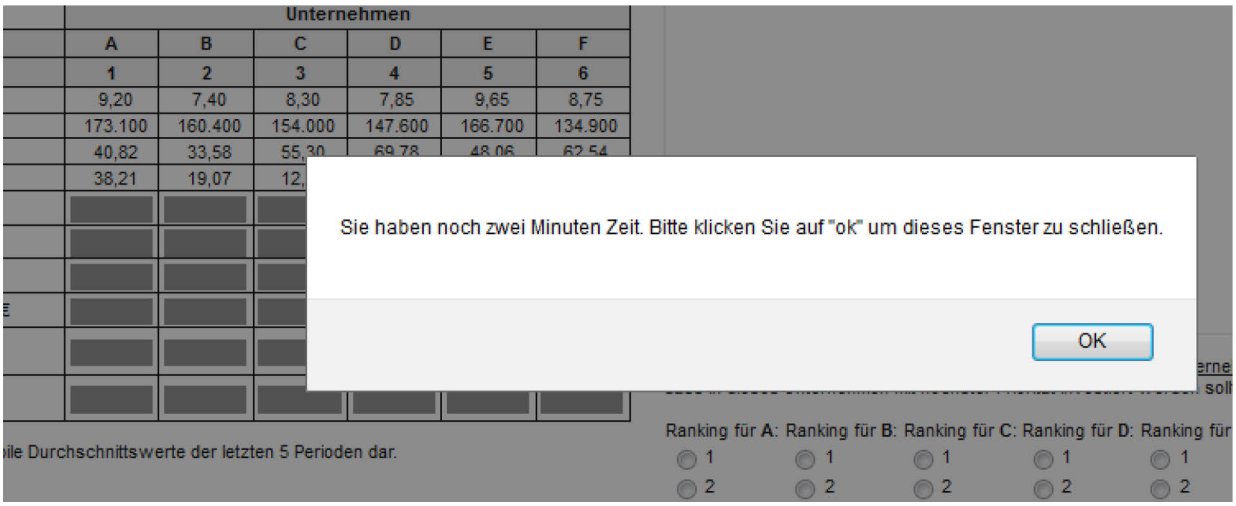


Ø Effektivität der Vertriebskanäle in %	50,21	54,98	59,75	40,67	45,44	64,52
Ø Marktanteil in %						
Ø Umsatzzuwachsrate in %						
Ø Anteil zufriedener Mitarbeiter in %		63,83				
Ø jährliche staatliche Förderung in Tausend €						
Einmaliger Instandsetzungsaufwand für Infrastruktur in Tausend €						
Einmaliger Nachqualifizierungsaufwand für Personal in Tausend €						

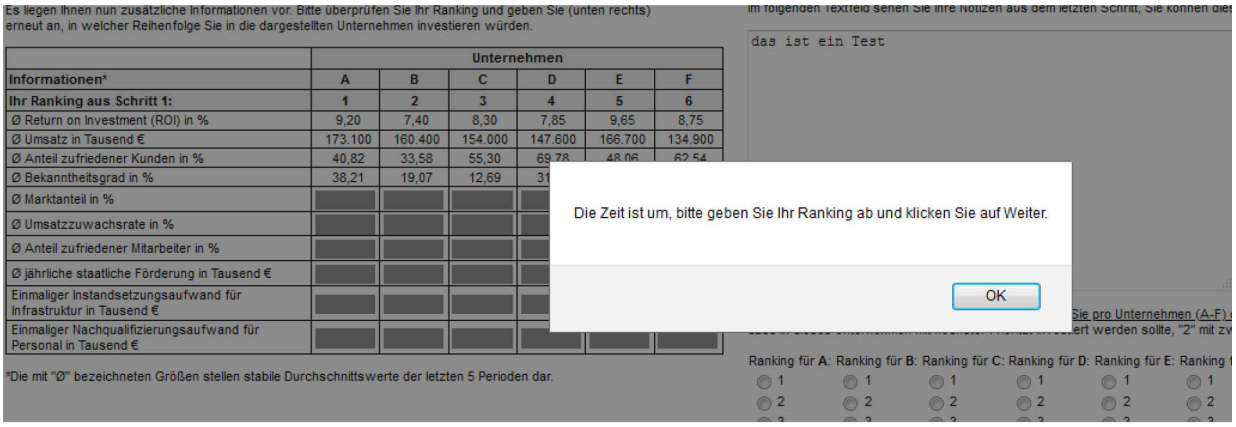
Option to consult task instructions during the task by clicking on "Aufgabenstellung erneut anzeigen":



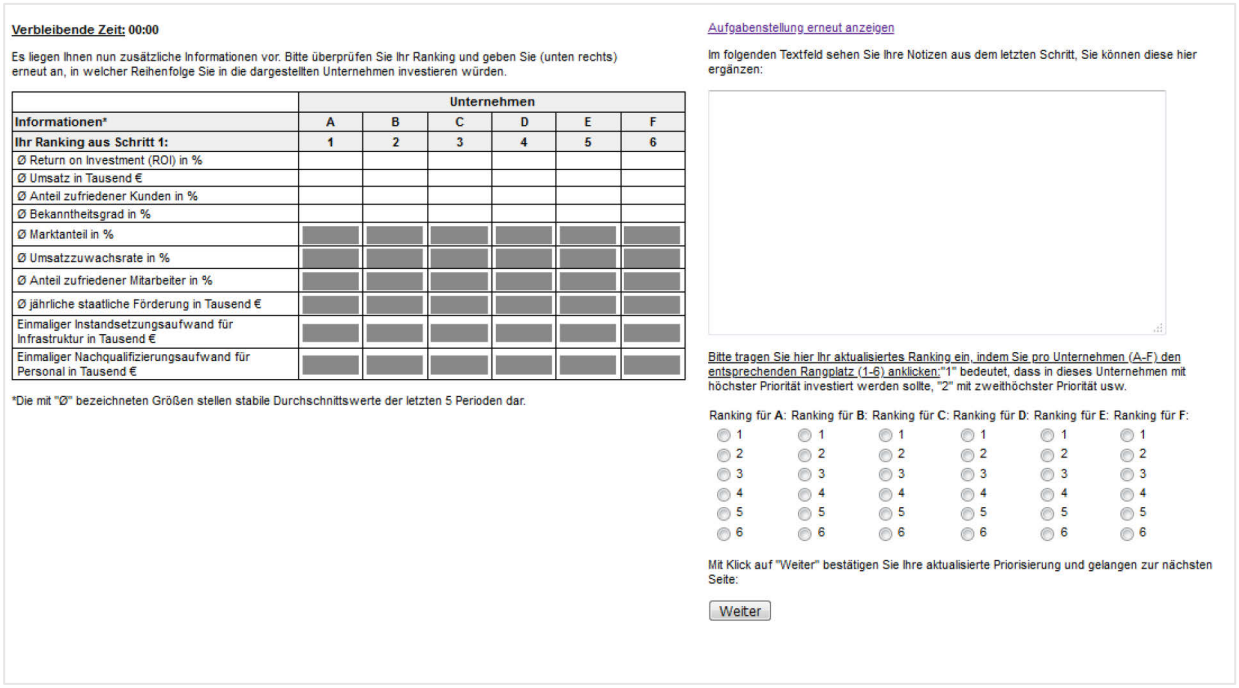
Warning message indicating that time limit would be reached in two minutes:



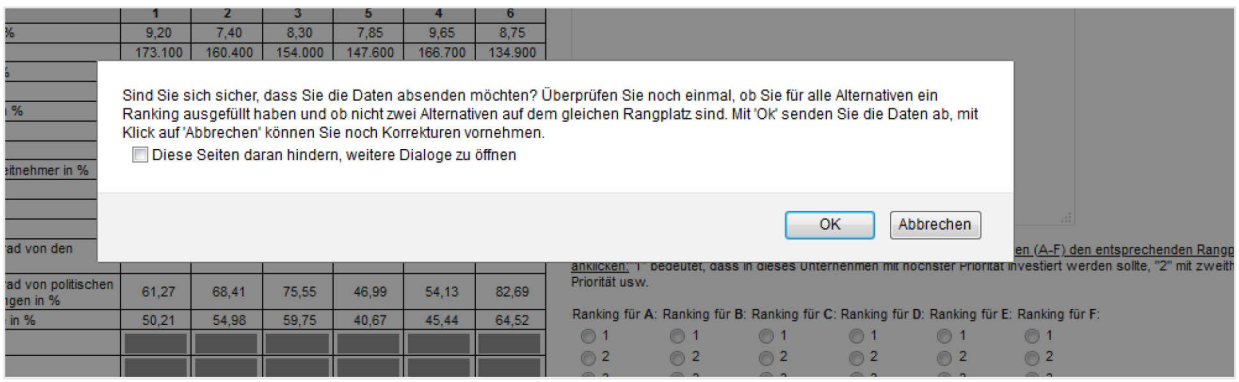
Warning message that time limit had been reached and ranking should be submitted:



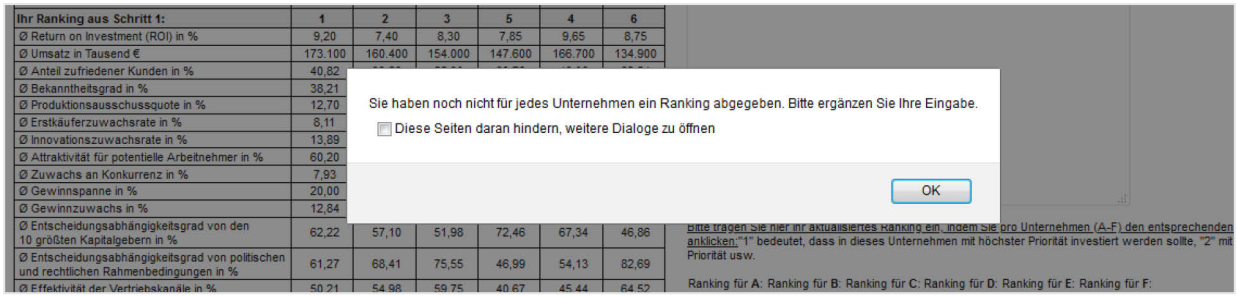
Notes and values disappeared after time limit was reached ("low initial information load" condition displayed here):



Message to verify whether final rating should be submitted:

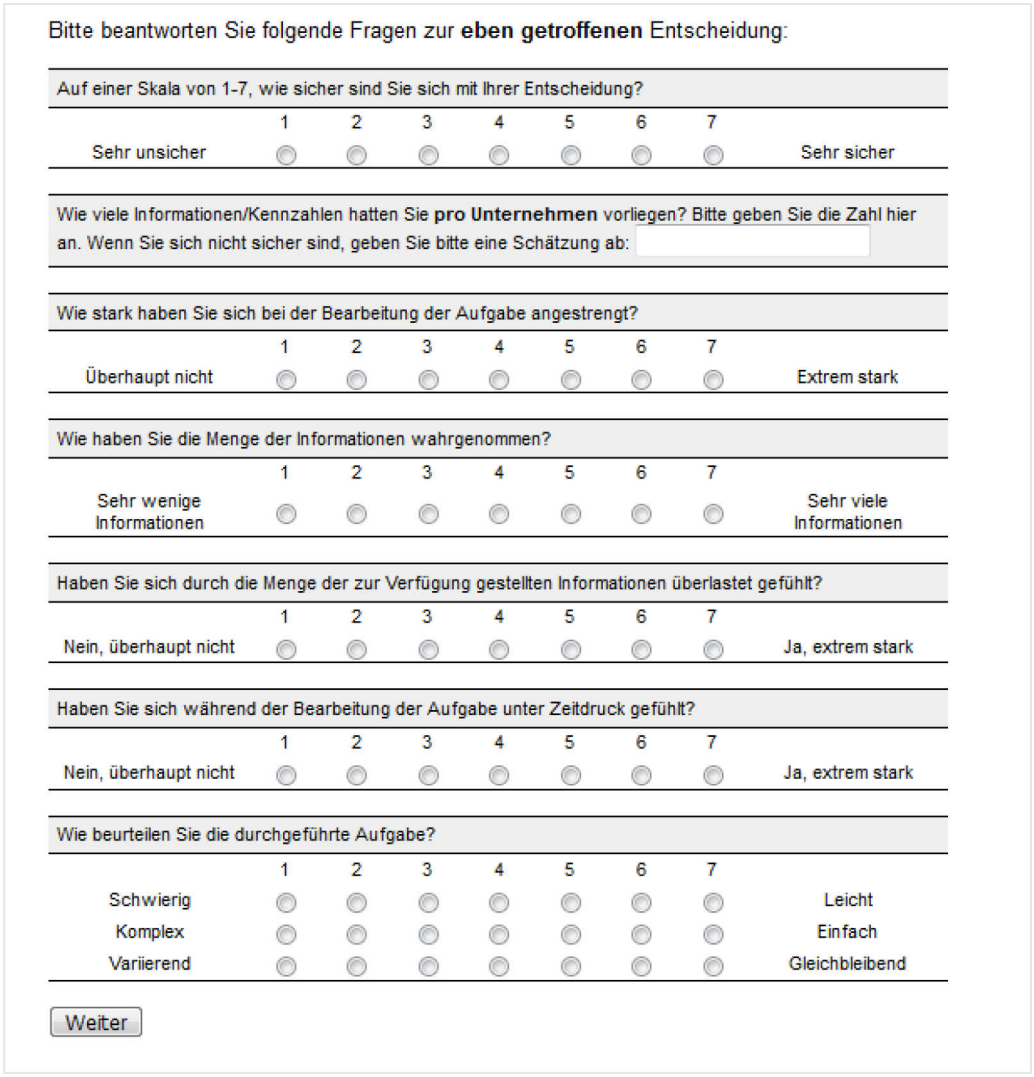


Message if not all rankings have been submitted:



Message if two investment alternatives had been assigned the same ranking:

Questions regarding decision in second step:



Bitte beantworten Sie folgende Fragen zur **eben getroffenen** Entscheidung:

Auf einer Skala von 1-7, wie sicher sind Sie sich mit Ihrer Entscheidung?

	1	2	3	4	5	6	7	
Sehr unsicher	○	○	○	○	○	○	○	Sehr sicher

Wie viele Informationen/Kennzahlen hatten Sie **pro Unternehmen** vorliegen? Bitte geben Sie die Zahl hier an. Wenn Sie sich nicht sicher sind, geben Sie bitte eine Schätzung ab:

Wie stark haben Sie sich bei der Bearbeitung der Aufgabe angestrengt?

	1	2	3	4	5	6	7	
Überhaupt nicht	○	○	○	○	○	○	○	Extrem stark

Wie haben Sie die Menge der Informationen wahrgenommen?

	1	2	3	4	5	6	7	
Sehr wenige Informationen	○	○	○	○	○	○	○	Sehr viele Informationen

Haben Sie sich durch die Menge der zur Verfügung gestellten Informationen überlastet gefühlt?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	○	○	○	○	○	○	○	Ja, extrem stark

Haben Sie sich während der Bearbeitung der Aufgabe unter Zeitdruck gefühlt?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	○	○	○	○	○	○	○	Ja, extrem stark

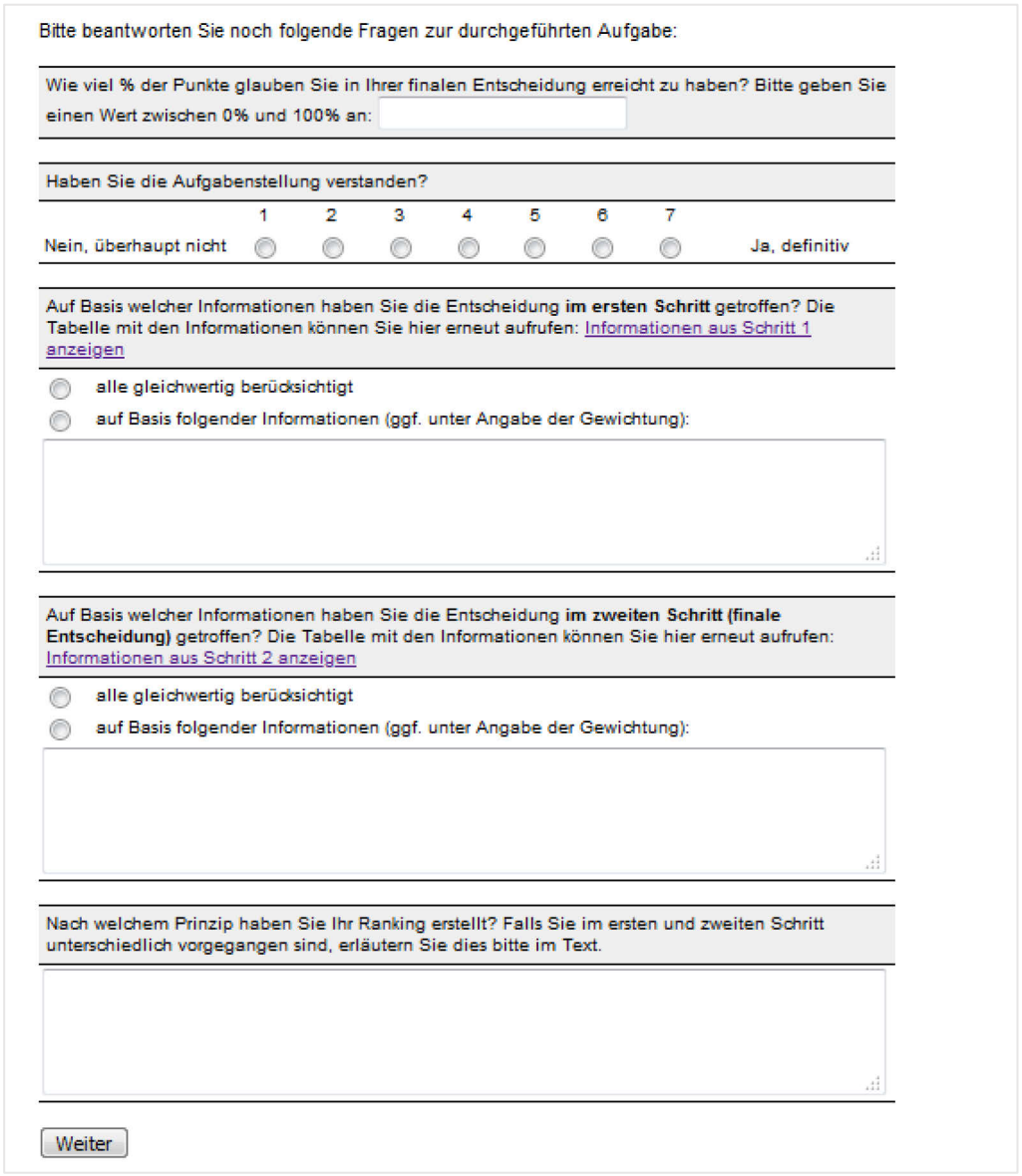
Wie beurteilen Sie die durchgeführte Aufgabe?

	1	2	3	4	5	6	7	
Schwierig	○	○	○	○	○	○	○	Leicht
Komplex	○	○	○	○	○	○	○	Einfach
Variierend	○	○	○	○	○	○	○	Gleichbleibend

Weiter

4) Post-experimental questionnaire

Questions regarding overall task:



Bitte beantworten Sie noch folgende Fragen zur durchgeführten Aufgabe:

Wie viel % der Punkte glauben Sie in Ihrer finalen Entscheidung erreicht zu haben? Bitte geben Sie einen Wert zwischen 0% und 100% an:

Haben Sie die Aufgabenstellung verstanden?

	1	2	3	4	5	6	7	
Nein, überhaupt nicht	○	○	○	○	○	○	○	Ja, definitiv

Auf Basis welcher Informationen haben Sie die Entscheidung **im ersten Schritt** getroffen? Die Tabelle mit den Informationen können Sie hier erneut aufrufen: Informationen aus Schritt 1 anzeigen

- ○ alle gleichwertig berücksichtigt
- ○ auf Basis folgender Informationen (ggf. unter Angabe der Gewichtung):

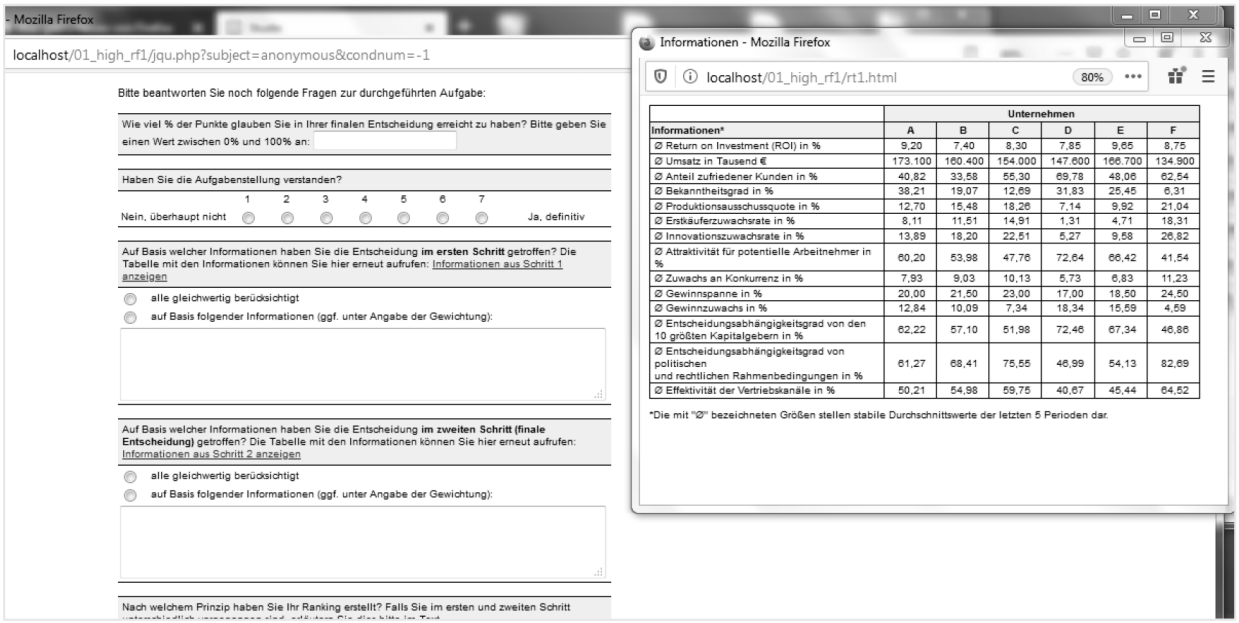
Auf Basis welcher Informationen haben Sie die Entscheidung **im zweiten Schritt (finale Entscheidung)** getroffen? Die Tabelle mit den Informationen können Sie hier erneut aufrufen: Informationen aus Schritt 2 anzeigen

- ○ alle gleichwertig berücksichtigt
- ○ auf Basis folgender Informationen (ggf. unter Angabe der Gewichtung):

Nach welchem Prinzip haben Sie Ihr Ranking erstellt? Falls Sie im ersten und zweiten Schritt unterschiedlich vorgegangen sind, erläutern Sie dies bitte im Text.

Weiter

Option to review information from step 1 and step 2 (displayed for "high initial information load" condition):



Questionnaire regarding potential information demand for standard reporting:

Stellen Sie sich vor, Sie könnten die Kennzahlen, die Ihnen für das Treffen einer **Investitionsentscheidung standardmäßig** zur Verfügung stehen, selber auswählen.

Welche der hier aufgeführten Kennzahlen würden Sie anfordern? Sie können so viele Kennzahlen auswählen, wie Sie möchten. Mit nochmaligem Klick auf die Checkboxen können Sie Ihre Auswahl bei Bedarf wieder rückgängig machen:

- ☐ Ø Return on Investment (ROI) in %
- ☐ Ø Umsatz in Tausend €
- ☐ Ø Anteil zufriedener Kunden in %
- ☐ Ø Bekanntheitsgrad in %
- ☐ Ø Produktionsausschussquote in %
- ☐ Ø Erstkäuferzuwachsrate in %
- ☐ Ø Innovationszuwachsrate in %
- ☐ Ø Attraktivität für potentielle Arbeitnehmer in %
- ☐ Ø Zuwachs an Konkurrenz in %
- ☐ Ø Gewinnspanne in %
- ☐ Ø Gewinnzuwachs in %
- ☐ Ø Entscheidungsabhängigkeitsgrad von den 10 größten Kapitalgebern in %
- ☐ Ø Entscheidungsabhängigkeitsgrad von politischen und rechtlichen Rahmenbedingungen in %
- ☐ Ø Effektivität der Vertriebskanäle in %
- ☐ Ø Marktanteil in %
- ☐ Ø Umsatzzuwachsrate in %
- ☐ Ø Anteil zufriedener Mitarbeiter in %
- ☐ Ø jährliche staatliche Förderung in Tausend €
- ☐ Einmaliger Instandsetzungsaufwand für Infrastruktur in Tausend €
- ☐ Einmaliger Nachqualifizierungsaufwand für Personal in Tausend €

Würden Sie neben den oben dargestellten Kennzahlen **noch weitere Kennzahlen** anfordern?
Falls ja, tragen Sie diese bitte im folgenden Feld ein:

Mit Klick auf "Weiter" bestätigen Sie Ihre Eingaben und gelangen zur nächsten Seite.

Weiter

Need-for-cognition and faith-in-intuition scales:

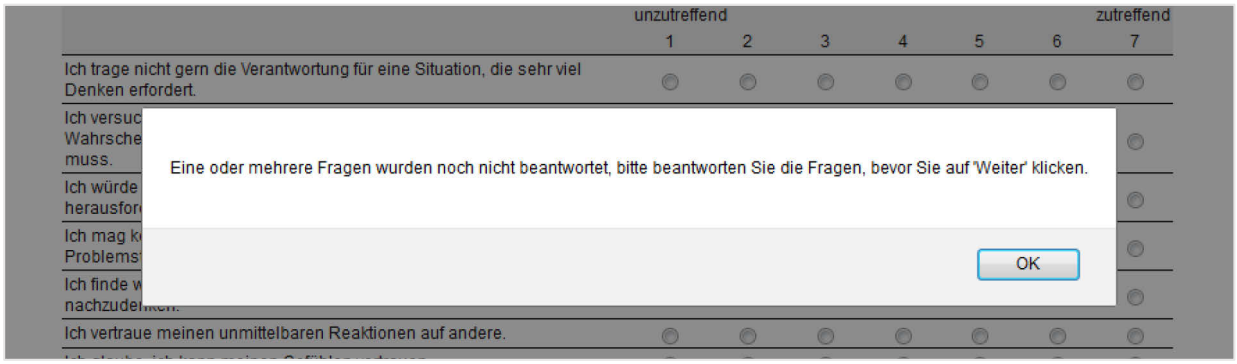
Im Folgenden finden Sie einige **Fragen zu Ihrer Persönlichkeit.**

Bitte beurteilen Sie, inwiefern die folgenden Aussagen auf Sie zutreffen:

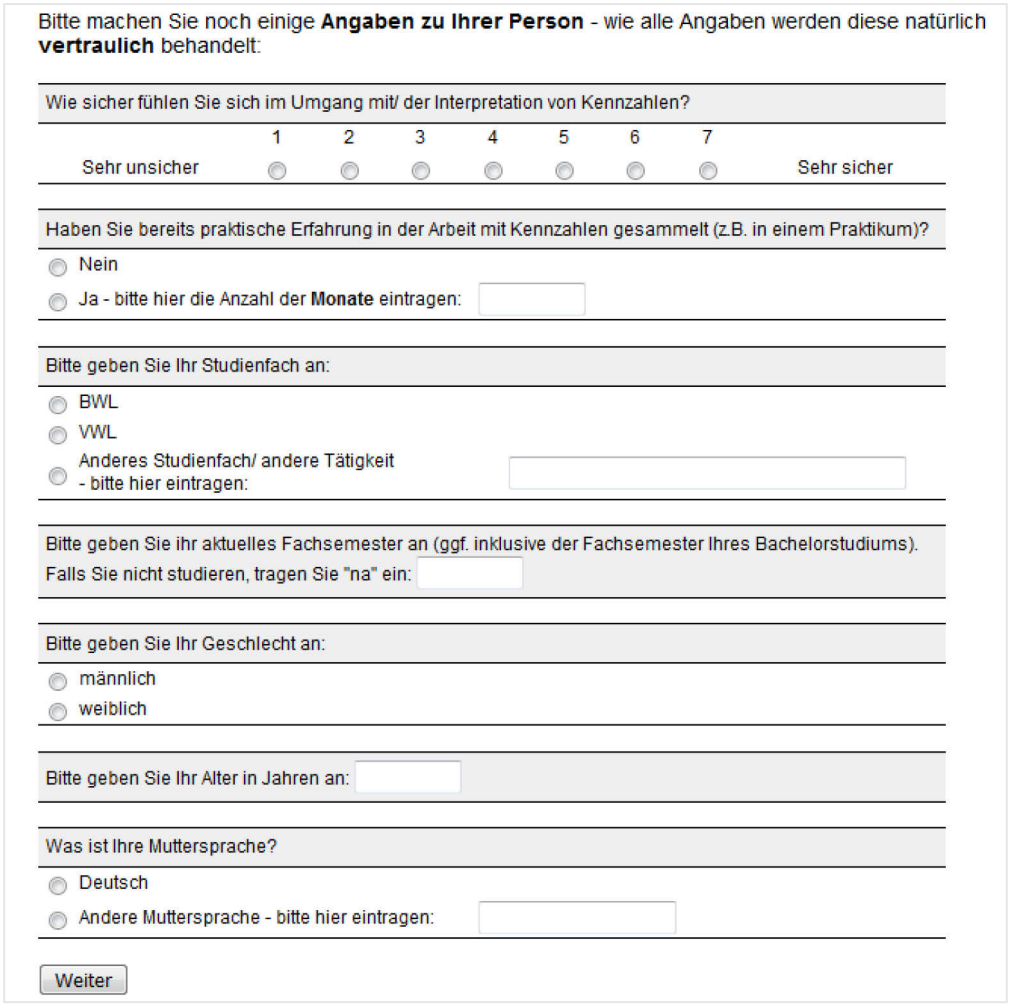
	Vollkommen unzutreffend 1	2	3	4	5	6	Vollkommen zutreffend 7
Ich trage nicht gern die Verantwortung für eine Situation, die sehr viel Denken erfordert.	○	○	○	○	○	○	○
Ich versuche, Situationen vorauszuahnen und zu vermeiden, in denen die Wahrscheinlichkeit groß ist, dass ich intensiv über etwas nachdenken muss.	○	○	○	○	○	○	○
Ich würde lieber etwas tun, das mit Sicherheit meine Denkfähigkeit herausfordert, als etwas, das wenig Denken erfordert.	○	○	○	○	○	○	○
Ich mag komplexe Problemstellungen lieber als einfache Problemstellungen.	○	○	○	○	○	○	○
Ich finde wenig Befriedigung darin, angestrengt stundenlang nachzudenken.	○	○	○	○	○	○	○
Ich vertraue meinen unmittelbaren Reaktionen auf andere.	○	○	○	○	○	○	○
Ich glaube, ich kann meinen Gefühlen vertrauen.	○	○	○	○	○	○	○
Mein erster Eindruck von anderen ist fast immer zutreffend.	○	○	○	○	○	○	○
Wenn die Frage ist, ob ich anderen vertrauen soll, entscheide ich normalerweise aus dem Bauch heraus.	○	○	○	○	○	○	○
Ich erkenne meistens, ob eine Person recht oder unrecht hat, auch wenn ich nicht erklären kann, warum.	○	○	○	○	○	○	○

Weiter

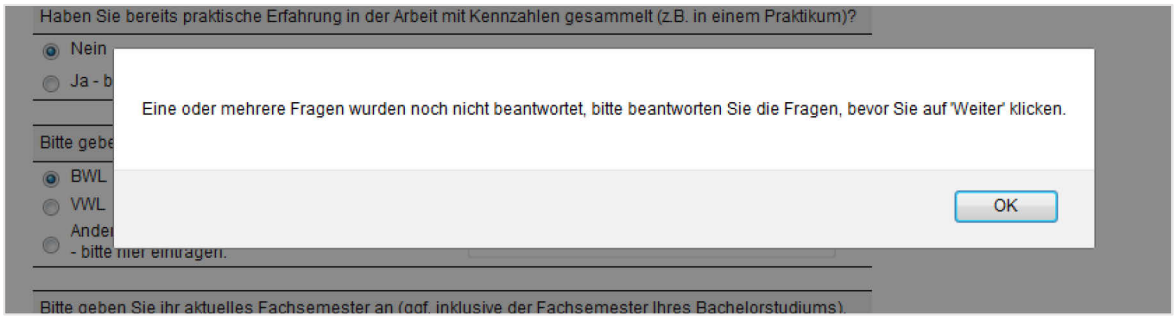
Message window if not all questions had been answered:



General questions on personal characteristics, education, and practical experience:



Message window if not all questions had been answered:



5) Payoff

Information on general payoff calculation and resulting individual payoff:

Vielen Dank für die Beantwortung der Fragen. Im Folgenden finden Sie **Informationen zu Ihrer Punktzahl und der resultierenden Auszahlung**:

Zur konkreten **Messung der Entscheidungsqualität** wurden Punkte vergeben, wobei sowohl die Reihenfolge (korrekte Folge einer Alternative auf den jeweiligen Vorgänger, 5 Punkte oder 0 Punkte) als auch der Listenplatz berücksichtigt wird (jeweils 5 Punkte abzüglich der Abweichung zum korrekten Listenplatz). Bei 6 Unternehmen konnten so maximal 60 Punkte erzielt werden. Bei 100% der möglichen Punkte (vollständig korrektes Ranking), erhalten Sie 10 EUR zusätzlich. Erreichen Sie weniger als 100% der Punkte, erfolgt dementsprechend eine anteilige Auszahlung (also z.B. 5 EUR, wenn Sie 50% der Punkte erreichen).

Beispiel zur Berechnung der Punktzahl: In dieser Aufgabe lautet das **korrekte Ranking E>F>A>D>C>B.** Angenommen, stattdessen wurde das Ranking E>B>A>D>C>F abgegeben, die Platzierungen für B und F wurden also vertauscht. In diesem Beispiel berechnet sich die Punktzahl folgendermaßen:

- **Im ersten Schritt** wird ausgewertet, ob die Alternativen auf den **korrekten Vorgänger** folgen. Dies ist im Beispiel für die Unternehmen C, D und E der Fall. Pro richtigen Vorgänger gibt dies 5 Punkte, in diesem Fall also 15 Punkte.
- **Im zweiten Schritt** wird der **Listenplatz** bewertet. Im obigen Beispiel sind alle Unternehmen auf dem richtigen Listenplatz, außer B und F. Für die richtig platzierten Unternehmen (E, A, D, C) werden jeweils 5 Punkte vergeben. Für die falsch platzierten Unternehmen werden jeweils 5 Punkte abzüglich der Abweichung zum korrekten Listenplatz vergeben. Hier also 5-4=1 Punkt, jeweils für B und F. In Summe ergibt sich somit aus der zweiten Komponente im Beispiel eine Punktzahl von 5+5+5+5+1+1=22 Punkten.
- **Insgesamt** ergibt sich in diesem Beispiel somit eine Punktzahl von 15+22=37 Punkten. Ein komplett richtiges Ranking würde in einer Punktzahl von 60 Punkten resultieren. Mit 37 Punkten wären somit 37/60=61.67% erreicht, und hiermit eine Gesamtauszahlung von 4 EUR + 6.17 EUR = 10.17 EUR.

Ihr Ergebnis:

- Auf Basis Ihrer Entscheidung haben Sie 29 von 60 möglichen Punkten errreicht.
  Dies entspricht 48.33 % und somit einem Bonus von 4.83 EUR.
- Ihre **Gesamtauszahlung**, die sich aus der Basisentlohnung von 4.00 EUR und dem Bonus zusammensetzt, beträgt somit 4.00 EUR + 4.83 EUR = 8.83 EUR.
- Die Details zu Ihrer Punktzahl finden Sie in der folgenden Tabelle:

Resultierende Punktzahl auf Basis Ihres Rankings:

	Unternehmen					
	A	B	C	D	E	F
Optimales Ranking auf Basis des finalen Informationssets:	3	6	5	4	1	2
Ihr Ranking:	1	4	3	2	6	5
Resultierende Punktzahl:	3	8	8	8	0	2

Weiter

6) Comments and thank you

Option to comment on the experiment:

Gerne können Sie hier Ihre Kommentare eintragen:

Weiter

Thank you note and request to remain seated until study was finished: