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Compilation and Validation of information systems effectiveness questionnaire

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Abstract

Information systems (IS) involve a variety of information technologies (IT) such as computers, soft-ware, databases, communication systems, the Inter-net, mobile devices and much more, to perform specific tasks, interact with and inform various actors in different organizational or social contexts. Of general interest to the field of IS are therefore all aspects of the development, deployment, implementation, use and impact of IS in organizations and society. However, there is no valid scale for measuring the effectiveness of information systems. This lack of conceptual engagement with 'IS' motivated recent calls to the IS community to further its engagement with core concepts that are central to the field and its research. Therefore, the current research sought to develop a questionnaire for the effectiveness of information systems. The current research method was applied and survey. In this regard, a questionnaire has been designed. The validity of the questionnaire has been checked using exploratory analysis. Data were analysed with Spss software. The results of data analysis showed the appropriate validity of the questionnaire questions.

Keywords: information, system, information system, IS typology, Decision making, IS applications, IS security, IS evaluation, IS evolution.

1. Introduction

Companies today are increasingly dependent on their information systems, which frequently leads management to focus on improving systems quality. For instance, Gorla et al. (2010) saw a well-developed and implemented system as a prerequisite for achieving organizational benefits. Likewise, high system quality usually enhances the results at a firm's operational level (Bradley et al., 2006). One component of a highly developed information system are enterprise resource planning (ERP) systems. These contribute to higher profitability and, through their integration, can improve the internal coordination of individual business areas (Hendricks et al., 2007; Gorla et al., 2010). Management accounting and control is one of these business areas. The implementation of ERP systems in the 1990s created new opportunities to support management accountants as well as their role change (Rom and Rohde, 2007). For example, standardization, integration and the availability of real-time data led management accountants to perform routine tasks less frequently (Scapens and Jazayeri, 2003). In line with this notion, Sánchez-Rodríguez and Spraakman (2012) found that automation led management accountants to engage in analysis tasks rather than data entry tasks. In addition, the standardization of available data resulted in more accurate and timely information, paving the way for more efficient and effective management accounting and control techniques (Fähndrich, 2022). Besides these technical benefits, the implementation of ERP systems also increased the use of non-financial information due to their greater and easier availability (Sánchez-Rodríguez and Spraakman, 2012). Consequently, when ERP systems became widespread in many organizations 20 years ago, information systems quality in management accounting was already crucial for management accountants (e.g., Burns and Quinn, 2011). This has not changed today, as high-quality and digitalized information systems are viewed as enabling management accountants to work more effectively than previously, thus promising to support effective control practices (e.g., Bhimani and Willcocks, 2014; Gärtner and Hiebl, 2018; Nielsen, 2022; Oesterreich and Teuteberg, 2019; Wolf et al., 2020; Youssef and Mahama, 2021). More generally, the use of digital technologies such as ERP systems, business analytics, and artificial intelligence is part of an ongoing transformation process in the management control functions of many firms worldwide (Youssef and Mahama, 2021; Thaller et al., 2023). Against this backdrop, we can assume that high-quality information systems provide an important resource for the management control function in the contemporary business environment (Knauer et al., 2020). That is, high-quality information systems can be expected to contribute positively to management control effectiveness. In this connection, such effectiveness reflects how well an organization's overall package of control systems helps the organization fulfill its strategic objectives (Bedford et al., 2016; van der Kolk, 2019). The available literature on information systems in management accounting, however, paints no unequivocal picture of how these systems relate to management control effectiveness. On the one hand, the qualitative research literature suggests that information systems enable management accountants to have more time to design effective control systems, which can in turn benefit the entire organization (e.g., Sánchez-Rodriguez and Spraakman, 2012; Scapens and Jazayeri, 2003). On the other hand, there are also results showing that the implementation of ERP systems has not necessarily led to significant improvements in the management control function. For example, Rom and Rohde (2007) found that there is no substantial relationship between ERP systems and improvement in the budgeting process. Granlund and Malmi (2002) came to a similar conclusion by showing that ERP

systems can lead to improvement in forecasting but have limited effect on other management control activities such as budgeting. These inconclusive findings about the impact of high-quality, digitalized information systems on management control practices make further empirical research necessary (Fähndrich, 2022; Möller et al., 2020). In particular, the relationship between accounting information systems and management control effectiveness has so far only been explicitly investigated in a quantitative study of small businesses with less than 50 employees in the developing country of Yemen (Al-Hattami and Kabra, 2022). While Al-Hattami and Kabra (2022) found a positive effect of accounting information systems quality on management control effectiveness, they call for further research in other regions and on larger firms. Indeed, it seems uncertain if their results can be generalized to larger firms and those situated in more highly developed countries since high-quality information systems may make less of a difference in highly-developed countries and larger firms (Franke and Hiebl, 2023). Consequently, in this study, we examine the relationship between information systems quality in management accounting and management control effectiveness in a different cultural context and test this relationship based on a survey of German Mittelstand firms. In addition, we examine the potential moderating role of process automation. Due to the changing business environment and advances in robotics and information technology, many companies have been increasing the automation of their production processes (e.g., Autor, 2015; Hiebl and Pielsticker, 2022, 2023; van Veen-Dirks, 2005). Due to process automation, many tasks can be performed by computers or machines, eliminating control problems that can occur when humans carry out work (Autor, 2015; Merchant and van der Stede, 2017). In addition, modern and automized production systems in the context of Industry 4.0 provide real-time data, which can inform and enforce information systems in management accounting (Kamble et al., 2020). We thus assume that if the business processes of an organization are generally more automatized and create real-time data along the way, high-quality information systems in management accounting will be even more valuable since management accountants can then make better use of such data to implement more effective management controls. Therefore, we assume that the degree of process automation positively moderates the relationship between information systems quality in management accounting and management control effectiveness. We test our assumptions based on a survey conducted among German Mittelstand firms in 2020. The results of our hierarchical regression analysis support the proposed hypotheses. Our study therefore contributes to the literature on management accounting information systems and the effectiveness of management control systems in two primary ways. First, it is one of the first, along with Al-Hattami and Kabra (2022), to quantify the relationship between information systems quality in management accounting and the effectiveness of management control systems and largely confirms the evidence from qualitative research on positive effects of information systems in management accounting (e.g., Sánchez-Rodriguez and Spraakman, 2012). Second, our study adds the moderating effect of process automation to this literature, showing that the positive effect of high-quality information systems in management accounting on management control effectiveness does not unfold universally in all organizations.

2. Literature review

1. Information Definition

According to Russell Ackoff, a systems theorist and professor of organizational change, the content of the human mind can be classified into three categories:

1. Data represents a fact or an event statement unrelated to other things. Data is generally used regarding hard facts. This can be a mathematical symbol or text used to identify, describe, or represent something like temperature or a person. The data simply exists and has no meaning beyond its existence (in itself). It can exist in any form, usable or not. The data exists in different formats, such as text, image, sound, or even video.

2. Information is data combined with meaning. Information embodies the understanding of a relationship as the relationship between cause and effect. Ex: The temperature dropped 15 degrees, then it started to rain. A temperature reading of 100 can have different meanings when combined with the term Fahrenheit or with the term Celsius. More semantics can be added if more context for the temperature read is added, such as the fact that this temperature concerns a liquid or a gas or the seasonal norm of 20 °. In other words, information is data that has meaning through relational connection. According to Ackoff, information is useful data; it provides answers to the questions: "who," "what," "where," and "when."

3. Knowledge can be seen as information combined with experience, context, and interpretation. Knowledge constitutes an additional semantic level derived from information via a process. Sometimes this process is observational. Ackoff defines it as applying data and information; knowledge provides answers to the question "how" For example, what happens in cold weather for aircraft managers? Observational knowledge engineers interpret cold by its impact, which is the ice that can form on an aircraft by reducing aerodynamic thrust and potentially hampering the performance of its control surfaces.

IF temperature <= 0 ° C THEN cold = true;

IF cold == true THEN notify personnel to remove ice from aircraft.

Indeed, knowledge is the appropriate collection of information such that it intends to be useful. Knowledge is a deterministic process. Memorization of information leads to knowledge. Knowledge represents a pattern and provides a high level of predictability regarding what is being described or will happen next.

Ex: If the humidity is very high and the temperature drops drastically, the atmosphere is unlikely to hold the humidity so that it rains.

This knowledge has a useful meaning, but its integration in a context will infer new knowledge. For example, a student memorizes or accumulates knowledge of the multiplication table. A student can answer 2 x 2 because this knowledge is in the multiplication table. Nevertheless, when asked for 1267 x 300, he cannot answer correctly because he cannot dip into the multiplication table. To answer such a question correctly requires a real cognitive and analytical capacity that exists in the next level ... comprehension. In computer jargon, most of the applications we use (modeling, simulation, etc.) use stored knowledge.

2. System Definition

The system is an aggregated "whole" where each component interacts with at least one other component of the system. The components or parts of a system can be real or abstract. All system components work toward a standard system goal. A system can contain several subsystems. It can be connected to other systems. A system is a collection of elements or components that interact to achieve goals. The elements

themselves and the relationships between them determine how the system works. Systems have inputs, processing mechanisms, outputs, and feedback mechanisms. A system processes the input to create the output.

• Input is the activity of collecting and capturing data.

• Processing involves the transformation of inputs into outputs such as computation, for example.

• Output is about producing useful information, usually in the form of documents and reports. The output of one system can become the input of another system. For example, the output of a system, which processes sales orders, can be used as input to a customer's billing system. Computers typically produce output to printers and display to screens. The output can also be reports and documents written by hand or produced manually.

• Finally, feedback or feedback is information from the system used to modify inputs or treatments as needed.

3. Information System Definition

An information system (IS) is a set of interrelated components that collect, manipulate, store and disseminate information and provide a feedback mechanism to achieve a goal. The feedback mechanism helps organizations achieve their goals by increasing profits, improving customer service [3], and supporting decisionmaking and control in organizations. Companies use information systems to increase revenues and reduce costs. elements, proposed in the 1960s by Harold Leavitt (Figure 1). The pattern is known as the "Leavitt Diamond."

1. Technology: The IT (Information Technology) of an IS includes the hardware, software, and telecommunications equipment used to capture, process, store and disseminate information. Today, most IS are IT-based because modern IT enables efficient operations execution and effective management in all sizes.

2. Task: activities necessary for the production of a good or service. These activities are supported by the flow of material, information, and knowledge between the different participants.

3. Person: The people component of an information system encompasses all the people directly involved in the system. These people include the managers who define the goals of the system, the users, and the developers.

4. Structure: The organizational structure and information systems component refers to the relationship between individual’s people components. Thus, it encompasses hierarchical structures, relationships, and systems for evaluating people.

3. Research Methodology

The current research method is based on the purpose of applied research and based on the method of data collection, it is considered a descriptive method of the survey branch. Based on this, first, the aspects and study topics related to the questionnaire of the effectiveness of information systems, as well as similar studies and researches, will be examined about the subject of the research, then by using field studies, the hypotheses will be explained according to the title and purpose of the research. According to the four methods of theorizing perspective, i.e. expanding or improving existing theories, comparing different theoretical perspectives, examining a specific phenomenon using different theoretical perspectives, and finally examining a documented and recurring phenomenon in a new environment and conditions (Feldman, 2004), the present research in It is placed in the fourth group.

4. Result

Before performing any analysis on the collected data and statistical inference, the reliability and validity of the measurement tool must be ensured. The reliability of the questionnaire was measured by Cronbach's alpha test and the test results showed that the used questionnaires have the necessary reliability and accuracy. In order to measure validity, there are various methods, and in this research, due to the fact that the variables of the research consist of several dimensions (components), the confirmatory factor analysis test has been used. Therefore, as stated in the third chapter, in conducting factor analysis, it must be ensured whether the available data can be used for the analysis or not. in other words; Is the desired amount of data suitable for factor analysis or not? For this purpose, KMO index and Bartlett's test were used. Based on these two tests, the data are suitable for factor analysis when the KMO index is greater than (0.6) and close to one and the sig of Bartlett's test is less than (0.05). The results of these tests are presented in the following tables.

Table 1: KMO and Bartlett test for questionnaire questions

0.906	KMO	
122	χ^2	**Bartlett**
276	df	
0.000	Sig	

According to table 1); the value of KMO index is equal to 0.906 (more than 0.6), so the number of samples (number of respondents) is sufficient for factor analysis. Also, the sig value of Bartlett's test is smaller than 0.05; which shows that factor analysis is suitable for identifying the structure of the factor model and the assumption that the correlation matrix is known is rejected.

In exploratory factor analysis, the principal components method was used to extract the factors and the Varimax method with Keyser normalization was used to rotate the factors. Criteria for deciding on the survival or removal of questionnaire questions from factor analysis; their share values are derived. In this way, if the extracted share value of each question is less than (0.5), we exclude that question from the factor analysis. Also, the criteria for deciding on the classification of questions, characteristic values higher than (1) and factor scores higher than (0.4) have been considered. The results of the exploratory analysis test are shown in table (2). In order to show in which factor each questionnaire question is placed, the highest factor load of that question is marked with another Color in the exploratory factor analysis tables.

Exploratory factor analysis of questionnaire questions

Table 2. Matrix of factors rotated by principal component analysis method and Varimax rotation method with Kiser normalization of questions

Extractive subscription	Factor 6	Factor 5	Factor 4	Factor 3	Factor 2	Factor 1	Questions
	Anticipation of future benefits	**User intentions**	**User satisfaction**	**service quality**	**System quality**	**Information quality**	
.687						.690	**Question 1**
.704						.743	**Question 2**
.645						.640	**Question 3**
.612						.542	**Question 4**
.562						.505	**Question 5**
.520						.580	**Question 6**
.566					.608		**Question 7**
.635					.684		**Question 8**
.566					.687		**Question 9**
.594					.606		**Question 10**
.543					.602		**Question 11**
.584				.578			**Question 12**
.707				.680			**Question 13**
.683				.735			**Question 14**
.688			.790				**Question 15**
.588			.544				**Question 16**
.552			.484				**Question 17**
.657			.676				**Question 18**
.646			.712				**Question 19**
.587		.474					**Question 20**
.643		.574					**Question 21**
.677		.590					**Question 22**
.676		.493					**Question 23**
.657	.656						**Question 24**
.634	.700						**Question 25**
.666	.734						**Question 26**

According to Table 2), the value of extracting commonality for all questions is more than (0.5) and no question from the questionnaire needs to be left out. According to the table, six factors with characteristic value higher than one have been extracted, and all the questions related to this variable are included in these six factors. Also, according to the factors of the questions; Each of the questions have the highest factor load in the same factor that was predetermined. Therefore, each question measures exactly the same factor for which it was designed, so the questions of the questionnaire have the required validity.

2. Conclusions

The objective of this study was to quantitively test the potential positive impact of Information Systems Quality in Management Accounting on Management Control Effectiveness. The majority of studies in this area are case studies that focus on the implementation of an information subsystem such as an ERP system (e.g., Scapens and Jazayeri, 2003; Dechow and Mouritsen, 2005; Quattrone and Hopper, 2006) and quantitative studies have so far been scarce (but see exceptions such as Al-Hattami and Kabra, 2022; Knauer et al., 2020; Youssef and Mahama, 2021). Based on a survey of 125 German Mittelstand firms, we find empirical evidence that high-quality information systems in management accounting lead to higher management control effectiveness. Particularly among the qualitative contributions, results on the influence of information systems (e.g., ERP systems) on the effectiveness of management accounting and control practices were mixed (e.g., Granlund and Malmi, 2002; Fähndrich, 2022; Rom and Rohde, 2007; Sánchez-Rodriguez and Spraakman, 2012). While we did not measure the usage or the sophistication of ERP systems, but rather investigated the quality of information systems in management accounting more broadly, our results are more in line with qualitative studies suggesting a positive effect of high-quality information systems on management control effectiveness (e.g., Sánchez-Rodriguez and Spraakman, 2012; Scapens and Jazayeri, 2003). This does not mean that our results on these positive effects can be generalized unequivocally, but at least in the context of our examined German Mittelstand firms, high-quality information systems in management accounting seem to have a net-positive effect on management control effectiveness. The evidence presented in this paper thus adds to the so-far small number of quantitative studies examining the relationship between information systems in management accounting and management control effectiveness. Our results thus respond to the call by Fähndrich (2022), who concluded his systematic literature review on the impact of digitalization on management accounting and control with the assessment that further quantitative studies are necessary to understand more precisely the influence of digitalized information systems on the effectiveness of management control systems. In comparison to three related quantitative studies (Al-Hattami and Kabra, 2022; Knauer et al., 2020; Youssef and Mahama, 2021), our paper extends current knowledge in several ways. First, it adds that the positive relationship between high-quality information systems in management accounting and management control effectiveness cannot only be found in the emerging-market context of Yemen and for small firms (Al-Hattami and Kabra, 2022), but also in the more developed context of Germany and for larger firms. Our results on this direct relationship thus confirm the findings by Al-Hattami and Kabra (2022) for a different cultural context. Second, we extend the findings by Knauer et al. (2020) and Youssef and Mahama (2021). Knauer et al. (2020) have found that high information systems quality in management accounting has a positive impact on data quality in such accounting. We relied on the same measurement of information systems quality in management accounting as Knauer et al. (2020), and add to their findings by showing that information systems quality in such accounting is also positively

related to management control effectiveness. Similarly, while Youssef and Mahama (2021) found positive effects of individual information systems (ERP,

24business intelligence, business analytics) on individual management control practices (e.g., budgeting, costing practices, performance evaluation), our results show that this positive relationship can also be found at the more general level of information systems quality in management accounting and management control effectiveness. The result of this positive relationship is not only relevant for research, but is also practically relevant, as it suggests that improving information systems and sustaining high quality is a driver of effective management control systems. According to Knauer et al. (2020), this can be realized by investing in IT, using innovative technologies, enhancing internal IT skills and adopting external consulting. In addition, our results show that the degree of process automation has a moderating effect in the relationship between information systems quality in management accounting and the effectiveness of management control systems. We find that in firms with higher degrees of process automation, the positive relationship between information systems quality in management accounting and management control effectiveness is more pronounced than in firms with lower degrees of process automation. As theorized above, we attribute this moderating role of the degree of automation to more real-time data being available in more automized firms thanks to modern production facilities. That is, our results add the contextual factor of overall process automation in an organization. This contextual factor has not yet been examined in the literature on information systems and the effectiveness of management controls. Our study thus shows that automation is not only a relevant feature of modern production facilities (e.g., Korhonen et al., 2021), but may – as a side-effect – also generate more detailed and faster available data that can boost the benefits of high-quality organizational information systems. For organizational practice, it can thus be concluded that process automation may not only increase production efficiency, but management accountants might also benefit in their daily work. At the same time, we assume that process automation might not be the only contextual factor that could potentially affect the relationship between information systems quality and management control effectiveness. For instance, based on the existing accounting and information systems literatures, we could expect that features of organizational culture such as a data-driven culture (Franke and Hiebl, 2023; Oesterreich et al., 2022), factors relating to actors' personal skills such as management accountants' IT skills (Franke and Hiebl, 2023; Oesterreich et al., 2019; Richardson and Watson, 2021; Thaller et al., 2023), or technology-related factors such as homogenous data infrastructures (Geerts and O'Leary, 2022; Shanks and Bekmamedova, 2012), could also impact this relationship. To create a fuller picture of the situations in which high-quality information systems in management accounting have their biggest benefits, we deem research on such additional contextual factors necessary from both a research and a practice viewpoint.

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Appendix

Questionnaire

questions	Questionnaire components
1-6	**Information quality**
7-11	**System quality**
12-14	**service quality**
15-19	**User satisfaction**
20-23	**User intentions**
24-26	**Anticipation of future benefits**

					questions	
Information quality						
					The data in HIS is comprehensive, accurate and provides an adequate overview of the clinic work.	1
					You can easily get the necessary information in HIS.	2
					The necessary information in HIS is clear and orderly.	3
					HIS information is always up to date.	4
					HIS provides the information required for work.	5
					It is easy to document information using HIS.	6
System quality						
					I can easily learn to work with HIS.	7
					The response time for logging into the system is satisfactory.	8
					There is a high speed and satisfaction in switching between HIS displays.	9
					HIS is stable and stable to a satisfactory degree.	10
					Logging into the system is easy.	11
service quality						
					I am very satisfied with the support I received during the first 14 days of implementation.	12
					I am very surprised by the support I received after the first 14 days.	13
					I am very satisfied with the guidance provided to users in this system.	14
User satisfaction						
					In general, HIS supports my work method.	15
					Implementation of HIS requires the creation of new tasks for me.	16
					Implementing HIS means that most of my tasks have been reduced.	17
					HIS replaces paper documents.	18
					Overall, HIS has made my job easier.	19
User intentions						
					A positive attitude towards the system has had a great impact on the acceptance and use of HIS.	20
					Avoiding uncertainty has had a great impact on the adoption and use of HIS.	21
					The degree of compatibility with HIS has a great impact on acceptance and use.	22
					A person's perception about the ease of using HIS has a great impact on its acceptance and success.	23
Expectations of future benefits						
					I expect HIS to bring great benefits to patients in the future.	24

					I expect HIS to bring great benefits to employees in the future.	25
					I expect HIS to bring great benefits to the hospital in the future.	26