# INCREASING INFORMATION VISUALIZATION COMPLIANCE IN SELF-SERVICE BUSINESS INTELLIGENCE WITH USER ASSISTANCE SYSTEMS

*Research Paper*

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## Abstract

*Self-Service Business Intelligence (SSBI) is increasingly used in organizations. While enabling laypersons in report design to create their own reports in a timely manner, studies show that Business Information Visualization (BIV) is often inappropriately applied in these reports. This may lead decision makers to wrong conclusions. As a result, companies start to establish BIV governance frameworks, which employees are expected to comply with when designing reports. For this, they often provide employees with documentations about which guidelines to comply with. However, since employees may perceive this as additional effort with limited benefit, they may opt to simply not comply. If they are instead equipped with software that provides the functionality to comply, this software often lacks a description of the benefits of this compliance. To overcome this, user assistance systems (UAS) could be used, since they may both reduce the effort to comply as well as describe the usefulness of compliance. To investigate this issue, we developed a prototypical UAS for BIV, suggest a design for a laboratory experiment, and present findings from a first preliminary study. Results indicate that using UAS for BIV may lead to increased perceived ease of use and perceived usefulness of complying with BIV guidelines.*

*Keywords: User Assistance Systems, Business Information Visualization Guidelines, Compliance, Self-Service Business Intelligence, Design Science Research.*

*DOI: 10.5445/IR/1000083113*

## 1 Problem Identification and Research Objective

To design business reports, Self-Service Business Intelligence (SSBI) is increasingly utilized in organizations (Bange *et al.*, 2017). Here, laypersons in report design (e.g., business users) may use multiple features (e.g., visualizations) to develop their own business reports in a timely manner and share them with decision makers (Poonnawat and Lehmann, 2014). Due to their lack of report design knowledge, however, they often do not correctly apply Business Information Visualization (BIV) within their SSBI reports (Eisl *et al.*, 2015; Beattie and Jones, 2008), which leads to wrong impressions due to a distorted perception (Arunachalam *et al.*, 2002). Thus, decision makers who receive and rely on these delusive business reports may be misled and conclude inappropriately (Arunachalam *et al.*, 2002; Beattie and Jones, 2008). To avoid these negative outcomes, approximately 75% of companies strive

for a standardized reporting (Riedner and Janoschek, 2014). In doing so, they often establish BIV governance frameworks in the organization, which employees are expected to comply with when designing business reports (Bange *et al.*, 2017; Gluchowski, 2014; Russom *et al.*, 2015). For this, they often provide employees with documentations about which guidelines to comply with. However, since employees may perceive this as additional effort with limited benefit, they may opt to simply not comply (Riedner and Janoschek, 2014). If they are instead provided with software that provides the functionality to comply, this software often lacks a description of the benefits of this compliance (e.g., Chart-me XLS (Gerths, 2018)), which in turn may reduce the intention to comply with BIV guidelines. Possible consequences of this lack of assistance with complying and explaining benefits of compliance are frustration and low efficiency of employees, resulting in overall dissatisfaction (Coch and French, 1948).

It is hence imperative to strive for a solution that makes it both easy for employees to comply with BIV guidelines and raises their understanding of the usefulness of complying with them at the same time. Due to their various applications, a promising approach to achieve these goals is the use of user assistance systems (UAS) (Ludwig, 2015). They help users to perform their tasks better (Maedche *et al.*, 2016) and hence, may increase the perceived ease of use of complying with BIV guidelines. In addition, when UAS are equipped with informative explanations as to why suggestions are made, they may raise an understanding of the perceived usefulness of complying with BIV guidelines (Morana *et al.*, 2017). According to the technology acceptance model (TAM) introduced by Davis (1986), this may in turn lead to an increased intention to comply with BIV guidelines.

In this study, we hence introduce a design science research (DSR) project that aims to develop a UAS that supports employees in complying with BIV guidelines. During the first design cycle, we focused on describing the development of a prototypical artifact, the "BIV Assistant" (Schelkle, 2017). With this current study, we aim to investigate how UAS for BIV may affect the intention to comply with BIV guidelines in management reporting. Having conducted a systematic literature search, based on our sample, we could not identify prior research that explicitly concerns questions whether UAS may actually foster the intention to comply with guidelines (see section 2). Therefore, we set out to evaluate a prototypical UAS for BIV to answer the following research question:

*RQ: To what extent do UAS affect the intention to comply with BIV guidelines in management reporting, in particular in an SSBI environment?*

To achieve this, we aim to evaluate this prototypical UAS for BIV in a laboratory experiment. Herewith, we follow the call of Maedche *et al.* (2016) to study the effects of UAS in the information systems (IS) domain. This research suggests an experimental design for our planned evaluation and provides findings from a preliminary study.

The remainder of this paper is structured as follows. Section 2 discusses related work followed by the terminology and theoretical background in section 3. Section 4 briefly describes the functionality and design of the artifact. The experimental setting and first evaluation results are presented in section 5. The paper closes with a conclusion and outlook for future research possibilities.

## 2 Related Work

To see whether UAS are used to foster acceptance of and intention to comply with guidelines, knowledge and solutions from prior literature have to be discussed (Peffers *et al.*, 2007). Hence, we conducted a structured literature review drawing on the taxonomy of Cooper (1988) (see Table 1).

| | | | | |
|---|---|---|---|---|
| Focus | Research Outcomes | Research Methods | Theories | Applications |
| Goal | Integration | Criticism | Central Issues | |
| Perspective | Neutral Representation | Espousal of Position | | |
| Coverage | Exhaustive | Exhaustive & Selective | Representative | Central/Pivotal |

| Organization | Historical | Conceptual | Methodological |
|---|---|---|---|

*Table 1. Taxonomy of Literature Reviews proposed by Cooper (1988)*

We *focus* on the identification of research outcomes on compliance with guidelines by using UAS as applications. The *goal* is to identify central issues in prior research that investigate UAS, which are used to affect the intention to comply with predefined BIV guidelines. Since our aim is to identify existing UAS, which evaluate the intention to comply with guidelines, we adopt a neutral *perspective*. Focusing on UAS as well as BIV as central aspects, we follow a *pivotal* approach. The search is *organized* conceptually, i.e., studies addressing the same idea, UAS used for compliance, appear together.

Since studies related to BIV are fundamentally multidisciplinary (Ware, 2004), we included literature from prior research in computer science and human visual perception (IEEE Xplore and ScienceDirect) as well as business and management (Emerald Insight) in our literature search. To reflect the AIS Senior Scholars' Basket of Journals and important conference proceedings in the IS field, we added the AIS Electronic Library. To complement the search, we included specific management accounting and IS journals (i.e., HMD Praxis der Wirtschaftsinformatik, Journal of Management Accounting Research, Journal of International Financial Management, and Accounting and Management Accounting Quarterly). We conducted a keyword search comprising title, abstract, and keywords applying the search term *"User Assistance System" OR "User Assistant" OR "User Support System" OR "Assistenzsystem"* to reveal literature in the above-mentioned outlets. As a result[1], *49* articles that deal with UAS could be identified. These range from assistance in healthcare (e.g., Henkemans *et al.* (2006)) and ambient assisted living (e.g., Schneider *et al.* (2016)) to education (e.g., Carlier and Renault (2010)) and many more. However, only one article is related to the information visualization domain and discusses a UAS that suggests to users different mappings between their data and possible visualizations (Guettala *et al.*, 2012). Although this study shows the potential of using UAS for BIV, compliance with specific BIV guidelines is not addressed. Since we could not identify literature that addresses UAS and compliance directly, we chose to draw on aspects of acceptance, which might indicate compliance characteristics to some extent. Six out of the 49 articles are related to acceptance. Four articles present technological aspects of acceptance, such as the importance of dialogues (Henkemans *et al.*, 2006), the acceptance of augmented reality (Bleser *et al.*, 2011), the acceptance of smart watches versus mobile phones among dementia patients (Schneider *et al.*, 2015), or pilots accepting a new cockpit assistance system due to its features (Onken and Walsdorf, 2001). The remaining two articles discuss an algorithm for a lecture allocation system at a university, in which students may accept the assigned lecture (Matsuo and Fujimoto, 2005a, 2005b).

As a result, although some papers address aspects of acceptance, we could neither identify studies that discuss UAS with a focus on compliance in general, nor how UAS may affect the intention to comply with BIV guidelines. Although there might be relevant publications in other outlets, we suppose that our literature review has a satisfying degree of comprehensiveness, since researchers argue that a search can be terminated when the authors are confident of the novelty of the identified area (Boell, Sebastian K. and Cecez-Kecmanovic, 2010). Hence, we claim that our search shows a research gap that we intend to bridge with our study.

# 3 Terminology and Theoretical Background

When information visualization technologies are used to visualize business information (e.g., charts or tables) it is referred to as BIV (Tegarden, 1999). Hence, BIV is the use of computer-supported interactive visual representations of business data to amplify cognition for improved decision making (Bačić and Fadlalla, 2016, p. 78). This involves defining graphical elements and their relationships to display relevant information (Al-Kassab et al., 2014).

[1] Due to length limitations, we are not able to list all identified references. The list can be provided upon request.

To establish a theoretical underpinning for how UAS might affect the intention to comply with BIV guidelines, we may first look at previous work on compliance in IS literature. A domain within IS that strongly focuses on user compliance is security, as there are many security policies that employees are expected to comply with in order to prevent organizations from potentially dire consequences (Bulgurcu *et al.*, 2010). In this context, it is argued that when it comes to an individual's decision whether to comply with such policies, they take into account both the benefit of complying with the policy as well as the cost of complying with the policy (Bulgurcu *et al.*, 2010). The reasoning for this is rooted in rational choice theory that posits that individuals take these parameters into account for any decision at hand (Paternoster and Pogarsky, 2009; McCarthy, 2002). Hence, in our context, individuals might also trade off their personal benefit of complying with BIV guidelines as well as the effort caused by complying with these guidelines. According to the theory of planned behavior, this has an effect on their attitude towards complying with BIV guidelines which in turn may influence the intention to comply with BIV guidelines (Fishbein and Ajzen, 1975; Ajzen, 1991). Additional important constructs that affect the intention to comply with security policies are self-efficacy to comply and normative beliefs (Bulgurcu et al., 2010). Self-efficacy to comply describes whether individuals believe they have the abilities and knowledge to comply with the policies whereas normative beliefs express social pressure to comply with these policies. Again, in our context, we expect to observe effects of self-efficacy with regard to complying with BIV guidelines as well as social norms that urge individuals to comply with BIV guidelines.

A prominent theoretical framework that ties these streams of thought together is the TAM (Davis, 1986). It postulates that an individual's intention to use a system (or in our case to comply with BIV guidelines) is determined by perceived usefulness and perceived ease of use (Davis, 1986). Perceived usefulness is defined as the extent to which a person believes that using a particular system will enhance job performance (Davis, 1986), which might in our case be interpreted as the benefit individuals expect from complying with BIV guidelines. The degree to which a person believes that using a particular system will be free of physical and mental effort is defined as perceived ease of use (Davis, 1986), which in our case refers to the individual's cost or effort of complying with BIV guidelines. Thus, when perceived ease of use (i.e., little effort to comply with BIV guidelines) and perceived usefulness (i.e., benefits from complying with BIV guidelines) are high, individuals have a high intention to use a system, or in our case, intention to comply with BIV guidelines.

One promising approach to increase the aforementioned antecedents of the intention to comply with BIV guidelines is using UAS. They guide users (e.g., management accountants) while performing a specific task (e.g., designing business charts) (Maedche *et al.*, 2016), thus fostering perceived ease of use of the task at hand. Since UAS provide guidance or advice on a topic (Maedche *et al.*, 2016), for example on how to adequately apply BIV, they might also foster perceived usefulness of complying with BIV guidelines, as the reason why to use them and what benefits this compliance might have are shown. In addition, this may foster self-efficacy about how to appropriately design business reports. Since SSBI users are at some point novices in report design, they are likely to have a low reporting-related self-efficacy (i.e., the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations (Bandura, 1995)) to design non-misleading reports. Hence, we also investigate how UAS may increase their perceived BIV related capabilities and thus their self-efficacy. Although normative beliefs in general play a role for the intention to comply with BIV guidelines, we do not expect a UAS for BIV to influence social pressure to comply with BIV guidelines, as accepting the system's recommendations is the users' decision. We hence propose the following hypotheses:

H1: Using UAS for BIV increases the intention to comply with BIV guidelines.

H2: Using UAS for BIV increases the perceived usefulness of complying with BIV guidelines.

H3: Using UAS for BIV increases the perceived ease of use of complying with BIV guidelines.

H4: Using UAS for BIV increases reporting-related self-efficacy.

In line with the propositions introduced in the TAM, we also expect to see positive relationships between the intention to comply with BIV guidelines and its antecedents. We thus propose:

H5: There is a positive relationship between the perceived usefulness of complying with BIV guidelines and the intention to comply with BIV guidelines.

H6: There is a positive relationship between the perceived ease of use of complying with BIV guidelines and the intention to comply with BIV guidelines.

H7: There is a positive relationship between reporting-related self-efficacy and the intention to comply with BIV guidelines.

To investigate these hypotheses, we will propose an experimental design as well as results from a preliminary study in section 5. First, we will briefly describe the functionality and design of the artifact.

# 4 Functionality and Design of the Artifact

## 4.1 Desired Functionality

The desired functionality of our UAS called "BIV Assistant" is divided into three steps (Schelkle, 2017). First, it screens business charts for inadequate BIV. This might for example be a truncated axis that exaggerates the magnitude of a trend. Second, a warning is prompted to the user that explains the visual deficiency according to BIV guidelines from the International Business Communication Standards (IBCS) Association. These guidelines describe how to assure appropriate BIV, referring to prominent information visualization literature (Hichert and Faisst, 2015). In consequence, users may perceive adequate BIV as being useful to support decision making, thus fostering perceived usefulness of complying with BIV guidelines. Last, the user decides if the BIV Assistant automatically amends the inadequate BIV by applying the guideline presented in the previous step. Since complying with BIV guidelines in this case is reduced to the click of a button, it may result in increased perceived ease of use. According to the TAM, this may lead to an increased intention to comply with BIV guidelines.

The current prototype of the BIV Assistant detects four different misleading visualization patterns (i.e., truncated axis, inverted timeline, filtered elements on the ordinate axis, and differently scaled axes) (Schelkle, 2017). This refers to Courtis (1997) as well as Beattie and Jones (2008) who examine annual reports on inadequate visualizations and illustrate misleading patterns along with improved versions.

## 4.2 Design of the Artifact

With its characteristics, the BIV Assistant provides guidance to users on how BIV guidelines have to be applied. Therefore, we draw on the integrated taxonomy of guidance design features proposed by Morana *et al.* (2017) to assure a comprehensive design of the artifact.

This taxonomy characterizes the dimensions audience, target, mode, directivity, invocation, timing, intention, content, format, and trust-building (Morana *et al.*, 2017).

SSBI is intended to be used by any employee who has to conduct business analyses and design business reports, no matter their expertise. Therefore, we primarily focus on BIV novices as *audience*, since they appear more likely to need assistance.

To increase the perceived ease of use, the *target* of the BIV Assistant is to facilitate to comply with BIV guidelines, which can be seen as engaging in a given activity (Morana *et al.*, 2017). In our case, the BIV guidelines are determined by the IBCS (see above). Hence, as *mode* of assistance we draw on a predefined framework. Since the task to comply with these guidelines can be complex, the BIV Assistant *directs* the user to adhere to the IBCS, which may result in a perceived ease of use of complying with BIV guidelines. UAS ought to reduce users' mental working memory and should not additionally burden the user with interruptions at the wrong time (Gregor and Benbasat, 1999). Hence, a user-triggered *invocation* and retrospective *timing* is chosen. Since the BIV Assistant does not con-

stantly interrupt the multi-staged BIV process (Ware, 2012), users remain in their thought process and receive assistance upon request.

To increase the perceived usefulness of complying with BIV guidelines, the BIV Assistant shows warning messages and thus informs what elements of the visualization can lead to a distorted perception (e.g., avoid truncated axes (Hichert and Faisst, 2015)). The *intention* of the warning is twofold. First, it is used to clarify why a specific inappropriately visualized element is misleading. Second, it provides working explanations and expert knowledge (i.e., terminological *content*), drawing on the know-how from the IBCS. The presentation *format* of these warnings is a combination of text and image. For the textual description of the misleading element, the BIV Assistant displays explanations provided by the IBCS. Since textual descriptions may have some limitations in terms of comprehension (Kuechler and Vaishnavi, 2006) and bear language barriers (Morana *et al.*, 2017), we complement the warning with an image of the improved business chart.

Trust in assistance, such as receiving guidance on why and how to comply with BIV guidelines, can have a strong effect on users' intention to follow suggestions (Morana *et al.*, 2017). Therefore, we intend to proactively *build trust* and hence increase reporting related self-efficacy by applying guidelines from the IBCS, which describe how to assure appropriate BIV.

In summary, the design aspects, which may lead to an increased perceived ease of use and perceived usefulness of complying with BIV guidelines as well as increased reporting self-efficacy may help to foster the intention to comply with BIV guidelines.

# 5 Experimental Evaluation

## 5.1 Evaluation Design, Participants and Procedure

To evaluate the artifact's performance, it should be evaluated against its research objectives (Peffers *et al.*, 2007). With this study, we aim to suggest an experimental design that helps to gain insight to what extent UAS affect the intention to comply with BIV guidelines, in particular in an SSBI environment. In addition, we performed a preliminary study to investigate whether the suggested design works. To determine the evaluation method, we refer to Venable *et al.* (2012). We chose a laboratory experiment, since the artifact already has been developed (i.e., ex post evaluation) and since an artificial evaluation environment provides the benefit of controlling for possibly confounding variables as well as allows measuring the efficacy of an artifact. More precisely, we chose a within-subject design for this experiment, where participants may experience report design both with and without using a UAS for BIV. Although within-subject designs are susceptible to possible learning effects (Charness *et al.*, 2012), we decided to follow such a design, since potential learning effects are of minor relevance when investigating the effects of UAS on intention to comply with BIV guidelines. Moreover, a within-subject experiment requires less participants compared to between-subject designs (Lazar *et al.*, 2010), which can be a relevant aspect for conducting a preliminary study. Since studies indicate that managers and students behave similarly (Bolton *et al.*, 2012), 14 university students (4 female, 10 male, average age: 22) of an IS course participated in this preliminary study.

To analyze the relationship between using a UAS for BIV (i.e., independent variable) and the intention to comply with BIV guidelines (i.e., dependent variable), we differentiate between two measurement settings. In both settings, participants have the task to identify inadequate BIV in four different business charts according to the IBCS guidelines. The settings of the measurements differ in the type of assistance, however. Since BIV guidelines are typically provided in written documents (e.g., Few (2012), Ware (2012), Hichert and Faisst (2015)), the only assistance allowed in the first setting were the IBCS guidelines, which are published via the website of the IBCS Association. In the second setting, participants could use our BIV Assistant to fulfil the requested task.

The experiment was structured in multiple stages (cf. Figure 1). First, participants were introduced to the experiment and got a short training on how to access the BIV guidelines of the IBCS Association website. In the next step, they had to accomplish the above described task according to the first setting.

After its completion, they were asked to answer multiple questions on their intention to comply with BIV guidelines. For this, questionnaires with validated items from prior research (Venkatesh and Davis, 2000) were translated into German and adapted to IBCS guidelines. For example, "Assuming I have access to the system, I intend to use it" was adapted to "Assuming I have access to the IBCS guidelines, I intend to use them." Due to the constructs of interest, the questions from Venkatesh and Davis (2000) comprised items for measuring the intention to use, which in our case is the intention to comply with BIV guidelines (ITC), perceived usefulness (PU), and perceived ease of use (PEOU). For measuring self-efficacy (SE), we draw on items from Spannagel and Bescherer (2009), who focus on scales of computer user SE. All items were measured on a 7-point scale, where 1 = strongly disagree and 7 = strongly agree.

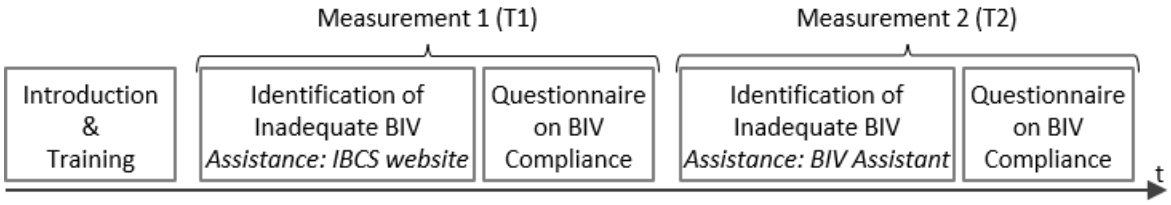


*Figure 1. Design of the Within-Subject Experiment*

To reduce potential learning effects for the second measurement, we slightly modified the business charts with inadequate BIV and changed the sequential order for the second setting. Here, participants had to fulfil the described task with the opportunity to use our BIV Assistant. To assess constructs related to intention to comply with BIV, the same questions as in the first setting were used.

## 5.2 Results of the Preliminary Study

Venkatesh and Davis (2000) as well as Spannagel and Bescherer (2009) show a high reliability (i.e., Cronbach's α) of their measurement scales. However, as we slightly adopted and translated these items, we computed the reliability of our scales to assure an appropriate basis for our analysis using SPSS version 24. The results of this reliability analysis are satisfactory and depicted in Table 2.

Next, we analyzed whether the intention to comply with BIV guidelines as well as its antecedents can be enhanced by the usage of our BIV Assistant. As we used a within-subject design, we conducted dependent t-tests and compared the differences between means of the variables under the conditions at measurement 1 (T1) and measurement 2 (T2). Any significant difference observed indicates an effect of using our BIV Assistant. The result of this analysis shows that means of all variables increased from T1 to T2. In particular, the increase in report SE was highly significant, and increases in PEOU as well as in PU were marginally significant. However, although there was also an increase in ITC, it was not significant. Hence, while not finding support for H1, we found support for hypotheses H2-4. The results of this analysis are presented in Table 2.

| | | Cronbach's α | | Dependent t-test | | | | |
|---|---|---|---|---|---|---|---|---|
| Scale | n | T1 | T2 | Mean at T1 | Mean at T2 | p | H | Legend |
| ITC | 14 | 0.96 | 0.69 | 5.32 | 5.71 | 0.290 | (H1) | (*) marginally significant (p < 0.10) |
| PU | 14 | 0.86 | 0.87 | 4.82 | 5.50 | 0.052 (*) | (H2) | * significant (p < 0.05) |
| PEOU | 14 | 0.81 | 0.94 | 4.64 | 5.62 | 0.061 (*) | (H3) | ** highly significant (p < 0.01) |
| SE | 14 | 0.84 | 0.85 | 4.36 | 5.14 | 0.002 ** | (H4) | |

*Table 2. Reliability of Scales and Dependent T-Test Results*

To examine if the propositions from TAM hold in the context of BIV guideline compliance, we conducted a multiple linear regression analysis to compute the influence of the independent variables PU, PEOU, and SE on the dependent variable ITC. Measurements were used from T2, as we intended to see whether the propositions from TAM hold after using our artifact. The $R^2$ for the overall model was .90 (adjusted $R^2$=.88) which indicates a high goodness-of-fit according to Cohen (1988). PEOU, PU, and SE were able to statistically significant predict ITC, with $F(3,10)=32.2$, $p<.001$. However, regression coefficients differ in their ability to predict ITC. While PEOU significantly predicts ITC ($\beta=.70$, $p<.05$), PU was not significant ($\beta=.30$, $p=.19$), which is also the case for SE ($\beta=-.02$, $p=.86$). Hence, while finding support for H6, this is not true for H5 and H7. These findings indicate, that in a BIV context, PEOU is especially important to foster ITC. These outcomes are depicted in Figure 2.

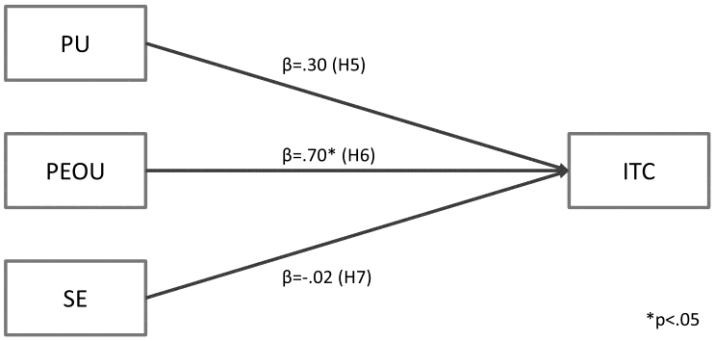


*Figure 2. Regression Analysis of Antecedents of ITC*

These first results show that using the BIV Assistant may lead to increased perceived ease of complying with BIV guidelines, perceived usefulness of complying with BIV guidelines, and report-related self-efficacy. In addition, they indicate that perceived ease of complying with BIV guidelines appears to be the most important antecedent of intention to comply with BIV guidelines. In the following, we provide a conclusion on these findings and outline possibilities for future research.

# 6 Conclusion and Future Research

Following the DSR activities proposed by Peffers *et al.* (2007), we showed that using UAS may impact compliance in a BIV context. Since we could not identify studies that examine whether UAS may affect the intention to comply with BIV guidelines based on our literature review, we proposed a design of a UAS that aims to improve this intention and introduced the BIV Assistant as a prototypical implementation. According to Briggs and Schwabe (2011), this is a DSR contribution of the applied science and engineering category, since we provide an instance of a generalizable solution in form of a proof-of-concept prototype. The second DSR contribution provided by this study is experimental research, which leads to hypotheses, experimental designs, and analyzed data sets (Briggs and Schwabe, 2011). Based on a within-subject experiment, we provide indications that the BIV Assistant has a positive impact on complying with BIV guidelines. In addition, the findings indicate that in a BIV context, perceived ease of use of complying with BIV guidelines is especially important to foster the intention to comply with guidelines.

Of course, this study only draws on data from a small preliminary study. However, based on the statistically significant findings provided by this study, we aim to substantiate our results in a next design cycle as proposed by Hevner (2007), using the proposed evaluation design. For this purpose, we intend to further develop the existing prototype to reflect a higher number of BIV guidelines, and seek to also evaluate it among actual decision makers in organizations.

Moreover, we also aim to analyze to what extent UAS and their design features can help to train BIV guidelines, since self-efficacy may also be influenced by the degree of a user's knowledge on how to appropriately design reports. With our BIV Assistant, we hope to provide a novel and fruitful avenue for improving BIV in SSBI and thus decisions based on the resulting reports.

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