Application of Software and Web-Based Tools for Sustainability Management in Small and Medium-Sized Enterprises

Matthew Johnson[1], Tobias Viere[2], Stefan Schaltegger[3] and Jantje Halberstadt[4]

Abstract

Recently, new approaches to organizational level sustainability management and reporting have emerged in the form of software and web-based applications. At first glance, it appears that such software and web-tools are applicable in small and medium-sized enterprises since they offer user-friendly and cost-effective alternatives to implement, manage and report on company-wide sustainability activities. Nevertheless, it remains academically and practically uncertain if such technologies will be adopted by a great number of SMEs. Using the Technology-Organization-Environment (TOE) model as a theoretical framework and empirical data from a recent survey with 1,250 German SMEs, this paper investigates various firm-internal and external factors that might influence managers' decisions to adopt or reject this new technology. As a result, this paper can help determine which factors play a role in the adoption of sustainability management software and web-tools in SMEs.

***Keywords**: Sustainability Management; Small and medium-sized enterprises; Software; Technology-Organization-Environment (TOE) framework; Web-based tools*

1. Introduction

Large and small businesses are increasingly confronted with sustainability issues, such a rising energy costs and health and safety issues of employees. At the same time, companies of all sizes are challenged by regulations, public scrutiny, and changing consumer preferences to take responsibility for their company endeavors and the linked effects to environment and society. Such responsibility can be taken as company-led initiatives and proactive sustainability strategies, such as improved energy efficiency, company-wide environmental management, integrative sustainability reporting, etc. Depending on the particular industry and challenges an enterprises faces, various management tools have been developed to support managers assess, measure and communicate these sustainability activities.

While large multi-national corporations development and implement a range of sustainability management strategies and tools, small and medium-sized enterprises (SMEs) are oftentimes lacking the necessary resources, personnel and know-how to effectively management growing environmental and social concerns relating to their business [10]. Many formal and complex management tools, such as the Sustainability Balanced Scorecard or life cycle assessment, find little practical application in SMEs [12]. With few exceptions [15], relatively few developments and academic attention has focused on SME-specific solutions for sustainability management.

[1] Leuphana University Lüneburg, 21335 Lüneburg, Germany, johnson@uni.leuphana.de, Centre for Sustainability Management

[2] Hochschule Pforzheim, 75175 Pforzheim, Germany, tobias.viere@hs-pforzheim.de, Institute for Industrial Ecology

[3] Leuphana University Lüneburg, 21335 Lüneburg, Germany, schaltegger@uni.leuphana.de, Centre for Sustainability Management

[4] Leuphana University Lüneburg, 21335 Lüneburg, Germany, jantje.halberstadt@leuphana.de, Centre for Sustainability Management

In addition, it remains uncertain which tools will find widespread application in SMEs. For example, an environmental management system (EMS) according to ISO 14001 or the Eco-Management and Audit Scheme are witnessing a period of stagnation in new German company members [5]. Most companies remain unaware und disinterested in the subject environmental and sustainability management. However, a recent study by Johnson [12] showed that the rate of application for sustainability management tools is strongly related with the rate of awareness. In other words, the higher the awareness of a tool (e.g. an EMS), the more likely that SMEs will adopt it. Therefore, a conclusion is to promote awareness-raising programs for such tools in SMEs through governmental initiatives and business network meetings.

More recently, new approaches to sustainability management have emerged in the form of software and web-based applications to support companies of all sizes assess, coordinate and communicate their sustainability activities [6, 20]. Organization-wide software and web-tools have been designed to facilitate various management tasks related to sustainability, such as self-assessment and strategy formation on sustainability aspects (e.g. N-Kompass – www.n-kompass.de; KIM Software - www.sustainum.de/index.html), sustainability controlling and benchmarking (e.g. EPM-Kompass) [8]; sustainability reporting (e.g. CR-Kompass – www.crkompass.de/; 360Report - www.360report.org/de/) [11, 20] as well as administration of occupational safety and environmental management (e.g. EcoTra).

However, an all-embracing software and web-tools containing all these sustainability management features is currently available [13], but few SMEs adopt it mostly due to high implementation and maintenance costs.

With very limited exceptions [1, 8], research has not yet investigated the adoption of sustainability management software and web-tools in SMEs. Furthermore, a research gap has emerged on the firm-level factors that influence the decision to adopt or reject such software and web-tools. This paper attempts to fill the gap by providing initial insights on the main influential factors that might affect the adoption of software and web-tools in SMEs.

2. Theoretical Background

Sustainability management entails a simultaneous organization of economical, ecological and social aspects regarding business activities in a conscious effort to improve environmental and social performance while remaining competitive and economically viable [3, 18]. In this light, a company should steer its activities in such a way to reduce negative effects and/or achieve positive outcomes for the environment while contributing to the sustainable development of society and the economy [19]. Visions and strategies of corporate sustainability in turn aim to integrate all these activities into the core business of a company. To support this integration, companies are now provided with a wide set of options, including sustainability management tools and software applications. A wide range of tools can facilitate managerial tasks across many business functions, including accounting, research and development, procurement and production, supply chain management as well as cross-functional activities [22].

Similarly to tools, software applications and web-tools for sustainability management can facilitate various management tasks including the assessment, planning, control, communication and reporting of sustainability activities. Commercialized software applications are increasingly emerging, promising to enable the overall coordination and communication of sustainability-related tasks shared between various functions and employees within the company. While it is understood that software is in no way a substitute for the human factor – from strategic visions and planning to the manual input

and coordination of data – it appears that software can offer many promising advantages once the strategies and responsibilities have been properly assigned.

At first glance, it appears that sustainability management software and web-tools are applicable to SMEs. These applications offer a cost-effective approach to dealing with sustainability activities. They can be tailored to an enterprise's particular structure and provide user-friendly features so that additional training is not required to input and retrieve the necessary data. While several authors promote the applicability of such software [8], there is a lack of empirical evidence on the adoption of such software in SMEs. It remains unclear if firm-level software and web-based tools for sustainability management will be applied by a great number of SMEs. Previous research has not investigate which firm-internal and external factors play a role in decision-making to adopt such technologies. Therefore, these practical and scientific uncertainties have lead us to propose the following research question:

Which firm-level factors influence the adoption of software and web-based tools for sustainability management in SMEs?

Instead of examine the current success and failure rates of individual software application and web-tools, this paper examines organizational factors that might influence adoption rates from a wider perspective. It is interesting to see how particular factors influence the rate of adoption for these new technologies for an enterprise's sustainability management. The next section will explain how the research question was addressed from a theoretical standpoint.

3. TOE Framework

In order to address this question, the Technology-Organization-Environment (TOE) framework [21] was chosen to examine various firm-internal and external factors that might influence decision-making for new technologies in SMEs. The TOE framework can be very useful in explaining the adoption and implementation of technologies at the organizational level. It combines factors in three contexts, including technological factors, firm-internal or organizational factors, and firm-external or environmental factors. An additional fourth context, individual factors, may be included into this framework.

The TOE has been applied frequently in SME research, especially with Enterprise Resource Planning (ERP) software [2, 16, 17], and e-business solutions [14, 23]. These papers' conclusions then reveal which and how various factors, such as prior IT-knowledge, attitude towards new software, top management support and external IT-support, play a role in decision-making of such software. For example, Ramdani et al. [16] illustrate how the adoption of ERP software in SMEs is mostly influenced by top management support since the primary decision-maker in SMEs is typically the owner-manager.

However, no account was found for the TOE framework in context of environmental or sustainability software. Therefore, we have adapted the TOE framework to sustainability management software in SMEs. Figure 1 below shows the overall research model as well as the various factors among the four contexts that were taken into consideration for this paper.

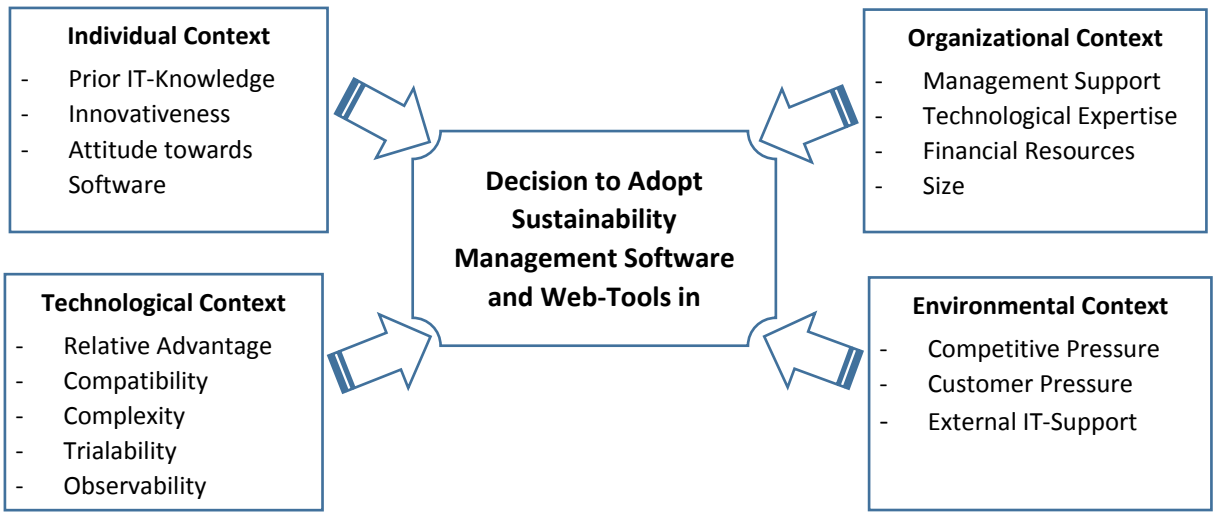

Figure 1 – Adaptation of Technology-Organization-Environment (TOE) Framework from Tornatzky and Fleischer [21]

Within the individual context, three factors were selected, including prior IT-knowledge, innovativeness and attitude. Prior IT-knowledge explains an individual's beliefs about level of competency with IT, which in this case is the perceived ability to use the computer and related software applications. Innovativeness refers to the managers' willingness to take risks and try something new through experimentation. Attitude refers to a managers' positive or negative feelings about a new technology [4].

From the technological context, relative advantage refers to the degree in which a manager perceives the software or web-tool to be superior to the previous method of operation. This factor is considered a key factor in improving the rate of new technology adoption to the extent that the innovation is perceived as advantageous [9]. However, it might not be as relevant in the case of sustainability management software and web-tools as most SMEs have not previously have had a formal approach to sustainability up till now [7]. Compatibility explains the degree in which software is perceived to be well-matched with existing organizational structure and software usage. Complexity is the perceived extent to which a new technology is difficult to understand and use. This would be reflected as a negative value in comparison to rate of adoption. Trialability and observability focus on the degree in which software can be experimented on a limited basis and can be visible to others.

Most organizational and environmental factors are self-explanatory so they will not be covered in great depth in this paper. For starters, support from top management can highly affect if such software will be implemented [9, 17]. Furthermore, the availability of in-house software support (technological expertise) and ample financial resources may play a role in decision-making. Company size has been revealed as a major determinant for the rate of new technology adoption [9]. From the environmental context, competitive pressure measures the perceived intensity level of competition and resulting pressure to adopt new technologies to remain competitive. Customer pressure is the perceived feeling of demands from customers to adopt software. In the case of SMEs, this may occur through large companies demanding their suppliers to adopt a certain software. Finally, external IT-support examines the perceived availability of external support from software companies and from state-funded programs. The next section will explain how these factors were are brought together in a quantitative analysis and provide the results.

4. Method and Results

In order to address this paper's research question, an online survey was conducted with top managers in German small, medium and large-sized enterprises from February to June 2014. In order to gain a suitable representation of German SMEs in all industry sectors, enterprises have been selected and classified according to two main criteria. First, companies were evenly distributed into four groups in accordance with the European definition of SMEs:

(1) small – enterprises up to 50 employees;

(2) mid-sized – enterprises with 51 to 100 employees;

(3) medium – enterprises with 101 to 250 employees; and

(4) large – enterprises with more than 250 employees.

Second, companies were selected according to various industry sectors. In total, enterprises from 10 main industries were included in the survey, for example manufacturing, construction, wholesale and retail and various service sectors. The number of companies selected from each industry was based on percentages of enterprises in each sector [5].

A total of 1,250 enterprises were sent an e-mail invitation to the online survey. However, 96 of these invitations were sent back as "not deliverable". In total, the survey produced 145 usable questionnaires from the 1,154 e-mails received. The response rate is 12.6%, which is comparable with other surveys with similar focus of sustainability management in SMEs [12].

The online survey consisted of questions with mostly closed-form responses using a 7-point Likert scale. The dependent variable was a simple yes or no question "Does your company currently use or plan to adopt sustainability management software within the next two years?" Questions on the relevant factors were organized according to the four contexts - individual, technological, organizational and environmental. For every individual factor (e.g. "top management support"), three to eight questions were provided, which were then averaged in the analysis stage.

An initial evaluation of the results looked into the descriptive statistics of the data including mean values (Avg.) and standard deviations (S.D.) of studied factors of the TOE framework. These factors can be separated and categorized into two groups: 1 = "decision to adopt" – managers who currently use sustainability management software and/or who intend to adopt such software within the next two years; and 0 = "decision to reject" – managers who neither use nor plan to adopt such software. As expected, the group "decision to reject" was much greater (110 enterprises) than the group "decision to adopt" (35 enterprises). Table 1 below shows the descriptive statistics of mean values and standard deviations from the various influential factors between the two groups of respondents.

From Table 1 we observe significant differences between both groups with the factors personal attitude, trialability, observability, top management support and competitive pressures. From these preliminary results, we can deduce that managers' perceived awareness of commercialized software is a major determinant for adoption, where they are able to test it on a limited basis (trialability) and see others using it (observability). Furthermore, the overall positive attitude towards software combined with added support from top management also positively influence the chances that such software will be used.

Other factors had also similar results, including prior IT-knowledge, innovativeness, complexity and customer pressure. In fact, the non-users actually had a slight edge on prior IT-knowledge, but it is not substantial to argue that commercialized software might be perceived as boosting such knowledge. From the environmental context, the results were below average for both groups. In the context of SMEs, these factors are not positively related to managers' decision-making in adoption of software.

Factors	Decision to Adopt		Decision to Reject		Difference
Individual Factors	*Avg.*	*S.D.*	*Avg.*	*S.D.*	*Avg.*
Prior IT-Knowledge	4.43	1.06	4.55	1.39	- 0,12
Innovativeness	6.01	0.85	5.85	0.91	0.16
Attitude	4.80	1.41	2.93	1.35	1.87
Technological Factors					
Relative Advantage	4.59	1.23	3.91	1.27	0.68
Compatibility	4.47	1.29	3.67	1.24	0.80
Complexity	4.18	1.42	3.86	1.21	0.32
Trialability	4.02	1.61	2.33	1.48	1.69
Observability	4.90	1.61	2.02	1.52	2.88
Organizational Factors					
Top Management Support	4.36	1.44	2.92	1.51	1.44
Financial Resources	4.93	1.67	4.31	1.79	0.62
Technological Expertise	5.47	1.20	4.54	1.65	0.93
Environmental Factors					
Competitive Pressure	3.87	1.52	2.80	1.37	1.07
Customer Pressure	3.23	1.51	2.95	1.56	0.28
External IT-Support	3.65	1.29	2.76	1.18	0.89

Table 1. Averages and Differences between Factors in the Decision-Making of Software Adoption

In a second step, a logistic regression analysis was conducted on those variables that had the greatest difference in mean values between the two groups (adopt and reject). These included variables are attitude, trialability, top management support, competitive pressure and external IT-support. Company size according to employee amounts was included as a control variable. The variable 'observability' was removed because it too strongly predicts adoption. The problem of multicollineartiy arose with observability in the regression model, as the variance inflation factor (VIF) was above 4. From another point of view, it could be argued that the other variables first influence observability and then the latter strongly influences adoption. Table 2 below shows the results of the regression analysis.

Independent variables	B	Wald	Sig.	Exp(B)
Constant	-7.801	24.07	0.000	0.00
Attitude	0.496	2.87	*0.090**	1.64
Top Management Support	0.421	3.56	*0.059**	1.52
Trialability	0.590	5.72	*0.017***	1.80
Competitive Pressure	-0.171	0.39	0.534	0.84
External IT-Support	0.000	0.000	0.999	1.00
Company Size	0.697	6.71	*0.010****	2.01

Notes: * = $p < 0.10$; ** = $p < 0.05$; *** $p < 0.01$; N = 112

Table 2. Logistic regression model for the adoption of sustainability management software

The most significant variable is company size (0.697), followed by trialability (0.590), personal attitude (0.496; only significant at the 0.10 level), and top management support (0.421; only significant at the 0.10 level). While other studies confirm that size plays a significant role [2, 16], these presented individual (attitude) and internal factors (trialability and top management support) are key determinants for the decision to adopt sustainability management software. Competitive pressure

and external IT-support were both not significant, confirming the descriptive analysis that environmental factors do not influence managers' decision making on sustainability management software.

5. Conclusion and Outlook

Besides the strong influence of company size, the results show that the decision to adopt sustainability management software mainly depends on the observability or in other words awareness that sustainability management software exists, that an SME managers have been able to try it out and that managers have an overall positive attitude towards the software. In addition, it is important that top management supports the decision to adopt it. Future research could further investigate these influential factors in qualitative interviews to better understand why companies should to adopt or reject such software.

While these results provide new insights on influential factors for the adoption of sustainability management software, several concerns remain. On one hand, it remains uncertain if companies with existing environmental and sustainability management systems have less of a need for commercialized software, as they have probably some IT-solution already, for example self-made Excel spreadsheets and Word documents. On the other hand, companies that are not interested in sustainability management in the first place will not perceive any benefit for related software.

Nevertheless, this paper was able to gain greater insights on the factors that influence the adoption of sustainability software in SMEs. It opens the discussion and offers new find pathways to consider in the adoption by highlighting the main factors that might encourage further adoption in SMEs. From a practical standpoint, it should help software developers understand their target market and position the product more effectively toward the end-user. In this way, the results can make a considerable contribution for future research to build from as well as support the further development of software in SMEs.

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