

Sustainable Software Design for Very Small Organizations

Stefanie Lehmann and Hans-Knud Arndt

Abstract Very small organizations rarely use software to organize their business processes, because there are comparatively few known solutions for their particular problems. On the one hand, these software solutions are often associated with high costs and on the other hand, particularly very small organizations do not have enough resources to find suitable solutions. These organizations miss a lot of opportunities: Through the use of the Information and Communication Technique (ICT) business processes can be processed not only resource-efficient due to reduced paper consumption. The ICT also helps to make business processes more efficient. To find such a sustainable software solution for very small organizations, requirements are identified. To determine a structure for such software to document business processes, it is important to apply design aspects for the implementation of the software. A definition of such design aspects can be achieved by the properties of a sheet of paper, which help to organize business processes in very small organizations. By analogy of the dominant metaphor of paper we specify requirements of sustainable software design for very small organizations.

Keywords Sustainability · Software design · Very small organization · Business process

1 Motivation

Very small organizations such as start-ups, associations or even societies are characterized by few employees and limited financial and time resources. Typically, the information transfer in these organizations is focused on handwritten notes on a sheet of paper. However, it is obvious that very small organizations should be able

S. Lehmann · H.-K. Arndt (✉)
Otto-von-Guericke Universität Magdeburg, Magdeburg, Germany
e-mail: hans-knud.arndt@iti.cs.uni-magdeburg.de

S. Lehmann
e-mail: stefanie.lehmann@ovgu.de

to easily transfer information from handwritten notes into an Information and Communication Technique (ICT)-based system. To do so, on the one hand reduces risks and losses of knowledge of business processes, such as caused by non-readable handwritings. On the other hand, based on ICT the exchange of knowledge can be done more efficiently. The limited resources of small organizations must be considered for such changes. In this paper, we discuss how sustainability of software design can support very small organizations during their day-to-day operations. This helps to improve the business processes especially in organizations, e.g., against the background of frequent change of personnel. One of our goals is that staff members can quickly see the important facts of the business processes. Today, most very small organizations fulfill their documentation of business processes in their own way, which may change over time. The consequences are uncertainties due to the documentation of business processes, which might hinder the sustainable operation when business processes need to be rethought or errors occur due to incorrect documentation. Therefore, staff members of very small organizations should be encouraged to handle information in a more uniform style by the use of a structured form and only one system.

Thinking of such an ICT-based solution, one idea might be to create something completely new (e.g., programmed by students during an internship). Instead, characteristics of a sustainable software design should be determined to identify existing sustainable software solutions (e.g., open source) especially for very small organizations.

2 Paper as the Most Important Information Carrier

Even in today's information age, especially very small organizations benefit from paper as the most important information carrier. Only occasionally ICT has prevailed over paper to transfer information in small organizations.

An established example to provide information with the help of technology instead of paper is shown by the step from a letter to an email (Hoffschulte 2011). There are similarities and differences between letter and email as a medium for providing information.

Similarities or parallels between letter and email are that, e.g., both present a structure by which the information for transmission is being performed. A significant difference between them lies in the technological implementation of the email: using technology information can be faster or even immediately distributed. In addition, digitalized information like emails can easily be reproduced. Furthermore, information can be transmitted more environmentally friendly by reducing paper consumption through emails.

Like in letters and emails, information is exchanged in business processes. Consequently, the general rule is that for business processes an ICT support is suitable for more efficiency and effectiveness in contrast to the use of paper, even in very small organizations. The use of ICT enables an improvement of business

processes. But in particular an ICT solution for very small organizations must be as paper-like as possible. On the other hand, many current pen-based methods of ICT (e.g., like the Apple Pencil for iPad Pro Apple Inc. 2016) serve the dominant metaphor of paper very well. Especially very small organizations have a need for long-lasting, sustainable software and in consequence also hardware solutions. Therefore, pen-based methods might be too modern and show little progress in the context to improve business processes of very small organizations. So this argument might guide them to a more conservative strategy.

Against this background the question about the best paper-orientated software design for very small organizations arises. In order to find an approach, design aspects can help here. In the past, it has been shown that the Ten Principles for Good Design stated by Dieter Rams (Vitsoe Ltd. 2016) can be used to evaluate the design of software (Arndt 2013).

3 Requirements of Sustainable Software Design for Very Small Organizations

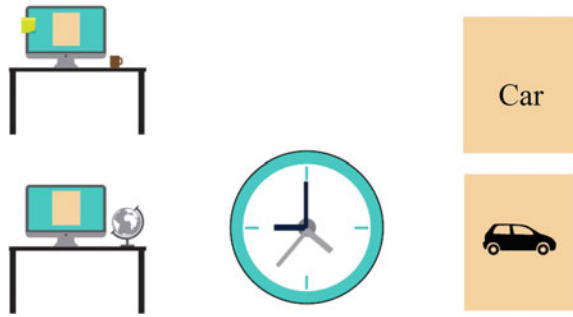
To represent knowledge-intensive business processes by a technology, the Ten Principles for Good Design by Dieter Rams could be helpful. In this step, the advantageous properties of paper-based information should be transferred into digitalized ICT-based information. Sustainable design requirements on ICT are described for the technological representation of typical paper-based information of very small organizations by using the various aspects of the Ten Principles of Good Design.

These principles provide a framework of requirements for good design of products, but are also suitable for the design software (Arndt 2014). In the following, the description of the principles is used to show analogies to the properties of paper-based information for ICT-based information in the context of very small organizations. Each principle is considered in detail. Consequently, there will be a derivation of requirements for ICT to represent information and, therefore, also business processes which can be described by such information.

3.1 Good Design Is Innovative

This principle implies that a technological development could optimize the utility value of a product. This innovative design is always produced in association with innovative technology. From the transmission of these statements to the support of business processes follows that with a modern ICT-based method instead of a

Fig. 1 Visualization of requirements based on the principle “good design is innovative”. *Source* According to Vector Open Stock (2015a, b)



paper-based method the business processes can be improved: The working times and places of work can be made more flexible, because the staff members are not tied to a single sheet of paper on which the information is stored. Moreover, thanks to modern technology, a flexible design of business processes is possible: Like on a sheet of paper there should no precise work instructions needed how knowledge has to be left. In addition, information cannot only be saved in the form of texts, but also, e.g., with the help of graphics.

Figure 1 outlines the requirements on an ICT to be innovative to support the business processes: Like a sheet of paper the information could be used at different workstations, at different times and the business processes could be designed according to the users' needs, if the information is made available by ICT.

3.2 Good Design Makes a Product Useful

In addition to the primary functions, also psychological and aesthetic features of a product must be observed. Such a product is also ICT. Compared to paper-based information, all information can be detained for a business process to document it and to protect it against information overload. The data must always be up to date, which helps in distributing information. Furthermore, the data must be manageable: A sheet of paper has no restrictions in this sense, because its contents can be monitored at a glance. When a page is full, another sheet for additional information could be added. Transferring to ICT, restrictions have to be avoided for mapping information: either by a character limit or by the dimensions of the screen.

Figure 2 depicts the requirements of ICT to be useful for supporting the business processes: Like with a sheet of paper there is no limitation, data can be sorted and searched, and information can not only be taken from each user, but the user can also add or delete data when the data are updated.

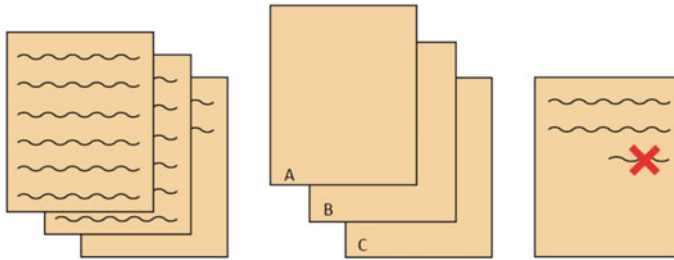


Fig. 2 Visualization of requirements based on the principle “good design makes a product useful”

3.3 *Good Design Is Aesthetic*

Devices that are used every day characterize the environment and affect the well-being. Consequently, in managing business processes with ICT, the operation should be as effective as or even better than by using a piece of paper. Just as the use of paper has prevailed in the daily office, also the use of a technological solution for information should be accepted and change the business processes positively. Thus, the business processes can be improved and thereby working time could be abridged.

Figure 3 visualizes the requirements of ICT to realize the aesthetic aspect for supporting the business processes: The procedures and processes can be improved, so that working hours can be reduced, and the user feels comfortable at his workplace, e.g., because there is less paper chaos.

3.4 *Good Design Makes a Product Understandable*

Following this principle, the structure of ICT has to be illustrated in a reasonable manner and without explanations. To organize information, it is established that the use of the data structure of lists is generally understandable. By analogy with a sheet or stack of paper the structure of the data is recognizable: A stack of paper can be sorted without many explanations. Expanding on the complete, global ICT, also its other functions should be as self-explanatory as possible. Limited on the natural language the use of the mother tongue within the system provides to understand this.

Fig. 3 Visualization of requirements based on the principle “good design is aesthetic”. *Source* According to Freepik (2011), Vector Open Stock (2015b)

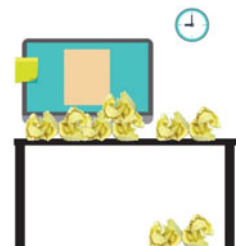


Fig. 4 Visualization of requirements based on the principle “good design makes a product understandable”.
 Source According to Vector Open Stock (2015b)



Figure 4 depicts the requirements of ICT to make it understandable for supporting the business processes: The use of lists illustrates a sorting of the data. The execution of the functions should be understandable to the user; the functions of ICT should be understood through the use of the mother tongue.

3.5 Good Design Is Unobtrusive

Products, which serve a purpose, have an instrumental character and should therefore have a neutral style. If the purpose is to manage business processes in a group, the focus is on the information contained in these business processes and the system itself moves into the background. If the design is as flat as possible, this corresponds to the design of a simple white paper where the notes are left on. Even if a system defines a certain structure, the user should be allowed a self-realization. So he/she can leave the notes in their own way. E.g., similar to a sheet of paper, the background color of information could be changed for communicating and sending various signals.

If the system acts as a tool, it should be apparent what kind of information is put in and is put out, is being processed. For this representation of business processes a simple Kanban Board can be useful, as outlined in Fig. 5.

3.6 Good Design Is Honest

A product has an honest design, if it does not break with the expectations of the users. Hence, also a knowledge management system should not promise more than that it collects information and distributes it for reuse. All other guaranteed

Fig. 5 Visualization of requirements based on the principle “good design is unobtrusive”

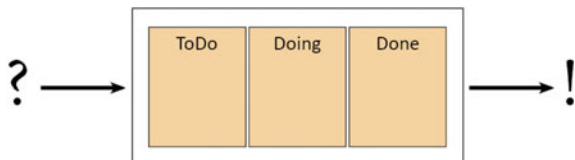
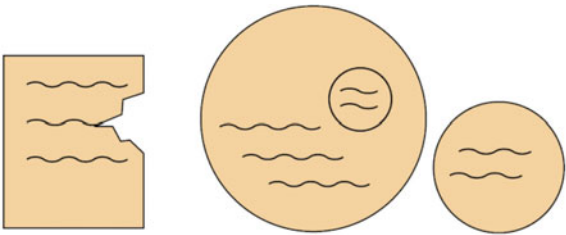


Fig. 6 Visualization of requirements based on the principle “good design is honest”



properties should be fulfilled: from the permanent availability of the data down to the smallest unit of a function. So each non-working unit, up to a system crash, counteracts the promise of the system. It may therefore be no loss of information. By analogy to a stack of paper also information should be saved in a data structure of lists. This data structure should be recognizable and no false ideas should be formed by unnecessary design. Figure 6 visualizes cases that contradict the thesis: data is lost or the structure of the data is not recognizable.

3.7 *Good Design Is Long-Lasting*

A long-lasting ICT should neither be modern or stylish, nor should it appear antiquated. In analogy to a white sheet of paper also its use and design has been proven over a long period. It will dispense with the use of design trends. For a long-term use and to counteract the throwaway society, analogous to paper an ICT should not only be able to archive information, but its design should also be durable. Figure 7 outlines the cases that are to be improved by the technology.

3.8 *Good Design Is Thorough Down to the Last Detail*

The design must not be left at discretion or be randomly. Thoroughness and accuracy of the design consider the use by the user. A uniform design can reduce



Fig. 7 Visualization of requirements based on the principle “good design is long-lasting”. *Source* According to Engineering Student Resource (2016)



Fig. 8 Visualization of requirements based on the principle “good design is thorough down to the last detail”. *Source* According to Vector Open Stock (2010)

the cognitive load of the user. Accordingly, the design is consistently implemented. In analogy to a sheet of paper, there are uniform formats. Transferred to ICT, therefore, each user should have the same functions and views, the various sub-pages should not differ from the layout and all elements should be equivalent. Figure 8 describes how this thesis is shown in an ICT: On the one hand, like in a conference all users have the same views and possible functions of the data and on the other hand, the design of any information is equal.

3.9 *Good Design Is Environmentally Friendly*

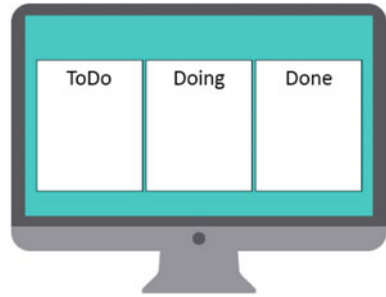
It is important to conserve resources to preserve the environment. Where information is organized ICT-based, a significant amount of paper can be economized. Apart from the physical conservation, also resource-saving design aspects have to be observed during the transition from paper to ICT-based information: Designing has to be done on a minimization of physical and visual pollution. It should contain no unnecessary elements in the layout. Figure 9 shows the goal of this principle: For slightest visual stress the extreme values of a white sheet of paper and a black font for the strongest contrast would be the use case for an ICT to strive.

Fig. 9 Visualization of requirements based on the principle “good design is environmentally-friendly”



Fig. 10 Visualization of requirements based on the principle “good design is as little design as possible”.

Source According to Vector Open Stock (2015b)



3.10 Good Design Is as Little Design as Possible

The most representative statement about sustainability is the statement of Bauhaus “Less is more”. Dieter Rams transferred this statement into “Less but better”. In this case, the design is to focus on the essentials and go back to the pure, to the simple. Based on this description, the design of a paper is as simple as possible, if it is a white sheet. Here, all previously mentioned properties are kept, which were described with reference to the other theses: e.g., the user can design the sheet to meet his requirements or if the sheet is full, another one will be added. Once again, the analogy is transferred from the paper in the ICT for organizing the business processes. If this last thesis is transferred into the ICT, also the previous theses are considered: For the organization of business processes applies that if the design requirements of ICT fulfill the previous theses, the design is kept as simple as possible. Figure 10 shows a possible implementation of the design requirements according to the thesis.

4 Conclusion and Outlook

We presented an approach to provide requirements for existing software solutions. As a base, the properties of paper have been identified for shaping the business processes. By transferring these requirements to ICT, some design requirements on ICT for the organization of business processes result. Consequently, in order to improve the business processes in very small organizations and to conserve resources by using an ICT, the design is used as a key. So, on the one hand, the limited resources of very small organizations can be saved, and on the other hand, there is less paper consumption by using an ICT. In the future, specific technical possibilities should be considered in more detail for the representation of business processes or for an analog implementation of writing a note on a paper with a pen. In addition, a more accurate solution for very small organizations should be found based on the determination of the available resources.

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