European Research Studies Journal
Volume XXIV, Special Issue 5, 2021

pp. 140-151

Ergonomic Context of the User Interface of Modern Enterprise Management Systems

Submitted 28/09/21, 1st revision 15/10/21, 2nd revision 14/11/21, accepted 10/12/21

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Abstract:

Purpose: *The objective of the study was to identify the features of the software that determine its ergonomics. This article focuses especially on system-specific features that support management. The text considers the wider context of using the system. This applies, inter alia, to the analysis of the functional features of the entire system, which affect the work of operators. The system does not replace human mental work but helps the operators of these systems in activities that are based on entering and analysing business data of the enterprise.*
Design/Methodology/Approach: *The analysis of the ergonomic features of the software was supplemented with interviews with employees using systems supporting management processes. Methodology of this research was based mainly on semi-structured interviews with additional unstructured in-depth interviews in some cases.*
Findings: *The paper shows that the ergonomic features of software for management processes support are not only related to the user interface and other features of this software analysed within a specific computer workstation. The system should be seen as a whole, taking into account the flow of information and the fact that it is also a medium of communication between employees and often also contractors. It should be taken into account that we are dealing not only with a human-technical object system, but also a multi-person-technical object system.*
Practical Implications: *The results of the research indicate the direction of software improvement in this area and describe the factors that affect the ergonomic characteristics of software supporting enterprise management. Additionally, interviews with users show that the complex context of use that occurs in management systems influences the specific working conditions of management system operators. In addition, one should strive to meet the individual expectations of users, and not rely solely on the features postulated by the majority.*
Originality/Value: *The article focuses on issues related to ergonomic features of software for enterprise management systems. The overall impact of the system on the user is taken into account. These features determine whether the software facilitates the work, reduces the number of errors, leading to the reduction of stress and inconvenience of work, taking into account the human perception capabilities.*

Keywords: *Ergonomic, usability, management systems.*

JEL classification: *M2, M29.*
Paper Type: *Research article.*

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1. Introduction

The complexity of interconnected systems based on a network is constantly increasing. This gives more and more opportunities to use them in various fields. An important group of IT systems of high complexity are systems supporting company management. However, the structural complexity in terms of technology and organization cannot directly translate into excessive complexity from the operator's point of view. This depends on the possibility of effective use of the software's capabilities and an adequate (both in terms of correctness and time) response to changes in the state of this system.

The complexity of interconnected systems based on a network is constantly increasing. This gives more and more opportunities to use them in various fields. An important group of IT systems of high complexity are systems supporting company management. However, the structural complexity in terms of technology and organization cannot directly translate into excessive complexity from the operator's point of view. This depends on the possibility of effective use of the software's capabilities and an adequate (both in terms of correctness and time) response to changes in the state of this system. For several decades, software development standards have taken into account usability requirements for the graphical user interface. In addition, some software vendors seek to use a menu layout similar to that of other software.

However, these measures do not always ensure sufficient ease of use. Very often, the use of systems that support company management requires long training of employees. Nevertheless, when access to certain functionalities is complex and unintuitive, the training will also not prevent errors and excessive nuisance of work. The objective of the research was to identify the features of the software that determine its ergonomics. This article focuses especially on system-specific features that support management. The above issues were supplemented with the results of interviews with employees for selected cases.

The methodology of this research was based mainly on interviews. To obtain greater freedom of probing the respondents' semi-structured interviews were used. The selection of respondents was to ensure the diversity of the analyzed cases. Whenever possible, the interviews were continued as unstructured, i.e., in-depth interviews, prompting respondents to talk normally and comment on difficulties in using the systems. The research did not aim to maximize the research sample, but to collect as many problem categories that operators encounter when using different software. For this reason, operators not only answered the prepared questions, but also had the opportunity to freely express themselves and comment.

2. Software Ergonomic Features

2.1 Ergonomic Criteria

Analysing the process of shaping of ergonomic criteria for the user interface, it can be concluded that the development of software in the last few decades does not significantly change this approach. This is confirmed by the publications in which the

lists of these criteria are still valid. For example, selected studies (Bastien and Scapin, 1993) present a list of ergonomic criteria in the form of:

- User Guidance – connected with available to advise, inform, instruct, and guide users throughout interaction with computer. This criterion is divided into: Prompting, Grouping/Distinction of items, Immediate Feedback and Legibility.
- Workload – connected with reduction of users' perceptual or cognitive load and increase of dialogue efficiency. This criterion is divided into: Brevity and Information Density.
- Explicit Control – connected with system processing of explicit user actions and control user on the processing of their actions by the system. This criterion is divided into: Explicit User Action and User Control.
- Adaptability – connected with system capacity to behave contextually and according to the users' needs and preferences. This criterion is divided into: Flexibility and User Experience.
- Error Management – connected with means available to prevent or reduce errors and to recover from them when they occur. This criterion is divided into: Error Protection Quality of Error Messages, and Error Correction
- Consistency – connected with the way interface design choices are maintained in similar contexts and are different when applied to different contexts.
- Compatibility – connected with the match between users' characteristics and task characteristics on the one hand, and the organization of the output, input, and dialogue for a given application, on the other hand.

Comparing the above list with the list of superior criteria presented after almost three decades by Perret *et al.* (2021) no significant changes are noticed. These superior criteria are:

- Compatibility
- Guidance
- Adaptability
- Actions and Information Costs
- Homogeneity & Consistency
- Threats & Error Management.

It should therefore be emphasized that it is not the development of the list of criteria that will be important when improving the interface, but their implementation for more and more complex systems.

2.2 Usability

Usability is defined as "a quality attribute that assesses how easy user interfaces are to use" (Nielsen, 2012), and generally product is defined as useful if "a person of average (or even below average) ability and experience can use the thing" (Krug, 2006). ISO 9241-11 standard defines usability as "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". It is a parameter that determines the level of

efficiency and satisfaction with which users can achieve their goals in a specific way (Bevan, 2001, Ahmad *et al.*, 2021). To verify quality of the user interface we can perform usability tests. As a basic we can mention three components from the framework of ISO 9241-11 standard:

- System Effectiveness
- System Efficiency
- System Satisfaction.

Generally, we should use more extensive usability criterion lists. One of the most known persons who popularized usability is Jacob Nielsen. He mentions that usability is defined by 5 quality components (Nielsen 2012):

- Learnability
- Efficiency
- Memorability
- Errors
- Satisfaction.

Nielsen criterion lists has general character. We can develop this list for verification of system attributes. For example, we can define criterion groups as in previous publication (Hankiewicz and Prussak, 2005):

- Suitability for the task
- Accessibility
- Legibility
- Error tolerance
- Self-descriptiveness
- Suitability for individualization
- Controllability.

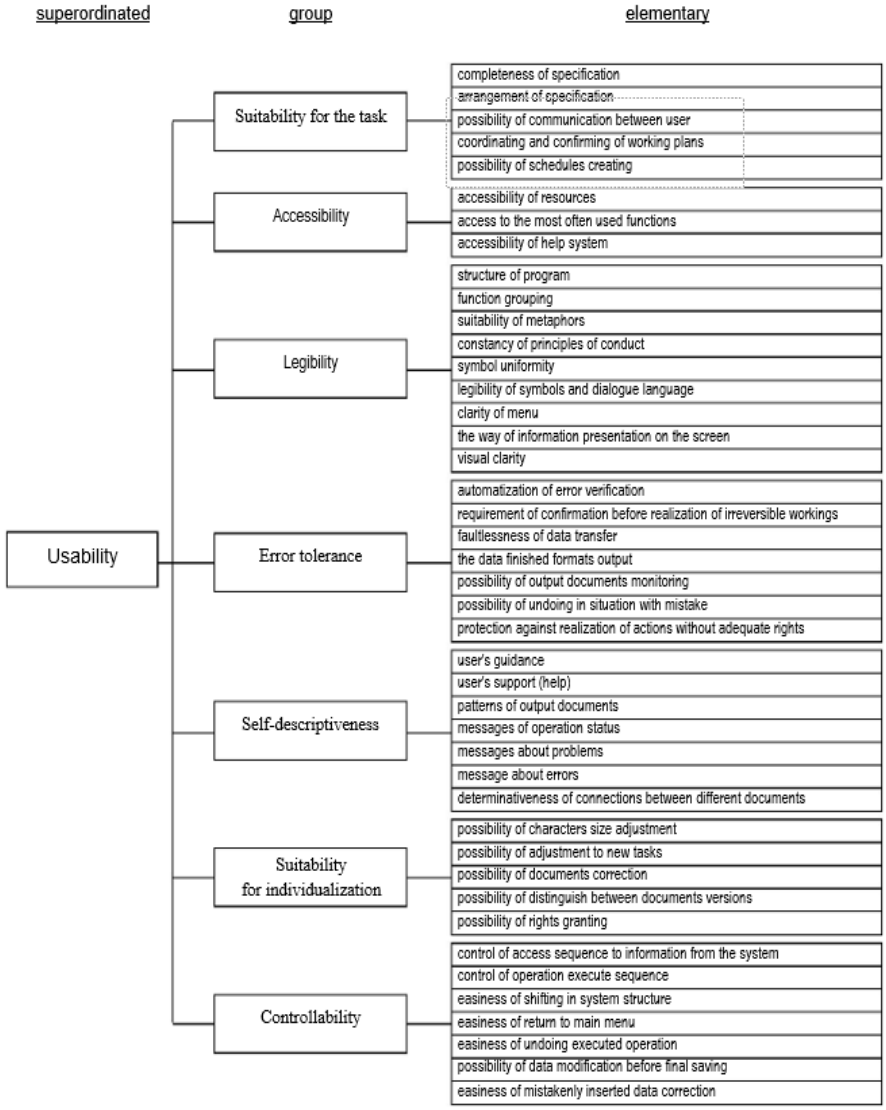
For every group we can prepare elementary criteria adequate to analyzed system. Figure 1 presents this structure as an example used for usability estimation in research. Usability is presented as superordinate criterion, next column includes group criteria and last column elementary criteria directly used for usability estimation. Elementary criteria can be adjusted to software specific.

Elementary criteria are used to software assessment in particular group criterion. Number of group criteria can be more extensive (Prussak and Hankiewicz, 2007):

- Easiness of use
- Usefulness
- Comprehension
- Using fastness
- Accessibility
- Self-descriptiveness

- Adequateness
- Error tolerance
- Aesthetics
- Ease learning of use
- Integrity.

Figure 1. *Hierarchic model of software quality by Hankiewicz and Prussak, 2005.*



Source: *Own study.*

Some of the elements in this list are applicable mostly to Web pages, but it needs to be emphasized that more often management systems adopt browser-based user interfaces. These criteria may be the basis for software evaluation, but it does not mean that the importance of groups of criteria is the same. When evaluating with the participation of

users, the weights can also be determined with their participation (Prussak and Hankiewicz, 2007). Above mentioned research verified whether the given criterion is met or not. We can also use System Usability Scale (SUS) design by John Brooke (Brooke, 2013) for measuring the usability of the IT system. Instead of "yes" or "no" answers we can use five response options: from "strongly agree" to "strongly disagree". Example of such research for usability of an open ERP system (Hankiewicz and Jayathilaka, 2018) use extrapolation of elementary criterion to usability issues in an ERP system (Singh and Wesson, 2009):

- Navigation
- Learnability
- Task Support
- Presentation (input and output)
- Customization.

We should also be aware of the differences related to the use of mobile versions of the software. Nielsen and Budiu (2012) point out in their research for websites that conversion rates of the tablet users were much closer to the desktop user than to the smartphone users. Defining "conversion rate" as percentage of visiting users who end up taking a desired action, we can estimate difficulties of using it. We shouldn't deal with mobile devices equally. This involves the provision of additional facilitation of the use of screens with smaller size. This should also consider usability assessments.

Moreover, Prantosh Kumar Paul (2021) emphasizes that Cloud Computing and Big Data Technologies are the most developing technologies for creating intelligent and advanced IT infrastructure. It also indirectly influences the functional features of the software which uses these technologies. and Big Data technologies are the most emerging for the creation of intelligent and sophisticated Information infrastructure.

2.3 User Experience

It needs to be emphasized that usability cannot be equated with user experience. User Experience can be defined as "the experience the product creates for the people who use it in the real world" (Garrett, 2011). This term is gaining more and more popularity since 2000 (compare https://books.google.com/ngrams). ISO 9241-210 standard define User Experience as "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" with note: "User experience is a consequence of brand image, presentation, functionality, system performance, interactive behaviour and assistive capabilities of the interactive system, the user's internal and physical state resulting from prior experiences, attitudes, skills and personality, and the context of use".

It can be briefly ascertained that User Experience is an even broader concept than usability (Norman and Nielsen, 2021). This term describes what happens when using a given product, and how it affects the user's feelings and emotions. Working in the field of User Experience requires interdisciplinarity, i.e., cooperation of various specialists involved in the project, whose attention is focused on meeting business needs and the

needs of users.

There are many factors that directly influence the user experience when using a particular product that must be met to ensure a positive feeling. Figure 2 shows "The User Experience Honeycomb" (Morville, 2004), which illustrates these factors, and its main assumption is to show the connections between them and to highlight the elements of a good User Experience.

Figure 2. *User Experience Honeycomb (Morville, 2004)*

Source: *Own source.*

The role of User Experience does not end with meeting the above guidelines. Once the product is on the market it is often necessary to further optimize the software as well as answers to what makes a system useful and acceptable (Ntoa *et al.,* 2021; Gao *et al.,* 2021).

2.4 Ergonomic Feature Defined Indirectly

Many modern IT systems are used by multiple people simultaneously. An example of such technology is the management support system. It needs to be emphasized that such software supports not only human - computer interaction, but also facilitates communication between humans taking the role of a proxy. Users utilize the system in different roles and with different authorizations. Changes in the system are often connected with the necessity to automatically notify other employees about them. In addition, the system should record data identifying the author of the document, subsequent authors of changes, as well as the time of its creation and the timestamps of subsequent modifications. Releasing an employee from the obligation to periodically check whether there is a new document that requires his/her activity is a typical ergonomic requirement. It is expected that when some business flow changes, the program can dynamically reorganize the business flow management part (Huang, 2021).

It is also expected that all necessary documents will be available in the system. The necessity to enter all necessary information into the system is a nuisance. However, we

deal less and less with documents that do not exist in the electronic version. The benefits of being able to search data in this form are related to the possibility to search for data that are only indirectly related to each other. The obvious advantage is the access time to the data.

Case research by Hankiewicz (2005) presents an example that without electronic data access time used on the information retrieval can reach even one-third of the working period for office employees and one-fourth of the working period for management staff. It is not uncommon that management level employees spend half of their working time on communicating with other workers to get necessary data or information. It needs to be emphasized that values presented above are specific to the shown example. Such metrics can vary significantly between different cases. However, any improvement in this regard is important, as it reduces the arduousness of work. It should be remembered that the preparation of summary statements and analyses necessary to manage the enterprise is performed under stress.

Designers of the enterprise management system should focus on users, not simply on technology, using the principles of interaction design (Preece *et al.*, 1994; 2002). The greater complexity of the activities increases the workload. As confirmed by Khayal (2019) the combination of resources within and between cognitive dimensions determines the level of mental load. An additional difficulty is the constantly evolving system of company management, in line with the idea of lean management.

However, in any case, compliance with the principles of ergonomics ensures that the physical and mental demands of the work system are within human capabilities (Gibson and Mrugalska, 2018). Ergonomics allows a better understanding of the interactions between humans and other elements of the system (Górny, 2015).

The disadvantage of such extensive and automated systems is that the system's continuous recording of the user's actions can make him feel trapped. For these reasons, the employees should have breaks during which they will not be supervised, they will be able to talk freely with co-workers, and be free to use a private smartphone. In addition, increasing the number and time of breaks is necessary for computer work.

3. Research

The analysis of users' expectations in relation to complex systems such as integrated management systems is difficult. One cannot expect unambiguous answers if we do not focus only on selected features of a precisely defined system. Thus, the analysis of users' expectations can only indicate the essential features of the interface or the entire system and the directions of their improvement. The methods of usability assessment can be used as the basis for the analyses, however, as presented in subchapter 2.4, they do not verify all the factors determining the ergonomic features of the system.

Interviews with users, the purpose of which is to further improve the software, may be an extension of the analyses and tests. The interviews were conducted with the users of management systems directly. The total number of people participating in the interviews

was 25. They were employees of various departments of selected companies, using various system modules. The issues discussed during the interviews are listed below, together with a summary of the responses obtained. Summing up the answers consisted in collecting the problems related to the analysed issue.

The way of hiding inactive elements – Hiding inactive elements is used nowadays in many applications - for example office ones. Usually, the name of an inactive function is shaded. Such an approach is positively received, but the users of management systems suggest introducing the possibility of hiding them completely. The rationale here is to overload the screen with an excess of available functions. This is of particular importance in mobile devices where the display area of available functions is limited.

Adapting the interface to the habits of users – Most of the users negatively assessed the automatic detection of their preferences for using the programs when it is combined with the simultaneous change of system settings. Rather, it is expected to allow operators to change them themselves as much as possible. In-depth discussions in this regard led to the conclusion that the result of the automatic detection of user preferences should be signalled by the system. This should allow the user to accept or disregard settings suggestions provided by the system.

Standardization of the interface in management systems – The majority of users stated that the differences in the program layout, in the form of a specific location of windows with the same functionality, are not significant. This can stem from the fact that many programs provide the ability to change the layout of windows. Different layouts are also used for different screen sizes. It is more important to use matching command names for similar commands and the icons that represent them graphically. At the same time, some users expect that predefined layouts should be available - in the form of templates - and they will be able to save their own settings so that they can later choose the layout that can facilitate their preferences.

Languages of the menu, description and help system – Regardless of whether the team of employees comes from different countries or not, the use of the native language in the program menu is not necessary, as stated by the users. It is more important that the commands are clearly defined. User experience shows that in the case of translation, imprecise or even contradictory terms appear. Users evaluate the issues related to language of the descriptions and help system differently. In this regard, the user is expected to be able to select the description and help language in each case. Thanks to this, user can also get to know the different language versions.

The ability to create a list of your own list of shortcuts – Many systems have this option, and it is positively received by users. If this is not possible, it is worth trying to modify the system in this regard.

Combining tasks with distant functions, e.g., management (working with business data, preparing reports) with communication – The question about the integration of communication functions in management systems did not give clear answers to users. The interviews show that users create scenarios of conduct for various complex

operations performed on the system. Some operators pay particular attention to the moment of switching to another group of tasks, perceiving it as the next stage of the task execution. Therefore, one should proceed with caution in this regard so that it does not cause errors and does not constitute an additional burden for users.

The impact of artificial intelligence elements – In the case of systems supporting decision- making process, users primarily expect information whether specific decision was taken by the system itself or if it was influenced by the human operator. It is especially important taking into consideration that such information affects an operator's reaction in the situation that system reaction is questionable. Moreover, users expect the possibility of quick reporting of abnormal system operation.

4. Discussion

When designing IT systems used in management, one should mainly consider those elements that are directly associated with the human-computer relationship: user-system communication, user interface, system messages, system response time and the help system. Due to better and better modelling of business processes, management support systems are becoming more and more complex. This increases the factors affecting the user that should be included in the analysis. Most users of this software are users who use it for many years a day.

Therefore, all requirements related to the system's configurability and adaptation to the user's needs are of fundamental importance. In other words, when evaluating software, the weighting of these criteria should be set at a higher level. As the assessment of ergonomic features concerns the interaction between human and the system, it cannot be zero-one. User requirements can be different and change over time. They are the sum of their perceptual abilities, previous experiences, and expectations (not always real but often contradictory). It is often forgotten that software evaluation cannot be carried out in isolation from hardware and network configuration and capabilities.

In addition to the performance of computers, servers and all network components, the number and size of screens and the functions assigned to them (often dynamically) should be considered. This also applies when certain system functions are periodically controlled remotely using mobile devices. In the case of complex systems, due to their extensive interface, the mobile version requires the use of a layered interface, where each layer has a limited range of functions. So, in this case the requirements will be different.

5. Conclusions

To fully adapt the IT system to human capabilities, activities should be expanded, also including those that seem seemingly unrelated to ergonomics. These should include the analysis of the method of entering and the flow of documents and information in the system. One should also consider the fact that currently IT system of enterprise management very often mediate communication between people. This communication applies both to contacts within the company in which a given system functions, as well as external contacts, e.g., with co-operators and customers. It can be expected that such

an extended ergonomic analysis will have a positive effect on reducing the nuisance associated with working with the system. The number of mistakes made is not without significance here. In addition, faster response to customer needs or market changes will positively affect the company's business results. It is often forgotten that greater satisfaction had a positive effect on employees.

Based on interviews with users, it can be concluded that the complex context of use that occurs in management systems affects the specific conditions of the operators' work. So, you cannot rely heavily on rules and similarities when evaluating software. The postulate of adapting the device and system to the user should not mean adjusting them to average expectations but to the expectations of a particular user. The results show that better adaptation to ergonomic requirements involves considering the individual judgments of users. If so far and still the workstation has been adapted to the average user, it was due to the limitations and the impossibility of differentiating it.

However, in the case of software, the possibilities for customization seem much greater. This is confirmed by the analysis of the interviews conducted. The obviously convergent comments show the direction of changes. However, many divergent user expectations can be met by allowing the system to be configured more freely, and in some cases simply not blocking certain system settings from being changed. Under the influence of the conducted research, it can be concluded that ergonomics is the sum of the cases, not their average. Thus, not a statistical analysis, but an individual approach can raise ergonomics to a higher level.

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