

QUALITATIVE AND ERGONOMIC CRITERIA OF DESIGNING INFORMATION SYSTEMS SUPPORTING LOGISTIC PROCESSES

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Abstract Logistic processes are realized in every company. The realization of determined processes is conditioned by an efficient information management. Design of SI must take under consideration quality aspects and criteria of ergonomics in reference to their further use; they must be always the superior stage of realization for these systems.

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1. INTRODUCTION

Logistics processes include among others: planning implementing into practice and controlling the efficient economic flow of assets, materials, half-products and products. They are generally connected with the operational activity of the enterprise. Still, they might also include such logistic functions, like customer service, order processing, product packaging, waste management and transport. Effective service of the entire system of logistic processes relates closely to efficient information system. Therefore, organizations in the 21st century use common ICT tools and technologies that support these systems. It refers particularly to manufacturing enterprises. It is directly connected with from one side – their composite organizational structure, from another side – with the multidimensional character of logistic processes. Therefore, the process of designing information systems in every organization, especially when they support logistic processes, should take under consideration the essence of the information systems, its functions, usability of information, as well as the progressive character of the information gap.

2. ESSENCE OF THE INFORMATION SYSTEM

2.1. Functions of the information

The information system integrates the entire activity of the enterprise because the information is necessary not only for its functioning, but also to enable its development. J. Kisielnicki and H. Sroka (2005, p. 18) define the information system as a structure with many levels, which allows the user to process input data into output data, using procedures and models of information. Information is one of most important assets in the economy of the 21st century. Proper information management determines possibilities of business activity in the market. It is particularly important for companies, operating on basis of the economy of scale that enables them surviving in the competing market. Basically, functions of information should be considered in relation to the sector, in which organizations (enterprises) function, as well as the specific character of their operational tasks (Lefebvre, 2005, pp. 7-8); (Madden, 2000, p. 344). From the point of view of logistic processes, it is particularly important to take under consideration following functions:

- notification function – it supplies the information concerning the realization of logistic tasks,
- decisive function – it is fulfilled when participants of the logistic process obtain information necessary for making correct decisions,

- steering function, consisting in shaping customer behaviour information in a way, to make them understand the role that have in the logistic chain in result of the transferred information,
- integrative function, it means cooperation of all elements and assets of the organization, with particular attention paid on logistic aspects.

Particular care about information, its correct flow and synchronization, is fundamental for enterprises. It is connected with big and composite assets of information and data, which affect the efficiency of functioning of divisions of logistics for manufacturing and service enterprises, as well as companies providing logistic services outside.

2.2. Usability of information

The *usability* of the term *information* is determined by its quality and its connection with the task (Sopińska, 2004, p. 166). There can be also other criteria of assessment of usability for the user, such as accuracy, truth, form, frequency of use (Szapiro, 1995, p. 343). From the point of view of organization management, the most often used terms of *usability* are those, which define its qualitative features (Kisielnicki, 1993, pp. 33-37). Qualitative requirements give a structural minimum to the information. It means that they enable determining when the information is useful enough that the dataset constituting it gives us *any* kind of information at all. Therefore, it is difficult to point at a universal definition of useful information, if it does not take under consideration the user, his information needs, as well as the moment, when they are used.

Therefore, it is so important to define users of its particular subsystems (modules) of the information system in the process of designing it. Generally speaking, users can be classified into the group of internal (general management and executive management) and external users (business partners, customers, shareholders or institutions which control the enterprise activity). In order to provide efficient functioning of the Information System, it is considered to be useful to introduce categorization (which can enter into the system already during the stage of design) of the method of use of the IS applied by individual users (Flakiewicz, 2002, p. 28). According to M. Kocójowa, it is important that the process of communication between the system and its user could have an iterative character (part 3.2). Sometimes the user is not satisfied with the first response of the system; he might ask additional questions in order to obtain a more precise answer. Similar method of operation appears when the user presents a vague or ambiguous question (Kocójowa, 2000, pp. 55-78). Basically, usefulness of the information is determined by the efficiency of the entire information system. From another side, its effectiveness affects possibilities of reducing the progress of the information gap.

2.3. Information gap

In today's companies, we observe a dynamic grow of volume and complexity of tasks, which causes a permanent demand of information. This concerns particularly logistic management. In result, possibilities of information systems reach their critical mass. The problem refers particularly to traditional systems, which IT technologies do not support (Jurga, 2010, pp. 53-59). The system's user has a smaller access to relevant information [Relevant information – an information that meets demands of the IS user and fulfils his information needs (Adamczak et al., 2010, p. 49)], so the problem of information gap [Information gap – a difference between the set of information that is gathered (set of information in the information system) and the information that is required. The gap occurs when information in the information system is inadequate to solve the problem (Adamczak et al., 2010, p. 49)] (Fig. 1) is more noticeable.

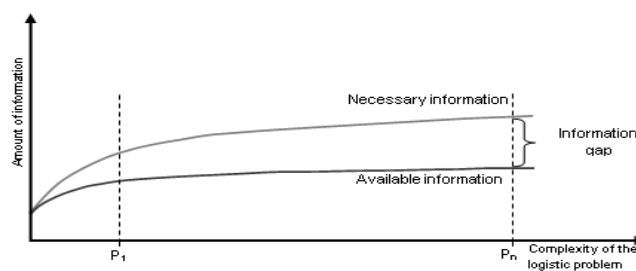


Fig. 1 The growing problem of information gap (Jurga & Sławińska, 2011, p. 24)

It should be noticed, that the complexity of the logistic problem might concern both situations of emergency or conflict but also making decisions related to tasks and functions realized in logistic processes. It is also worth noticing that the problem of the information gap, as well as the gap itself, grows along with the complexity of the situation that the process of logistic processes management must face. Equipping information systems with widely interpreted ICT tools and implementing systems of enriched reality can be one of methods for overcoming the effect of the information gap in the system (Dźwiarek et al., 2005, pp. 6-8).

3. ASPECTS OF EFFICIENCY OF THE INFORMATION SYSTEM DESIGN

3.1. Quality requirements for information systems

Quality demands concern both organization sphere (methods for organizing the information flow in the IS) and technological solutions – information systems.

Therefore, in order to make the information system efficient, these requirements must always be met in both cases [At present, it is being considered that the most appropriate initial point for designing an information system, which can guarantee high quality of use, is to obtain an accurate knowledge of the target context of use (especially in reference to barriers, needs and expectations of the user) and iterative reaching best possibilities of solutions, with participation of future users, who often take part in big parts of design work (Sikorski, 2010, p. 12)]. They constitute one of most important aspects of information systems' design. The Table 1 presents a set of qualitative requirements.

Table 1 Quality requirements and their characteristics; own study

Quality requirements	Characteristic
Accessibility	It enables the SI user to obtain an information that he needs to realize particular tasks.
Timelessness	It reflects the current state of reality described by determined information.
Reliability	Its measure must take under consideration methodological aspects and the accuracy of reflecting real economic events.
Completeness	It prevents losing a part of information – in reference to the primal information.
Comparability	The possibility of making comparative analyses within frames of the principal or related sphere, from which the information comes.
Reliability	The essence of efficient functioning of the information system. It affects the completeness and timelessness of the information.
Processability	It is connected with the type of information that can be absorbed by the information system.
Flexibility	It means the reaction of the system to changes that take place both inside the organization and in its environment.
Efficiency	It is the skill for processing and transmitting a determined amount of information in a defined time interval.
Economic aspect	In practice, it means a set of criteria that have a direct and indirect influence on IS user's costs.
Appropriate reaction time	It means the time that the system needs to give an answer to a question presented by the user. In many cases it constitutes an essential factor that decides on the comfort of the IS user.
Detail	The amount of details describing the object, phenomenon or event, enclosed in the information.
System stability	Resistance to internal and external disturbances. Requirements of ultra-stability, i.e. possibility to return to the state from before the disturbance of system's work.
Prioritization	It determines the sequence for fulfilling information demands on different levels of management.
Confidentiality	It concerns the protection of the information. It formalizes the access to a determined information for defined groups of users.
Security	It is related to the growth of importance of the information in contemporary world and with the development of techniques for information processing.

3.2. Ergonomic requirements for information systems

The ergonomic aspect for information systems concerns mainly technology and tools supporting those systems. It is related with providing an *easy use* of the com-

puting system, without which no information system can operate. Therefore, in practice, *easy use* means in practice mainly provision of an ergonomic interface of the system used by the operator [Minimum ergonomic requirements concerning the interface are determined in the standard ISO 9241/10.], because it affects the real easiness of realization of IS functions. Therefore, the initial stage in designing an information system is to understand interactions taking place in the environment of logistic processes and in their target context. So-called Nielsen's heuristics are most popular principles for designing interactions. They can be used as criteria for assessment of the usability of the interactive product (Sikorski, 2010, pp. 63-66) and it can be presented in form of suggestions, with are presented in a synthetic way in the Table 2.

Table 2 Ergonomic requirements and their characteristic, own study

Ergonomic criteria	Characteristics
System status is always visible	Enables noticing important information concerning the functioning of the system state.
Match between system and real world	Means of assessment of the sense of fulfillment of the task that the user was responsible to do.
Sense of control and freedom of action	Ensuring the conditions for a natural feeling of integration with the information system and the environment.
Consistency and standards	Measures of user interaction with the technical system that convinces him of logic system relations.
Error Prevention	Means of assessment of system assets in disposition, from the point of view of the efficiency of interaction design.
Recognition rather than recall	Means for the implementation of knowledge about cognitive processes to design an information system.
Flexibility and ability to work on shortcuts	It favors the interaction between man and the information system in the process of steering the preferred mechanism of method of cooperation.
Aesthetic and economical design	It enables a comparative analysis of various information environments in reference to their comfort of interaction process assessment.
Assistance in recognizing, diagnosing and correcting errors	Means for shaping and giving access to review (system) statistics.
Support and Documentation	System means for support of information assets for individual user's profile.

Suggestions presented in the Table 2 support the process of designing a flexible information model [Information model is a set of information that man uses when he realizes his tasks, evaluates current situations and makes proper decisions (Ratajczak, 1988, p. 227)]. They constitute the basis for assessing the degree of compliance with ergonomic requirements and in further approximations, it gives conditions and means appropriate for the individual employee (customization). It is particularly important in designing IS supporting logistic processes (Pacholski et al. 2009, pp. 131-149).

The verification of ergonomic aspect of use in IS uses empirical methods – an experiment on a scientific workstation. One simulate conditions of task load that take place during the interaction between the operator and the IS interface. There is being created an information environment for particular task context in order to examine potential difficult situations (Wickens & Hollands, 2000, pp. 296-306); the system’s user uses necessary information (which is precise and which refer to particular course of interaction). Considering the context of theoretical deliberations and practical aspects of IS design, it seems to be reasonable to take into account the human-centric aspect of the design process (Majchrzak, 1988, pp. 21-23). Thus, it leads to the need for designing the interaction process that would include the entire system. “Designing a technical part of the information system should also take under consideration operations of man and his work conditions” (Jaźwiński & Ważyńska-Fiok, 1993, p. 88).

Presented approach to defining design requirements results with an increase of number of optional solutions. This allows keeping in the user’s memory the image of the task that was formed in the beginning of the operation and the information system becomes appropriate for the system man – to – means of work; this system creates favourable conditions for cooperation, because:

- every activity is preceded by preparations to the next action,
- the user has the possibility of simultaneous realization of several tasks referring to the same objective,
- the user tends to realize not one, but several objectives, i.e. he has the possibility to undertake many actions.

Table 3 Statement of categories of assessment for different phases of creating an information system (Jurga & Sławińska, 2011, p. 30)

No.	Quality requirements of SI designers	Criteria for assessing utility of the SI users
1.	security	sense of control and freedom of action
2.	efficiency	preventing errors to occur
3.	keeping proper priorities	flexibility and possibility to work on shortcuts
4.	system stability	system status is always visible
5.	economic aspect	assistance and documentation

Research conducted at the stage of prototyping using the monitor prototype stage confirms the need to expand cooperation with users while improving the resulting solutions. Every method of current assessment of prototypes along the process of their construction requires accepting a preliminary list of criteria for their evaluation (Sławińska, 2008, pp. 75-79). The group of IT systems’ designers assigns higher indexes of significance to the set of design criteria; they do not always respond directly to the positive evaluation of the user and to the provision of ergonomic conditions in processes of information processing. The essential difficulty is that both sides have different hierarchies of criteria of assessment (Tab. 3).

The first column – importance of qualitative requirements; second column – criteria, which are important from the point of view of cooperation between the user of information coming from the IS (assessment of the usefulness of the system) (Sławińska, 2009, pp. 185-194). There is a clear discrepancy in what is important for the user in relation to the intentions of designers of information systems. Users find important to keep the natural way of interaction (that would not be limited by technical solutions) and designers focus on security and economic criteria. The ergonomic approach favours the compromise between these intentions and expectations. The iterative modification allows combining both methods (Fig. 2).

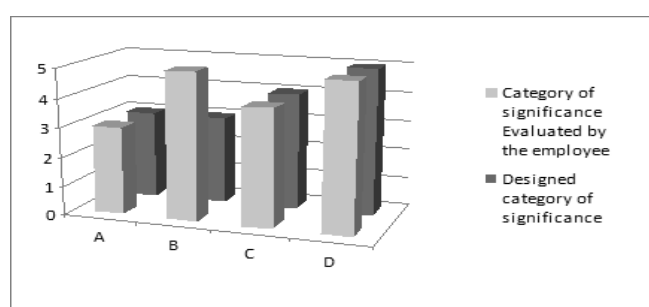


Fig. 2 Statement of experimental data related to the effect of transmission of the attention by breaking rules in decisive tasks (A-employee uses a computer workstation, B- employee uses an interface in a mobile device, C- employee uses an interface in an actuator, D- employee uses an interface in under difficult conditions of use of the IS (Jurga & Sławińska, 2011, p. 31)

Good ergonomic design solution come from taking under consideration the ergonomic approach that is implemented already in the stage of organization and requirement defining for the information processing process. Warehouse management and control of the flow of goods in the warehouse are good examples for illustrating the importance of taking under consideration ergonomic requirements concerning the design of information systems in the context of their implementation in logistic processes [The essence of an information system supporting warehouse logistic management is to store information concerning the state of the warehouse (Walsch, 2003, p. 514). The ultimate goal is the method of documentation of warehouse turnover. This means that it automatically eliminates discrepancies between different methods of record. An IS should localize efficiently each part of stocks and every individual piece of stored good. It should have information on the number and localization of the stock, but also on its physical characteristics. In reference to the evaluation of the superior objective of warehouse activity, which is: best quality of realization of orders and lowest costs of completion processes, the service of exceptional orders is a critical test for the ideal system. The process of completing order scan be a good example (Lysons, 2002). In one warehouse it is realized by successive collecting one

order; in another – orders are divided into different spheres, stores; or they are combined in reference to the preliminary division of bigger orders on many warehouses. The variety of potential on-going orders can be ensured if the SI will consider the situation context for a wide spectrum of logistic processes, in this case – warehouse activity].

3. CONCLUSION

Logistic processes are realized always and in every company, independently from its size, sector, or are of the market, in which the firm operates. Their realization is conditioned by efficient information management. Information management is *run* by an information system, which constitutes a nervous system of the company. Usefulness, and IS efficiency resulting from it, is the conjunction of qualitative requirements and ergonomic criteria considered in the stage of their design. Besides, it is worth to notice that information technologies significantly affect modern information systems. They constitute technical means supporting the functioning of IS, especially in reference to the sector of logistics, where realized processes are characterized with high complexity.

Taking under consideration the aspect of creating a flexible IS, it is reasonable to accept an approach based on a perceptive synthesis, which is the one that favors optimum efficiency of realization of logistic tasks, it combines expectations and experiences coded in the cognitive structure of man. Man's knowledge, which constitutes the context organizing the perception and the element of perception that interprets data, for needs of realized tasks. A process approach supports it because it significantly contributes to the reduction of the information gap, which might affect the efficiency of logistic processes realized in the company.

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