A Concept of an IT Tool for Supporting Knowledge Transfer Among Facility Maintenance Employees as Part of Intelligent Organization

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Abstract. The article presents a concept of an IT tool, supporting knowledge transfer among people working in a facility maintenance department. The developed assumptions of the tool are a continuation of the previously conducted investigations into the current status and expectations regarding the transfer of knowledge among the employees of such a department in an international enterprise producing pre–insulated steel pipes. The presented concept includes a description of the functionality and a data structure which enables ensuring this functionality. The tool's functionality has been presented by means of use case diagrams. Particular cases have been characterized in detail in scenarios presented in tables. To increase the clarity of the description in the study, also systems of windows used to present the scenarios have been shown. The data structure which allows obtaining the pre–defined functionality of the tool has been presented by means of a model compliant with IDEF1x.

Keywords: Maintenance · Organization · Knowledge · Management · Employer · Breakdown · Database · Transfer · Support

1 Introduction

One can say that contemporary economy is based on knowledge. Knowledge is one of the major factors that allow enterprises to develop and build a competitive advantage. Its acquisition and propagation in a right time and scope enables an organisation to effectively and intelligent manage the resources possessed [1]. The creation, learning and transfer of knowledge is considered one of the major problems related to the functioning of today's organisations – intelligent organizations; therefore, such issues should be dealt with by contemporary science [2, 3].

In literature devoted to knowledge management one can encounter various approaches to the perception and definition of the notion of knowledge. D. Paulin and K. Suneson [4] propose separating two major trends in this area. According to one of them, knowledge is considered as an object, whereas in the other one it is perceived more intangibly – as a subjective contextual construction. The approach proposed by D.J. Skyrne [5] places the notion of knowledge among the notions of data, information

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and wisdom. According to it, data includes facts and figures, information is data in an appropriate context, knowledge is information with understanding, whereas wisdom means knowledge combined with intuition and insightfulness. The definition of knowledge proposed by A. Brooking [6] is similar. Both approaches can be included in the first of the above mentioned trends. A different, less technical definition has been proposed by I. Nonak and H. Takeuchi [7]. According to it, knowledge refers to beliefs, activities, expectations as well as meanings and is equivalent to "confirmed beliefs". According to this definition, knowledge is an orderly reflection of reality in human mind. Irrespective of the adopted definition, one can see that knowledge is always inseparably linked with man. According to I. Nonak and H. Takeuchi [7], only an individual can have and process knowledge.

Major processes involving knowledge that are implemented in an organisation include: creation and transfer of knowledge. Transfer can concern processes implemented in the organisation itself as well as processes between the organisation and environment [8–10]. The very notion of knowledge transfer is frequently used in literature interchangeably with knowledge sharing. This phenomenon has been noticed by A. Jonsson [11]. Considering the problem of ambiguous differences between the two notions, D. Paulin and K. Suneson [4] suggest a greater correlation between the notion of knowledge sharing and knowledge perceived as subjective interpretation referring to a particular context as well as a stronger relationship between the notion of knowledge transfer and knowledge perceived as an object. G. Szulanski [12] uses the notions of knowledge transfer and good practices transfer interchangeably, defining them as replication of organisational operation algorithms. In particular, this applies to the methods of working which have been developed in a certain area of the organisation and are better than the previously used ones.

Knowledge, its generation and transfer are also very important for facility maintenance service teams. The quality of work and, in consequence, the quality of services provided in this scope, is inextricably linked with the employees' experience and skills. It is crucial that knowledge generated by particular individuals is shared with the remaining workers Practically, each facility maintenance employee carrying out their daily work deals with situations that involve generating new knowledge, which they can make available to the remaining co–workers [13, 14]. In such terms each employee of this section of the enterprise is considered as a knowledge worker. The term "knowledge worker" was first proposed by P. Drucker in 1960 [15]. One of the most popular current definitions has been proposed by T.H. Davenport [16]. According to it, a knowledge worker has reached a high level of specialist knowledge, education and experience, and the work he/she performs requires creation, distribution and usage of knowledge. In a similar way knowledge is perceived by M. Lotko and A. Lotko [17].

The phenomenon of knowledge transfer among facility maintenance employees was the subject of earlier research conducted by the authors of this article. These investigations were carried out in an enterprise producing pre–insulated pipes. The company in question is a part of an international concern, employing in Poland approximately 700 people in production departments and 40 facility maintenance workers. In the aforesaid research it was found that facility maintenance workers were aware of the meaning and need of knowledge transfer, and the process of its sharing was often effected on their

own initiative [18]. This awareness is visible in both basic workers and managerial staff. However, attention was drawn to the fact that there are no tools which could be used to support knowledge transfer processes. Moreover, the managerial staff signaled a need for greater formalisation of these processes.

2 General Outline of the Proposed Tool's Functionality

Based on the conclusions resulting from the previously conducted investigations, an appropriate IT tool was proposed to streamline the processes of knowledge transfer among facility maintenance workers. Apart from facilitating the transfer of knowledge, this tool would force specific methods of operation, which to a certain degree would formalize the processes implemented in this scope.

After repairing a device or subassembly, precise descriptions of such repair are created in the proposed tool. In the concept of the tool the devices or subassemblies are called elements and the repair is referred to as an operation. Detailed descriptions refer to procedures included in an operation. Each operation can consist of a few procedures. When creating a procedure, an employee verbally describes the actions performed, defines the time necessary for their performing and encloses indispensable documents in a form of attachments. From time to time the team responsible for verifying the procedures entered in the system has a meeting. Until verification all the procedures have the status of pending verification. After verification they can be accepted or rejected. If the procedures have been accepted, they can be recommended as a good practice. When a breakdown has been reported, a facility maintenance employee in charge of the repair can become acquainted with the existing methods of implementing relevant procedures by means of the proposed IT tool. In case of doubt concerning the operations to be undertaken in response to particular symptoms, the employee can check what operations are related to particular elements or symptoms in the system. The assumed scope of functionality for the proposed tool has been presented by means of use case diagrams. There are three main use cases, such as:

- "Adding methods of operation" – implemented after a facility maintenance employee finished the repair,
- "Becoming acquainted with a method of operation" – effected before undertaking the repair,
- "Verification of a method of operation" – effected periodically during a meeting of the team in charge of verification of the operating methods entered in the system.

In specific situations the "Adding methods of operation" case can be extended with "Adding an element", "Adding an operation", "Adding a symptom", "Adding a procedure", "Adding documents" and "Assigning a symptom to an operation". The case entitled "Becoming acquainted with methods of operation" can be extended with "Modification of the operation list". The use case diagram for the proposed tool has been presented in Fig. 1. For all the use cases detailed scenarios have been developed, which are presented in tables in the next part of the article. To describe the scenarios, elements of computer programme structures were used, such as a loop, presented by means of

[FOR EACH] [END FOR EACH] block and a conditional statement presented by means of [IF] [ELSE] [END IF] block.

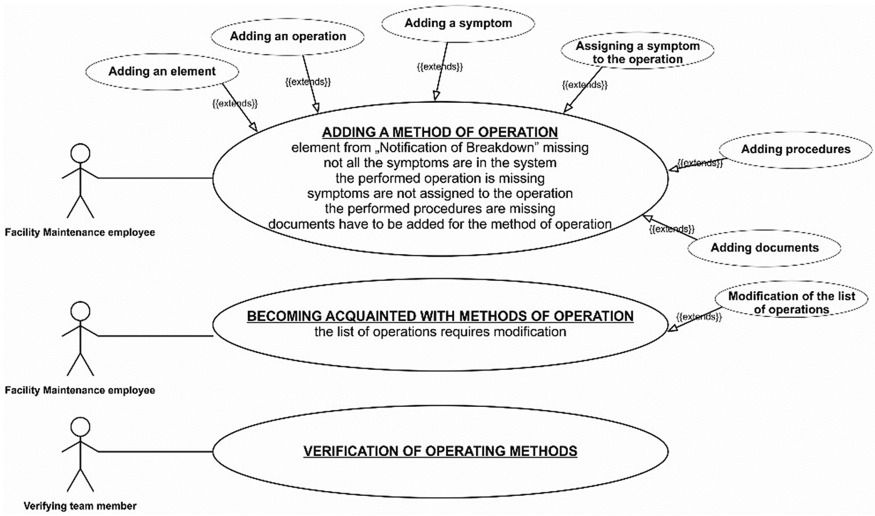

Fig. 1. Diagram of use cases for the proposed tool

Tool responses have been preceded with designation [SYSTEM] and the implementation of another use case has been presented by means of [PU] and the name of the case. In the first place, in Table 1, a scenario for the basic part of "Adding methods of operation" use case has been presented. In subsequent tables descriptions of extending cases have been contained. To increase the description transparency, in Fig. 2 visual drafts of application windows have been shown, such as symptoms edition window, element adding window, symptom adding window, operation edition window, procedure adding window, method of operation adding window, new documents assigning window and document adding window, used in the process of implementing particular scenarios.

Table 1. Use case scenario: adding methods of operation

Step	Description
1	Selecting the symptom edition window
2	[SYSTEM] Displays the symptom edition window – the list of available elements
3	[IF] The element for which symptoms have been described in „Notification of Breakdown" does not exist.
3.1	[PU] „Adding an element"
3.2	[FOR EACH] For a symptom described in „Notification of Breakdown"
3.2.1	[PU] „Adding a symptom"
3.2	[END FOR EACH]
3	[END IF]
4	Selecting an element
5	[SYSTEM] Displays the list of symptoms
6	[IF] Not all the symptoms described in „Notification of Breakdown" exist in the System
6.1	[FOR EACH] For a symptom not included on the list
6.1.1	[PU] "Adding a symptom"
6.1	[END FOR EACH]
6	[END IF]
7	Selecting the operation edition window
8	[SYSTEM] Closes the symptom edition window. Displays the operation edition window. Displays the list of elements
9	Selecting an element
10	[SYSTEM] Displays the list of operations assigned to a selected element and the list of symptoms assigned to the selected element as well as its master and slave elements
11	[IF] The performed operation is not included on the list
11.1	[PU] "Adding an operation"
11	[END IF]
12	Selecting an operation
13	[SYSTEM] Displays the list of symptoms assigned to a selected operation as well as the list of procedures of which the operation consists
14	[IF] There are symptoms described in Notification of Breakdown which have not been assigned to the operation
14.1	[FOR EACH] For the symptom which is described in the notification and has not been assigned to the operation
14.1.1	[PU] „Assigning a symptom to an operation"
14.1	[END FOR EACH]
14	[END IF]
15	[IF] There are procedures which have been performed as part of a selected operation but they are not included on the list
15.1	[FOR EACH] For a procedure not included on the list
15.1.1	[PU] "Adding a procedure"
15.1	[END FOR EACH]
15	[END IF]

16	[FOR EACH] For a procedure for which a new method of operation is to be added
16.1	Selecting a procedure
16.2	Selecting the „Add a method of operation” command
16.3	[SYSTEM] Displays the method of operation adding window
16.4	Supplementing the details of a method of operation. Introducing a description, duration of a procedure, employee’s code.
16.5	Approval
16.6	[SYSTEM] Creates a new method of operation. Adds an identification number for it. Introduces the status as “1 – pending verification”. Adds the date of creation. Assigns it to a selected procedure.
16.7	[IF] There are documents which should be linked to the added method of operation.
16.7.1	[PU] „Adding documents”
16.7	[END IF]
16.8	Selecting the “finish” command.
16.9	[SYSTEM] Closes the method of operation adding window.
16	[END FOR EACH]

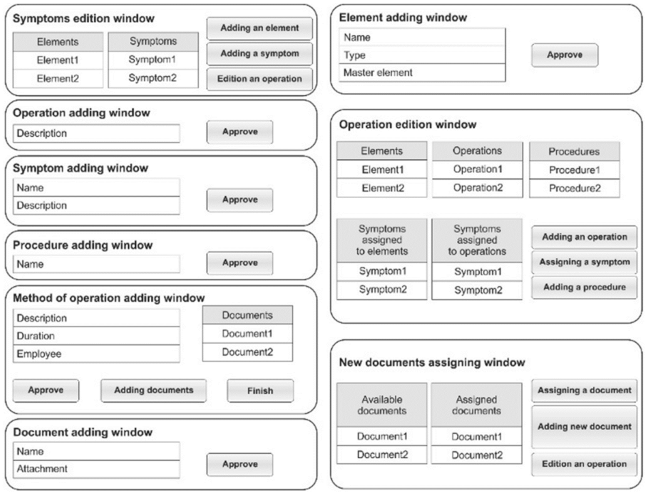

Fig. 2. Visual arrangement of windows for procedure scenarios

The first use case extending the case presented in Table 1 which can occur when employing the described tool is “Adding an element”. It is effected when the element for which a breakdown has been reported does not exist in the system. The course of this case has been described in Table 2.

Table 2. Use case scenario: adding an element

Step	Description
1	Selecting the „Add an element" command
2	[SYSTEM] Displays the element adding window
3	Entering a value for attributes „name", „type"
4	[IF] Type of element other than „Device"
4.1	Entering the id of a master element
4	[END IF]
5	Approval of data
6	[SYSTEM] Creates a new element, adds an identification number to it, closes the element adding window

Another extension of the basic course of the case presented in Table 1 is a situation in which the symptom described in the notification of breakdown was not entered in the system before. Another extending case for "Adding methods of operation" is "Adding an operation". It is effected in a situation when the performed repair was not entered in the system before. In a situation when not all the symptoms described in the notification of breakdown are displayed for a particular operation, it is necessary to implement another extending case entitled "Assigning a symptom to the operation". Another extending case for "Adding methods of operation" is "Adding a procedure". It is necessary in a situation when a particular operation involves procedures which have not been entered in the system before. The last extension of the use case described in Table 1 is "Adding documents". It is implemented when the description of a particular procedure requires enclosing additional documents. This case is effected when the enclosed documents already exist in the system as well as in a situation when they have to be added.

The remaining use cases, i.e.: becoming acquainted with a method of operation and operating method verification have not been included in this study due to its limited size.

3 Database Structure

As part of the IT tool concept, the following entities have been proposed to be separated for the issue in question: Elements, Operation, Types of elements, Symptoms, Procedures, Methods of Operation, Employees, Documents, Status, Operations–Procedures, Symptoms–Operations, Documents–Methods of Operation. Short characteristics of the entities are contained in Table 3.

The data structure which enables implementing the pre–defined functionality of the tool has been presented by means of a model compliant with IDEF1x. This model is shown in Fig. 3.

Table 3. Description of separated entities

Entity	Description
Elements	A device, assembly, subassembly, part – each device or its separated subsystem
Types of elements	A type assigned to an element. Currently there are two types of elements: device and other. The device does not have an assigned master element
Symptoms	A symptom of improper functioning of an element requiring corrective measures
Operations	A set of procedures performed on a given element due to corrective measures
Procedures	A basic activity involved in the operation.
Employees	Facility maintenance employee
Methods of operation	A method of conducting the procedure
Status	The status of the manner of performing a procedure. Currently 4 statuses are possible: pending verification, accepted – good practice, accepted, rejected
Documents	A document which can help to document the method of operation
Symptoms – operations	Defining the operations undertaken after particular symptoms have occurred. The operation assigned to an element can be undertaken in the case of various symptoms assigned to various elements
Operations – procedures	Defining the procedures that make up a particular operation. An operation can consist of a few procedures. A procedure can be included in a few operations
Documents – methods of operation	Assigning documents to particular methods of operation. A few documents can be assigned to a method of operation. A document can be related to a few methods of operation

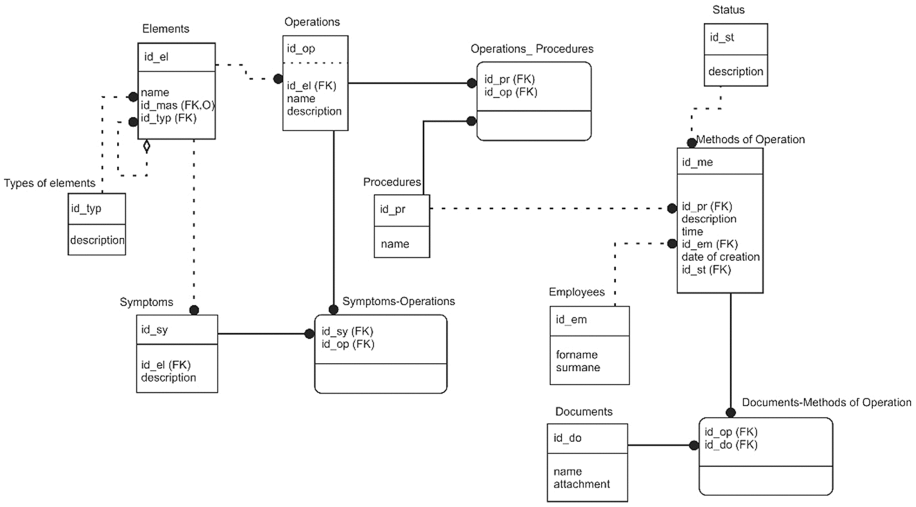

Fig. 3. Data relational model for the proposed tool

4 Summary

The tool whose concept has been presented in the article should enable improving the transfer of knowledge among facility maintenance employees. On the one hand, it should improve the employees' access to a particular piece of information when it is really needed, while, on the other hand, it should allow the development of knowledge collected at an organization by enabling the identification of operating methods that are considered recommendable and imitable. Further investigations should include the implementation of the solution in a real production environment so as to verify the concept and assumptions made.

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