Effective Management of Practitioners’ Knowledge-Development of a System for Quality Tool Selection

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Abstract. The paper presents the stages in the development of a computer system for quality tool selection (with DSS characteristics) for the purpose of process improvement in production companies. The basic premise adopted in the development of the system was to acquire and save (store) in a system the knowledge of practitioners from this area in order to use the knowledge repeatedly, e.g. during staff training. A gap in knowledge was noticed in this respect. According to practitioners, the purpose of using quality tools given in the literature should be more precise in terms of the time in the production process when a given tool may be used, and the type of problem that may be solved with the tool. Specific information on these issues was gathered through a survey conducted among managers. All actions taken within this research study illustrate the key processes of knowledge management proposed in [1].

Introduction

Today companies face a situation in which the ability to dynamically adapt to changing environmental conditions is a key competitive factor. All employees must be therefore equipped with the right tools, enabling them to make decisions quickly and readily, and consequently to act effectively in all areas where value for the customer is created [2]. The tools include, among others, quality management tools. They are used to collect and process quantitative and qualitative data (derived from processes) into information facilitating quality-focused decision-making in performance areas. There are many such tools, and they differ in terms of their nature and application. The need to develop a method for an easier access to the necessary and relevant quality tools inspired the authors to develop a computer system for quality tool selection. The basic premise adopted in the development of the system was to acquire and save (store) in a system the knowledge of practitioners from this area in order to use the knowledge repeatedly. The developed solution, with the characteristics of a decision support system (DSS), constitutes also training material for teaching purposes. At the same time, all actions taken within this research study illustrate the key processes of knowledge management proposed in [1].
Key Processes of Knowledge Management in Production Companies

Since the idea of knowledge management originated in consulting organizations, we must consider the importance of knowledge management in a production company where material flow dominates and the final result of processes is a physical product. Knowledge management is a knowledge-oriented process, aimed at expanding the knowledge resources and their effective use in various areas of the organization. In a company with a complete production cycle, the areas include, among others, research and development, design, production planning, manufacturing, sales, product quality control. The processes in the companies involve mainly technical expertise and managerial knowledge. It can be divided into declarative knowledge (e.g. knowledge about customers, relationships with customers, products, market competition) and procedural knowledge (know-how of the company). What distinguishes the functioning of production companies is above all the fact that employees play dual functions – they are the sources of knowledge and users of knowledge.

In order to improve the effectiveness of knowledge management, many methodological guidelines, models and tools have been developed. One helpful solution is a set of key knowledge management processes, specific and interrelated, described in [1]:

— **knowledge location** – includes the methods of searching and discovering internal and external sources of knowledge for the employees and organization to acquire the knowledge;

— **knowledge storage** – involves the selection, giving structure and form to information and updating the knowledge resources or suitable media and devices used to record the resources;

— **dissemination and knowledge sharing** – concerns the question of who has access to specific resources of knowledge, to what extent and in what way; the process of knowledge sharing usually takes place during team work [3];

— the dissemination of knowledge is related to its development, because each employee reached by a new piece of information associates the information with their previous knowledge; knowledge development contributes to increasing the workers’ ability to take action [4], which results in new projects, process improvement, problem solving abilities, etc.;

— **process of knowledge use**, contained in the model [1], is treated by the authors of this study as an executive process, whose effectiveness is guaranteed by performing key management processes.

Stages in the Development of a System for Selecting Quality Management Tools for Production Process Improvement

Locating the Knowledge about Quality Tools

Over the years there appeared a variety of quality management concepts (focusing on employee involvement (TQM), reaching quantitative targets (Six Sigma), meeting standards (ISO 9000)), which sometimes additionally merged with other management concepts (e.g. production in the form of Lean Six Sigma) resulted in richness and diversity of quality management tools. They are described in the extensive literature on the subject which includes, among others, [5, 6, 7]. There have been many attempts at structuring and organizing the knowledge about the tools, resulting in numerous classifications. Information about them can be found in books, manuals,
training materials, as well as on the Internet – e.g. on the website of the American Society for Quality (ASQ).

Therefore, in order to learn about the quality tools described in the abovementioned works, the authors had to conduct a detailed review of the literature. At this stage, a gap was noticed in the available information about quality tools, regarding the purpose of using the tool as described in the available sources; from the point of view of practice, the purpose required clarification: at which stage of the production process the given tool can be used effectively? Furthermore - what problem could be solved with the tool?

**Using a survey to acquire knowledge about quality tools**

The knowledge necessary to build and to develop a support system for selecting quality tools was gathered through a survey conducted from 2008 to 2010 and from 2013 to 2014. The statistical population consisted of companies with implemented, standardized quality management systems. The sample unit was a company operating in the technical industry, in accordance with the selected classes of European Classification of Economic Activities. A sampling limit was adopted in the study. The main inclusion criterion in the study was intentional restriction to one geographical region (the Wielkopolska region), while maintaining the representativeness of the sample and the selection quota (100 companies were tested).

The aim of the study was to identify the state of the art, examine the rate of use of quality tools and evaluate the effectiveness of their use in the production processes of the surveyed companies.

The standardized survey questionnaire referred to 37 different quality tools. The survey was designed in such a way that when the respondents (managers) indicated the tool used in the company, it was possible to determine:

- at which stage of the production process the tool is useful (1 - market research, 2 - design of products, 3 - technical preparation of production, 4 - manufacturing process, 5 - control and measurement, 6 - transport, 7 - storage, 8 - sale, 9 - servicing, 10 - disposal of products);
- what problem is solved with the tool (management, operating environment, process performance, method, material, machine, control and measurement, man).

The collected data show that some quality tools can be assigned to one of two categories:

- dedicated to processes; they are used at selected stages of the production process (e.g. 4 – manufacturing) and are also useful to solve all kinds of problems, at this stage of the process; these may include: descriptive statistics and the FMEA method (Fig. 1);
- dedicated to problems; they are used to solve problems of specific nature and are also useful at all stages of the production process; these may include check sheets and run diagrams (Fig. 1).
Storing the Acquired Knowledge in a Computer System for Quality Tool Selection (With DSS Characteristics)

The main purpose of this application is to aid the user in the selection of the right quality tool by asking a series of questions that clarify the needs and expectations of the system user. Knowledge gathered in the system can be defined as:

--- relatively constant - entered at the stage of system implementation:
- stored as an algorithm for quality tool selection, based on the author’s own method of criteria patterns [8],
- stored in the form of rules of conflicts between the selection criteria
- and rules of relations among the tools, and

--- constantly updated - acquired when users are working with the program:
- entered by the user during the work with the application;
- stored as an algorithm of the system’s learning of user preferences and behavior;
- stored in the form of statistics on the selection and evaluation of tools used.

The application has been designed to provide the greatest possible flexibility of knowledge stored in the system database. The application enables the user and helps to:

--- via the interactive user interface:
- search for quality tools;
o learn about the selected tool;
o add effectiveness evaluation of tools used in practice (off-line);
— via the expert’s interface:
o add more tools to the system;
o define dependencies (links) between the tools;
o introduce new criteria for the selection of tools;
o introduce rules of conflict between the selection criteria.

In the system the authors implemented the algorithm of criteria pattern method. As a result it was possible to store in the system the knowledge about quality tools in the form of sets of features that describe the tool (e.g. the type of the tool, its place in DMAIC, purpose of use, process stage, etc.), and the possible versions of the features. It was therefore possible to include and store information about quality tools derived both from literature and from the survey.

Expanding System Knowledge by Using the System

Algorithms used in the application allow the user to act in two ways, as it is frequently emphasized in the literature focusing on knowledge management in production companies. Each employee of a production company acts in two ways: as a user and supplier of knowledge [9, 10, 11]. An employee, using the application, is on the one hand a user of the already gathered knowledge, and on the other, a source of information about choices and evaluation of tools used in practice. In this way the resources of the relatively constant knowledge are expanded by the resources of acquired knowledge. The knowledge is supplied by experts (see expert’s interface), and by the system’s learning mechanisms (the designed algorithm), which gathers information about:

— the choices made by users (learning behaviour and user preferences – the system remembers the selection paths in order to more promptly guide the user to appropriate tools during future sessions with the application);
— evaluations assigned to tools used in practice.

Gathering information about past sessions in the system and using previous experience of other system users makes next search queries more effective. The application remembers changes made by the user selecting the features of quality tools in the criteria pattern method (the module with the same title can be found in the main window of the application). The sequence of selection criteria made by the user is stored in the database. The user - having used the selected tool - may return to the previously saved session and evaluate if the selected tool fulfilled his expectations in practice.

Knowledge Dissemination

The dissemination of knowledge gathered in the system of quality tool selection is aimed at offering the knowledge to be applied in practice by production companies. The application has been tested in several production companies, both by quality experts and people without in-depth knowledge about quality management tools. Moreover, it has been presented during several national and international conferences related to quality management. It has been recognized as a useful tool for managers/quality engineers, particularly in SMEs. As an interactive application it may be used as a training instrument, but it may also be used as a storage of employee knowledge, allowing them to use the tools and methods of quality
management in practice. Experts and practitioners indicated several directions for future development of the application, e.g. improvement of system functionality, expansion of practitioners’ knowledge in the system, and development of a network version.

Summary

The development of a computer system for quality tool selection (with DSS characteristics) for the purpose of process improvement in production companies required the authors to gather information by reviewing the literature. Information from the literature is complemented by knowledge acquired from a survey conducted among practitioners. With the knowledge stored in the system database, the system facilitates the access to appropriate quality management tools. The survey examined the popularity of quality tools useful in the improvement of production processes and technical services, the rate of use and evaluation of usefulness of such tools. At the same time, all actions taken within this research study illustrate the key processes of knowledge management proposed in [1].

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References


