CONTROL OF NONCONFORMING PRODUCTS USING SOFTWARE AGENT BASED SYSTEMS

Iliescu DRAGOŞ[1]

The control of the nonconforming product using the software agent based systems represents a new approach of the quality management ISO 9001 requirements. Focusing on the nonconformity solving method, system is guiding the user based on a preloaded algorithm. Final results it is represented by the efficient management on the nonconformity solving methods, synthetic reports and email messages offered by the system, actively support the analyzing and decisions needed in such cases.

Keywords: quality management, control of nonconforming product, software agent based system

1. Introduction

Implementation of the standard ISO 9001 from the point of view of the control of nonconforming product arise certain difficulties on the implementation stage. These difficulties occur under various conditions as determined by each organization[2]. To solve these difficulties, an extensive training is needed with personnel direct involved in the nonconformity solving subject. It is proven that this approach is finally useful and efficient; nevertheless this can be solved based on a different approach. The new approach is presuming the existence of a so called software agent based system. The advantages of using such a system are related with the modeling technique for complex and dynamics processes. This approach will better reflect the behavior of different actors as well as the interactions of them [5].

There are several characteristics that need to be appointed to get success with the process of system implementation [8]:

- System quality
- Information quality
- Service quality
- Use

---

[1] Eng., Quality Manager, S.C. Doosan IMGB S.A., Bucharest, Romania, email: dragosiliescu2005@gmail.com

[2] It is predicted that the enterprise systems market will record a significant increase because the management's desire to increase efficiency by process reengineering. These processes will finally affect by consequence organizational structure [6]

- User satisfaction
- Net benefits

2. Software agent based systems

Developed starting with early '90, the concept of software agent had continuously evolved, becoming today a concept of advanced informational technology. Even there is not a common understanding regarding the definition of software agent, we will note across the various references regarding the subject, the characteristics related to software agents as shown in [1].

- Autonomy
- Proactive
- Reactive
- Communicative

As related to an informatics programming routine, these can surprise at first hand. It has to be noted that these routines start to be developed initially to solve mainly intensive repetitive tasks. Simple rules are often implemented among the agents, but running these agents will conduct to complex adaptive systems [5].

Further developments did enlarge the scope of this technology as today it is used for a large type of applications.

Once the software agent concept is available, applications that use this concept have started to be developed. Essentially this application type represents a structured method to solve a problem where may exist more than one method. The system will exactly guide and support the user in the solving process.

3. Control of nonconforming product

An application of the software agent based systems will be presented for the control of nonconforming products[3]. The application is taking count of the requirements expressed by ISO 9001 and of recommendations in ISO 9004.

Information revealed within this paper is referring to an application that runs under real environment; however some of the details may be the result of theoretical development occurred after this application has been initiated.

---

[3] It is shown by [9] that the involved process of reengineering it is direct affected by understanding and modeling of business process and workflows. Involving users in their problem solving could solve a larger class of problems than other methods usually do; user interaction framework became an efficient tool. By consequence an interactive system, question – answer based, it is expected for a better result.

3.1 Process Map

The process map for issuing, analysis, disposal and closure control it's presented in Fig. 1. The organization structure involved, the moment of involvement as the decision routing of the nonconformity solving process are shown too. It is to be noted the large process scope that needs to be managed as well as the concurrent style that is present inside. It is not only a system that is blocking non-authorized usage or fabrication of nonconforming product, but it is a system that actively supports the users to correct and efficiently solve the nonconformity. It is a so called proactive system. From this perspective such a system will increase the quality of communication between different actors.

3.2 Decision and disposition route

Different routes are presumed for the decision making process as shown in Fig. 1. Traditional approach will make the members to feel confused. It is simply too complicated. It is the role of a software agent based system to help the organization members in such cases. The decision routing it is controlled based on a preloaded logics. Logics referred here are nothing than the quality system procedure translated into informatics logics. In this way it is not needed that some members to send physically a document to other member, the system will manage the information instead. To measure the impact that the system is having we need to understand tangible but intangible too benefits. Reference [8] is proposing the metrics shown in Table 1.

Table 1

Metrics for system impact measurement

| System quality	Information quality	Individual impact	Organizational impact
Ease of use	Availability	Learning	Organizational costs
Ease of learning	Usability	Awareness/recall	Staff requirements
User requirements	Understandability	Decision effectiveness	Cost reduction
System features	Relevance	Individual productivity	Overall productivity
System accuracy	Format		Improved outcomes/outputs
Flexibility	Conciseness		Increased capacity
Sophistication			e-Government
Integration			Business process change
Customization			
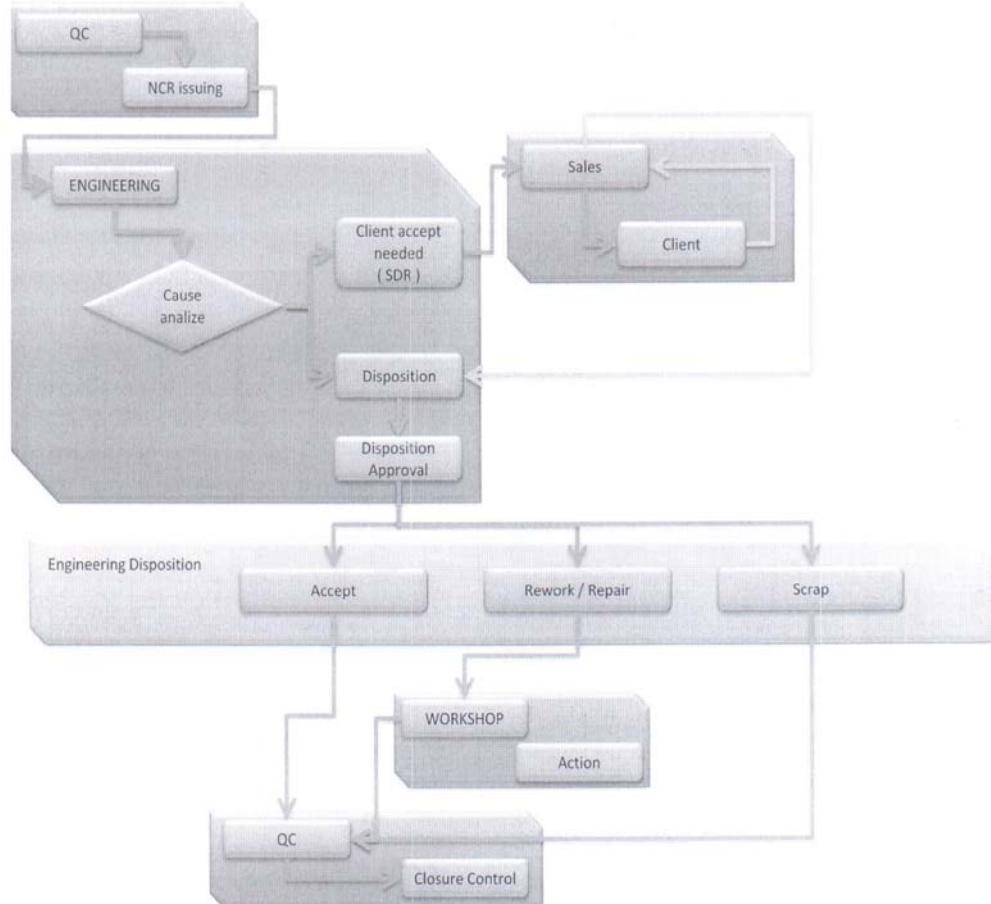
Fig. 1 – Process Map

As shown in the above process map there were defined several actors[4], members of different teams that in particular conditions will perform particular actions. Table 2 is summarizing the roles and responsibilities implemented within the application.

As shown in practice, it is a very difficult task to perform the process described in the picture 1 based on a traditional approach[5]. Difficulties occurred in

---

[4] Consideration from the point of view of user resistance must be adopted. Combined metrics of system quality with user acceptance can make the difference between success and failure. Business process will follow in this way to be influenced too by the same effect [9].
[5] Discrete-event systems, traditionally applied, it is today still useful in cases when the processes can be well defined in a queue-like structure with none or a minimum level of concurrent processes [7].

connection with different routes, returning points etc. With IT system, task becomes easier. It needs to load in the system a so called routine logic.

Roles and Responsibilities for issuing and disposition on the NCR system

	Team	Action description
1	QC	As a result of nonconformity identification, QC members will open and describe the deviation against requirements. After the task is completed, NCR will be sent to Engineering queue for further processing.
2-0	Engineering	Once a NCR is received, a responsible member is appointed. After cause analyze, proposal for disposition is made on the system.
2-1	Sales	If case, after Engineering is issuing the SDR as NCR translation, Sales person will contact the client to get approval for nonconformity solving proposal. Reply from the client is returned to Engineering for next processing.
2-1	Engineering Manager	Approve the proposal described in 2-0 and / or 2-1.
3	Workshop	For rework / repair disposition, workshop is called to ensure the needed resources for processing.
4	QC	After re-inspection for closure control, QC member will send the NCR to QC manager with proposal for closure.
5	QC Manager	After closure approval the nonconformity it is to be considered as solved. NCR can be archived.

3.3 Principle regarding the logic of preloaded routine

Preloaded routine in this type of application is having a major importance. Developed in the administrator zone, these logics will conduct the user on the right path to the desired result. For detailing this concept, deviation and cause understanding analyze, will be exemplified as shown in Fig. 2 and Fig. 3.

Check list type method shown in Fig. 2, it is intended to ensure that the responsible Engineering member will correctly understand the (potential) effect of the deviation. The method uses a 5 point questionnaire similar with the FMEA method. Within this paper only the principle it is described as details regarding the implementation itself it is very strong related with the particular condition of the organization, further settings will case-to-case be different.

Next step in the disposition route logic will lead the user to the root-cause analysis, Fig. 3. As methods for this purpose are commonly known, they will not be detailed but only summarized here.
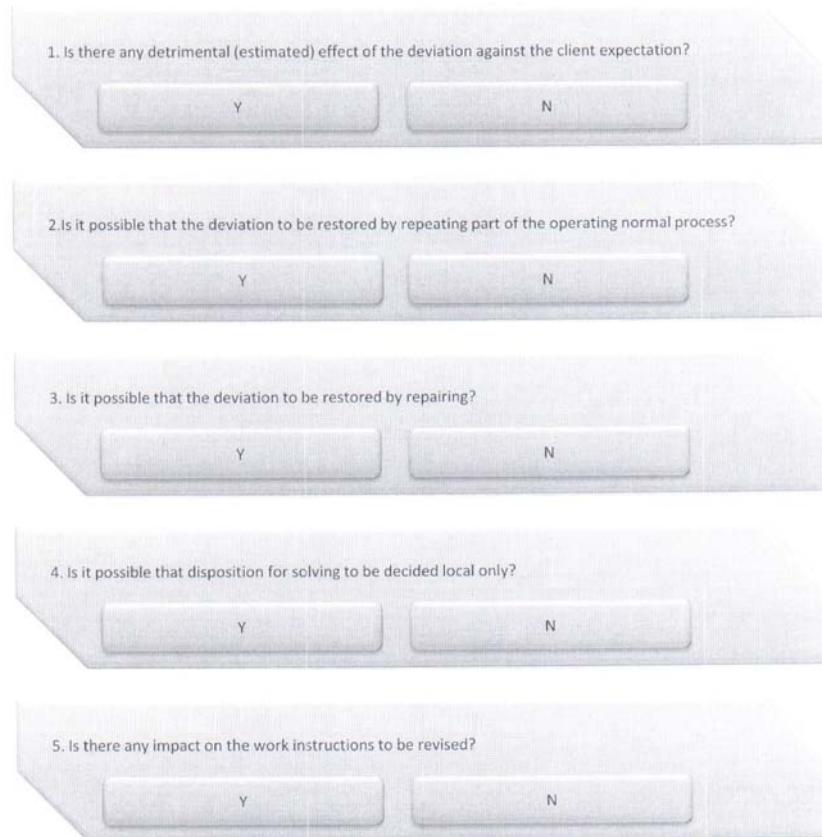
Fig. 2 – 5 step check list for understanding the deviation and expected effect

Fig. 3 – R / Cause analyze

3.4 IT approach

The method described based on the software agent systems it was developed on the concept of distributed, relational databases. The implementation is built on an Oracle server database using different methods: triggers, procedures etc.

From this point of view there are the following requirements against the application capabilities, Fig. 4

Describing in detail the programming methods used is out of this work scope. Only a short presentation of two interesting capabilities will be considered instead.
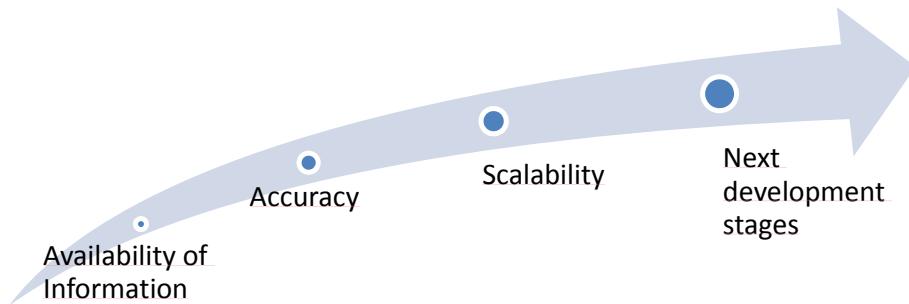
Fig. 4 - Application requirements for a flexible and consistent environment

3.4.1 E-mail messages capability

One of the most helpful capabilities of the presented system is referring to a so called background notification capability. This performs the task of announcement of certain members across the organization as decided within administrator settings. Monitoring this module over the time, it was recorded that there are more than 100 messages in average daily. The notification happens in the background.
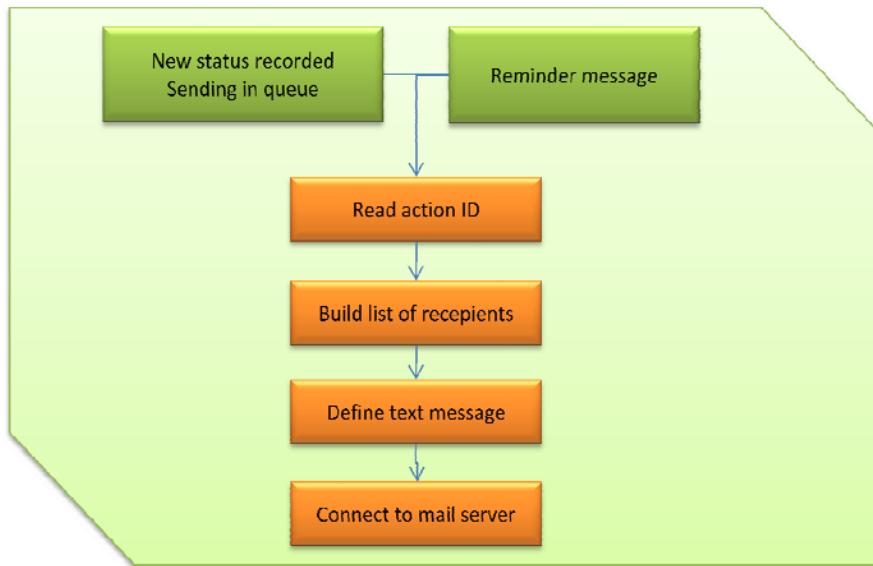

Fig. 5 – Send email message procedure

To run such a procedure, it is required a mail server to be configured within the organization network. The programming sequences are based on the pl/sql language. There are several methods that can be used within this language in order to send a mail message. Here the UTL_MAIL package has been used to build the script.

Describing shortly the mail procedure, the script is triggered on by two types of events:

- There is a new record that updates the status of a NCR

- There is a special reminder message for NCR with no change in status

3.4.2 Reporting capability

When performing a root-cause analyze, as well as a deviation understanding, it would very helpful if the person that is running the checking described here, would have a synthetic history available. Information regarding the type of deviations, frequencies etc are important to be available. Reporting capability of the system will offer such information live.

4. Conclusions

The subject described within this work is a new approach regarding the implementation of the quality system. Based but not limited to ISO 9001, this system is running live since September 2007. The last update of the system was applied September 2010. Best control on all aspects regarding the control of nonconforming products, sharing information capability, short time of reaction and a complete traceability is that the software agent based systems to be used on a larger scale than described here.

R E F E R E N C E S

[1] *Emil Scarlat*, AGENŢI şi MODELAREA BAZATĂ pe AGENŢI în ECONOMIE, 2005, http://www.biblioteca-digitala.ase.ro/biblioteca/carte2.asp?id=467&idb=
[2] *Dragos ILIESCU*, Sistemul eNCR, prezentare internă DIMGB, 2007
[3] ISO 9001, Quality management systems – Requirements.
[4] ISO 9004, Managing for the sustained success of an organization — A quality management approach.
[5] *CM Macal, MJ North*, Tutorial on agent-based modelling and simulation, Journal of Simulation, 2010
[6] *Tim Klaus, J. Ellis Blanton,* User resistance determinants and the psychological contract in enterprise system implementations, European Journal of Information Systems, 2010

[7] *PO Siebers, CM Macal, J Garnet, D Buxton, M Pidd,* Discrete-event simulation is dead, long live agent-based simulation!, Journal of Simulation, 2010

[8] *Stacie Petter, William DeLone, Ephraim McLean,* Measuring information systems success: models, dimensions, measures and interrelationships, European Journal of Information Systems, 2008

[9] *John Krostie, Guttorm Sndre, Havard Jorgensen,* Process models representing knowledge for action: a revised quality framework, European Journal of Information Systems, 2006