



Research Article

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Research on the application of error proofing theory in the enterprises quality management

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ABSTRACT

The introduction of the error proofing theory and methods is conducive to preventing enterprises from errors in quality management, reducing potential risks in the process of quality management and improving the stability of quality management. From the perspective of the two sides of quality management, the paper discusses how to apply the theory and methods of error proofing in the enterprises quality management. Based on this, the paper explains the definition and key elements of quality management error proofing. From a holistic perspective and systematic view, the paper constructs a conceptual frame of enterprises quality management error-proofing system and discusses the operational mechanism of the enterprises quality management error-proofing system with the analysis of the process of quality management error proofing.

Keywords: Management error-proofing; Quality management; Robustness; System construction

INTRODUCTION

The Quality management should not only control the quality of products, but also control the quality of the management process which generates and forms quality. No matter the quality of products or services or the quality of management, they all have two sides: offensive and defensive for products or services and excellence and robustness for management. Up to now, research has mainly focused on how to enforce the offensive of products or services and improve the excellence of management, but has paid insufficient attention to how to prevent enterprises from errors so as to satisfy the enterprises' needs for negative quality. Though Japanese scholars have researched on the two sides of quality and presented a lot of influential articles and works, yet monographs about research on negative management quality in its true sense are numbered and quality management error proofing has not been brought into the comprehensive quality management system and comprehensively and systematically studied. The paper is designed to research on how to apply the theory and methods of error proofing to prevent quality management activities from errors from the perspective of preventing enterprises from getting worse and based on the reflection on the stability of management quality. Due to the unreliability and cognitive limitations of the managers and employees, errors in management are inevitable, which will bring a lot of consequences, such as increase in costs, loss of time, risks or damages, loss of business and so on. Management errors lead to the management failures so that systematical error proofing in management is necessary. By constructing quality management error proofing system and establishing scientific management error proofing mechanism, enterprises can predict potential failures in departments, prevent errors and optimize the management process and products or services design. Preventing systematical error risks in the sources, controlling errors in the potential risks and reducing damages out of failures are forward-looking means to improve management quality. Error proofing in

quality management is a new idea to improve the stability of the management system and creates a new angle of view for research on quality management.

2. Application concept of the theory and methods of error proofing in the enterprises quality management

2.1 Research on the two sides of management quality

(1) Offensive and defensive of the quality of products or services

Kaoru Ishikawa divides quality into negative quality and active quality. Negative quality means that absolute defects, errors and problems are causes of the customers' dissatisfaction. Active quality means that the advantages of the products, the comfort to the customers and so on are factors of the customers' satisfaction and the competitive edges of the enterprises. Therefore, eliminating negativeness and defects and obtaining defensive quality help stabilize markets. Offering attractive products or services and obtaining offensive quality help win markets. For example, safety is foremost to transportation system, so transportation tools have to consider safety in their design, manufacture and operation, which is the defensive quality. Fast and convenient transference, comfortable interior design, high-quality services and competitive prices are considered to be the offensive quality.

(2) Excellence and robustness of the quality of management

Management quality also has two sides. Excellence is its active quality and robustness is its negative quality. Robustness is also called stability and initially emerged in the modern control theory [1]. The robustness of a system is a property or characteristic to control the stability of the system on disturbed and uncertain conditions. From the perspective of management, robustness refers to the reliability and stability of the management system, i.e. the tolerance of management quality (the management process meeting the organization objectives) towards management errors and failures.

Excellence reflects the active need of the enterprises for developments and robustness presents their negative need for preventing enterprises from getting worse. Nowadays, excellence in management quality is a noticeable concern. All enterprises have established a series of excellent and replicable means. However, stable quality is potential. Therefore, the enterprises managers are required to examine themselves and investigate the markets, carefully discover and prevent the potential factors leading to management failures, actively face with problems, reduce the impacts of errors to improve the robustness of management.

2.2 Description of the theory and methods of error proofing

From the perspective of different cultures and control, there are quite a lot of definitions about error proofing and there are also requirements and descriptions in associated management books and ISO standards. Definitions of error proofing mainly refer to the measures to eliminate unnecessary errors [2]. Means of error proofing is professionally called Poka-Yoke. More specifically, they are a series of preventive measures to effectively prevent human errors or reduce the adverse effects due to human errors to the largest degree [3]. Poka-Yoke is a Japanese imported term and has developed to a world common word for error proofing. As shown in Figure1, the core methodology of Poka-Yoke mainly includes five principles and ten countermeasures. The five Poka-Yoke principles include exclusion, replacement, simplification, inspection and alleviation, which point out the basic ideas to handle errors in practices. The ten countermeasures further put forward concrete measures and methods to prevent and eliminate errors, mainly including elimination of root causes, insurance, automation, conformity, sequence, isolation, replication, levels, warnings and alleviation [4].

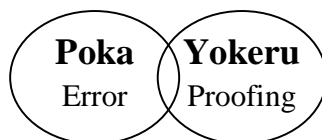


Fig.1 Japanese Interpretation Figure of Poka-Yoke

2.3 Application of error proofing in the enterprises quality management

Application of the theory and methods of error proofing into enterprises quality management and implement of quality management error proofing will utterly change the concepts of quality management, which emphasizes on transformation from "adjusting managers to management activities" to "adjusting management activities to

managers” so as to effectively prevent quality management failures or reduce the adverse effects due to the quality management errors. To further adjust management activities to managers is essential to error proofing in the enterprises quality management.

(1) Process of quality management error proofing

Scientific and reasonable process of quality management error proofing is the basis of the effective operation of enterprises quality management error proofing. Figure 2 shows the process of enterprises quality management error proofing. When enterprises make new strategic goals for quality management and decide to apply error proofing theory to improve its robustness of quality management, they should first of all redesign and improve the original quality management system, which require three steps: identification of errors in the design of the quality management system and analysis of the effects, error proofing in the design of the quality management system and modification of the design of the quality management system [5]. Besides, the process of quality management should be optimized and controlled, which also require identification of errors in the process of quality management and analysis of the effects, error proofing in the process of quality management and modification of the process of quality management. Eventually, enterprises are able to conclude concrete error-proofing plans for quality management to direct the enterprises to realize new goals of quality management and finally form standard executive procedures of quality management activities so as to prevent management failures due to human factors to the maximum extent and ensure the effective performance of error proofing in the enterprises quality management.



Fig.2 Diagram of the process of the enterprises quality management error proofing

(2) Methods for error proofing in the enterprises quality management

Methods for error proofing in the enterprises quality management are ways to employ error proofing theory and methods to improve the robustness of enterprises quality management. Based on the process of enterprises quality management error proofing, there are two main methods of enterprises quality management error proofing, i.e. the design of the quality management system and the process of quality management.

Tab.1 Methods for error proofing in the enterprises quality management

Methods	Concrete methods
redesign the quality management system	<ul style="list-style-type: none"> ➤ Eliminate the conditions for errors and improve the environment for errors; ➤ Redesign the management functions or management activities procedures; ➤ Transfer the management functions; ➤ Change models; ➤ Change the types and characteristics of management activities or managers
the process of quality management	<ul style="list-style-type: none"> ➤ Change or add automatic intelligent management tools or devices; ➤ Change management approaches; ➤ Change the procedures or links of management activities; ➤ Increase using standing books, inventory and models and improve supervision; ➤ Implement control figures, carry out quality collaborative management and reinforce

knowledge management.

3. Construction of enterprises quality management error proofing system

3.1 Definition and key elements of enterprises quality management error proofing

For general manufacturing activities, the error proofing object is the functions of parts and the failure mode is their malfunction. That is to say, parts do not work or their functions decay. Similarly, as to management, the error proofing object is the functions of management activities and the failure modes are management errors, management faults and management failures. Errors lead to the failure of management functions or decline of management levels.

(1) Definition of enterprises quality management error proofing

Quality Management Error Proofing(QMEP) is the forward-looking design of quality management activities with the application of error-proofing principles and methods, aiming at preventing or correcting unintentional management errors in quality management so as to establish standard executive procedures to adjust quality management activities to managers and meet requirements for standards, plans, goals, values(strategies, process, SOP, contracts), etc [6].

Enterprises quality management error proofing is an important part of comprehensive quality management. It manages the whole process of quality management failures and includes preventive error proofing and reactive error proofing from the perspective of stages and error-proofing levels. Quality management preventive error proofing means identifying the function failures of quality management activities from the perspective of enterprises operation and employing scientific and systematic methods to make feed-forward control in the whole period: before occurrence, after occurrence and after solution so as to reduce losses to the maximum degree. Quality management reactive error proofing means taking concrete steps including directing, coordinating and controlling to handle the occurred function failures of quality management, aimed at timely and effectively handling the occurred failures of quality management and reduce the adverse effects due to the quality management errors to the maximum extent.

(2) Key elements of enterprises quality management error proofing

Enterprises quality management error proofing is the operation strategy of constructing the enterprises strategic competitiveness. The design and implementation of enterprises quality management error proofing need pay attention to the key elements that influence the whole organization performance. Grasping the macroscopic direction of organization development has strategic significance and acts as a powerful tool to improve the robustness of quality management and satisfaction of parties concerned.

According to the enterprises profit chain and based on different sources, the key management elements can be identified from internal management and external management. The internal management elements include the organization culture, resources, capacities, strategic organizations, systems and the external management elements include the market trend, knowledge and relations between the parties concerned.

3.2 Construction of enterprises quality management error proofing system

When it comes to management, “mechanism” is no different from “system”. Therefore, management error-proofing mechanism is also called management error-proofing system. Qian Xuesen explained system from the perspective of control theory, “System consists of several interactive and interdependent components. It is an organic integrity with certain functions which is a part of a larger system” [7]. In the construction of quality management error proofing system, an integrated view and systematic point are necessary.

(1) Principles for the establishment of quality management error proofing system

Quality management error proofing is process management. If the output of management process can satisfy needs from parties concerned, it indicates that the error-proofing process is effective. If the process output is higher than the error-proofing cost, the error-proofing process is effective. If going through practices, the error-proofing process is applicable to various situations, it implies that the error-proofing process has universal applicability. To effectively manage the process of management error proofing not only needs to conform to the basic principles of process management, but also ought to pay attention to the following seven aspects: □Principle of systematization and sequencing; □Principle of prevention first in combination with treatment; □Principle of fast response; □Principle of executive support; □Principle of information share with the parties concerned; □Principle of improvement of learning and systems; □Principle of matching error-proofing measures with management failures.

(2) Construction of the conceptual frame of enterprises quality management error proofing system

The conceptual frame of enterprises quality management error proofing system should be constructed (seen as Figure 3), according to the principle of establishing quality management error proofing system and clinging to the two values of “stable management” and “error proofing theory”. Quality management error-proofing is a complicated and systematic process. The conceptual frame divides the main content of quality management error-proofing system into three categories according to the development stages: before error proofing, error proofing and after error proofing.

According to the management framework of ISO 9001 quality management system and on the basis of the three levels of management activities: operation level, process level, activity level, the enterprises managers carry out quality management error proofing as follows.

First of all, historical data, brain storm, collection of employees’ complaints, complains from customers are employed to identify the potential failure modes of quality management activities at different levels as much as possible and recognize the warning signals of emergency and their preventive measures. Fishbone diagrams, Five Whys, FMM models are applied to find out the root causes of the quality management errors. From the perspective of activities of quality management system design and quality managing process, FMEA analysis is employed to analyze the severity, occurrence, detection, due to the quality management errors and arrange the improvement sequence according to RPN.

Additionally, based on the principle and methods of Poka-Yoke and in combination of the theories and practices of enterprises quality management, the basic principles of quality management error proofing can be concluded and further researched. Quality management error-proofing principles should be applied to design quality management preventive error-proofing system and implement reactive error proofing to the quality management process.

Furthermore, to verify the reasonability and effectiveness of management error-proofing system, the enterprises managers should borrow the index system of MBNQA awarding model to draw expert-decision questionnaires on the effectiveness of the enterprises quality management error proofing and apply evidence theory to carry out scientific and quantitative analysis of the data to evaluate the performance of quality management error-proofing system.

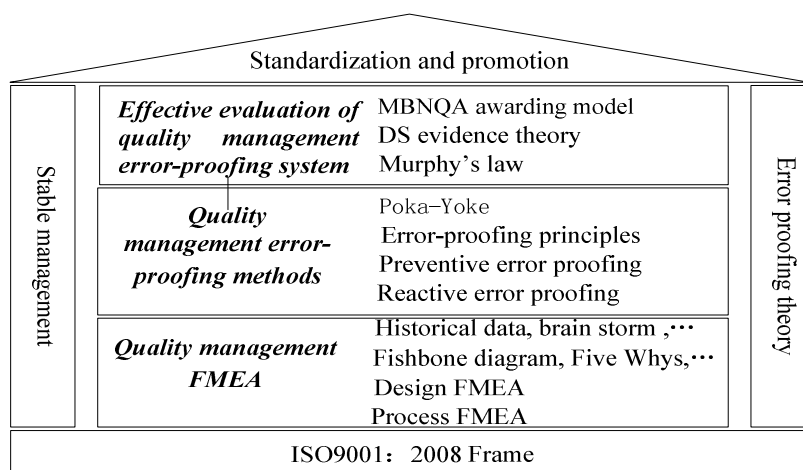


Fig.3 Conceptual model of enterprises quality management error proofing system

Finally, the enterprises managers should pay attention to the conclusion of the practices of quality management error proofing. After evaluating the error-proofing performance, the managers should review, examine and sort out the adopted quality management error-proofing measures as soon as possible, standardize and promote these measures and include them to the enterprises knowledge management system to make them the basis of future operation.

The following mode shows the basic frame of enterprises quality management error proofing. Enterprises can identify their own weakness and potential problems according to the frame model and adopt corresponding error-proofing measures to improve the efficiency and effectiveness of error proofing. Failure analysis, management error

proofing, improvement and development, re-failure analysis, re-management error proofing, re-improvement and development, such a circular, spiraling and leaping route is the whole process of the history of human management development.

4 Analysis of the process of enterprises quality management error proofing

The process of management error proofing is a series of interactive steps for enterprises to prevent quality management errors, remedy the influence of quality management function failures and improve the satisfaction of parties concerned. In another word, the process of management error proofing is quality management error proofing procedures and flows, which is the operation system of the quality management error-proofing system. Figure 4 shows the process of management error proofing.

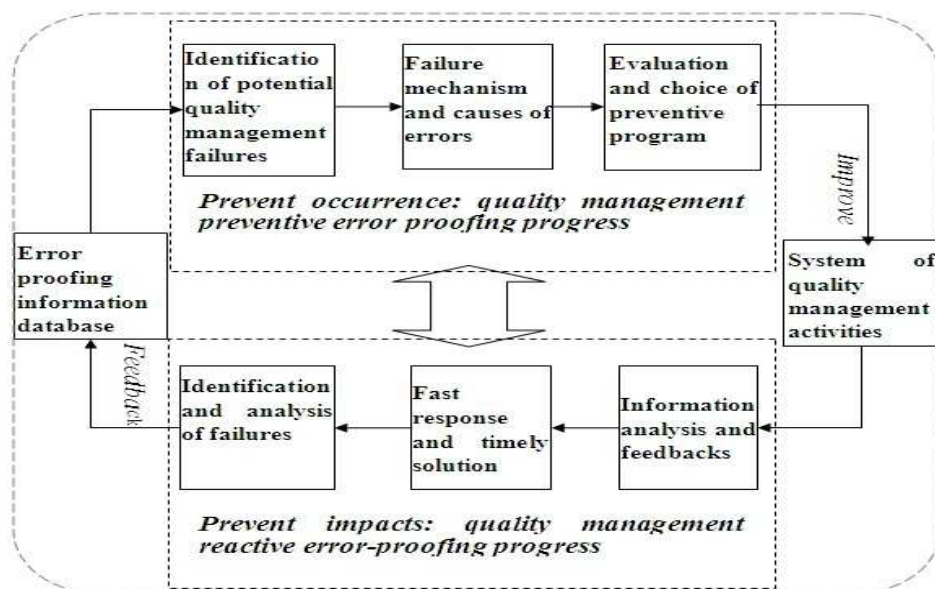


Fig.4 Process analysis of the quality management error-proofing conceptual systems

The operation of quality management preventive error-proofing subsystem is the precondition of the timeliness and economy of quality management error proofing measures. More specifically, it includes the identification of potential failure modes, failure mechanism and causes of errors and evaluation and choice of preventive programs. Based on the prediction and identification of potential quality management function failure, it carefully analyzes the causes of quality management failures and adopts corresponding preventive measures to improve the management activities. Due to the longstanding unreliability of human factors, it is unrealistic to avoid human errors in the quality management activities, so quality management function failures are inevitable. The quality management preventive error-proofing subsystem includes the identification and analysis of failures, fast response and timely solution, and analysis and feedbacks of information. After the occurrence of management errors, the subsystem responds and remedy quickly to reduce the impact scope and alleviate the impacts of failures as much as possible. Meanwhile, as there is a lot of valuable information communicating in the process, enterprises may review the failures and employ the information to better summarize error-proofing knowledge and improve their services [8].

Since management FMEA does not trace the causes of management failures from the results of customers' dissatisfaction, but concludes the past experience and lessons or future predictable possibility of failures from the perspective of various links like humans, machines, laws, materials, environment, inspection and so on, so as to identify risks. However, such converse evaluation has limitations because the expert brain storm cannot exclude the unreliability due to the uncertainty of their personal knowledge and experience and it is not likely to cover all the risk sources at the beginning of management design. Hence, the quality management thoughts like PDCA closed loop and conclusion are very significant.

CONCLUSION

(1) Management quality has two sides. One is the active quality, i.e. the excellence of management. The other is the negative quality, i.e. the robustness of management. The paper discusses how to apply the error-proofing theory and methods to the enterprises quality management based on the basic principles and methods of error-proofing theory and from the perspective of the process and methods of enterprises quality management error proofing. To achieve development, enterprises should not only pursue excellence, but pay more attention to the robustness of their management.

(2) The paper describes the definition and key elements of enterprises quality management error proofing, based on which constructs the conceptual frame of enterprises quality management error-proofing system in combination with the application of error-proofing theory in the enterprises quality management and analyzes the process of enterprises quality management error proofing according to the preventive and reactive process.

(3) The ultimate purpose of constructing enterprises quality management error-proofing system is to improve the level, reliability and stability of quality management. Enterprises should combine their own characteristics and practices to establish and implement quality management error-proofing system and pay attention to implementation so as to improve the effectiveness of error proofing.

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