Advanced Journal of Chemistry-Section B
Natural Products and Medical Chemistry

Journal homepage: http://www.ajchem-b.com/

Original Research Article

Risk Management with Maintenance and Repair Strategy in Industries

Ronak Rahimian

Department of Environmental Civil Engineering-Water and Wastewater Engineering, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

ARTICLE INFO

Article history

Submitted: 2020-07-21
Revised: 2020-07-28
Accepted: 2020-08-14
Available online: 2020-09-16
Manuscript ID: AJCB-2007-1056
DOI: 10.22034/ajcb.2020.114267

KEYWORDS

Strategy
Probability of Failure
Reliability
Maintenance and Repair
Risk Management

ABSTRACT

The overall aim of the maintenance and repair process in industrial companies is to reduce costs and increase the benefits of operating and optimize life cycle costs, taking into account all safety considerations. Choosing a maintenance and repair strategy is one of the most complex and necessary processes that can affect the safety and cost of equipment. The main aim of this study is to select a risk-based maintenance and repair strategy to improve safety, maintenance and repair indexes. Risk assessment integrates product reliability with safety and environmental issues and can therefore be considered as a decision-making tool for repair planning. One of the most important strategies in the field of maintenance and repair planning and optimization of related activities is the system or process of maintenance and repair with Reliability Centered Maintenance (RCM). This system provides a framework for all the physical facilities and equipment of organizations to continuously fulfill their planned tasks in the specified operational context. Risk analysis-based repair planning can reduce the likelihood of system failure and the consequences of such failures and help management make the right decisions to make the right investment in maintenance and repair and thus lead to better use of existing assets and capital.

GRAPHICAL ABSTRACT

* Corresponding author: Ronak Rahimian
✉ E-mail: ronak.rahimiyan@yahoo.com
☏ Tel number: 00989382800418

INTRODUCTION

Lack of proper maintenance and repair planning in the organization will reduce the life of the equipment. Risk management is a technique that will quickly increase the level of effectiveness by being institutionalized in the chain of maintenance and repairs of organizations and provide powerful tools for the rapid detection of functional failures and breakdown to maintenance system leaders. Therefore, it is possible for trustees and planners to prevent them from becoming big bottlenecks in the future by managing technical risks and through the implementation of preventive and risk-based activities, they prevent the waste of time and money in the maintenance and repair process. Accordingly, choosing an optimal maintenance and repair policy can be a solution for industrial units to increase production and efficiency by reducing the sudden drop in equipment given that other restrictions such as the human force cost and working hours are reduced. Different strategies for maintenance and repair have been stated which has advantages and disadvantages, depending on the industry.

Maintenance

The set of activities that are clearly and usually planned and aimed at preventing the sudden failure of machinery, equipment and facilities are called maintenance activities [1-3].

Repairs

It is a set of activities that are performed on a system or device that has been damaged or disabled to return it to the ready and operational state.

Corrective Maintenance

This hypothesis is based on the premise that it should not be replaced or repaired until the part is broken or defective. In other words, the equipment will be used until it reaches the breakdown or failure stage and it will be repaired in case of failure.

Preventive Maintenance

Preventive maintenance refers to the planned maintenance and repair activities that take place when the system is in operation. The aim is to keep the system in good working order by preventing breakdowns.

Failure mode and effects analysis (FMEA)

It is an analytical method of risk assessment that seeks to identify and score the potential risks within the scope of the risk assessment and the causes of the associated effects as much as possible [4].

Maintenance does not directly generate any revenue for the port but it has a huge impact on port profitability. Good maintenance and repairs form the basis of the reliability and availability of equipment on which the reputation of port services depends. Maintenance will also increase the optimal use of equipment and reduce leadership costs and the port will have the opportunity to reduce tariffs and gain more competitive position. If the equipment is maintained in excellent condition, it will be less damaged during use and can perform more efficiently and as a result the capacity of the facility will increase with less investment [5]. Therefore, it can be argued that the profitability and competitiveness of ports depend entirely on their performance in conservation. In this study, different risk management strategies in maintenance and repair have been studied and by mentioning different types of methods, the best methods in this regard have been studied by studying other articles. In figure 1 the internal and external Risk is shown.

Risk management process in maintenance and repairs

Today, one of the biggest problems in the industry, especially in the continuous production industry is an island encounter with the maintenance category and the absence of operators, operating factors and energy carriers has turned access to the desired level of

efficiency and sustainable production into the mirage of industry which always imposes great opportunity costs on industrial systems.

In traditional maintenance structures, communication and information flows are generally limited to three technical parts: engineering security and supply and executive layers (mechanics and electricity) [6]. In such structures, processes will gradually be repair-based and the operational range and kingdom of sections is limited to the emergency supply of spare parts and repairs, accidental and frequent mechanical and electrical and not paying attention to the key position of planning causes the creation of maintenance island in the organization and since most of the results of breakdowns and emergency stops are mostly in the form of mechanical and electrical faults, maintenance executives will always be involved in fixing the same flaws [7]. In any case, corrective measures can be taken to eliminate mechanical and electrical defects at that time. Unfortunately, since the root cause of most mechanical and electrical failures lies in the process of production and operation, the same defects will be repeated in the coming days and given that the operational structure of maintenance is an island, there is no real focus on the defects root and causes and executive agents are always involved in relieving electrical and mechanical disabilities.

Fig. 1. Internal and External Risk

Since there is a high percentage of mechanical and electrical defects in the production and operation process, the lack of proper operation of the operators and the fluctuations of the parameters and operating conditions cause mechanical and electrical defects in the equipment and not paying attention to the defects root cause forces the executive agents to take corrective action on a daily basis and the constant repetition of these things becomes a big weakness in the organization and mistakenly depicts an unfavorable and weak image of the maintenance and repair department. Due to the ineffectiveness of actions in reducing failures and stops, it causes the real position of the maintenance in the organization to be shaken.

Identifying maintenance chain risks

This stage is the most difficult task of risk management because it will require a culture and a context for teamwork. At this stage, team members from different executive levels come together and identify potential risks. Arranging brainstorming sessions is a good way to identify risks because it forces people to think and allows them to develop each other's thoughts and experiences and it should be noted that the identification of the maintenance and repair chain risk is not completed in one session and this must be updated during the equipment lifetime [8].

Risk assessment in the maintenance chain

In this step, the potential losses associated with each risk are assessed. This assessment will include: the probability or chance of failure or breakdown, the severity and consequences of damage and the system's ability to discover and detect failures before they occur. At this stage, the prioritization of risks is determined and according to the results obtained and in accordance with the situation of each organization, the risks are divided into general safe, low-risk and high-risk categories.

Choosing a strategy to control risks

In this step, risk management technique provides the organization with the best strategy for controlling potential risks and quick management of actual risks, providing the necessary platform for the development of maintenance and repair activities and programs [9].

Monitoring previous steps to ensure performance

One of the key tools in risk management technique to create effectiveness in the maintenance chain will be moment-by-moment monitoring of the quality and quantity of applications. In this section, all the weaknesses and strengths in the performance of the maintenance chain are depicted and this will allow managers and those in charge of maintenance affairs to make the right decisions.

Status control according to the analyzed results

The risk management process will be able to provide the necessary solutions and corrective measures to put the maintenance system in the main path by monitoring the steps of doing things and identifying the weaknesses in the maintenance chain in order to do this, it quickly controls the situation by providing corrective measures to control the risks [10].

Analysis of the failure causes of traditional maintenance and repair structures

Island encounters and the daily routine of maintenance executive departments

Perhaps the question has been asked many times why the effectiveness footprint is faint in most of the country's manufacturing industries despite the establishment of different maintenance systems and in most industries, despite the high cost of design and deployment, executive structures suffer from inconclusive sequencing and daily routine. In figure 2. The Risk Information in Industry is shown.

Fig. 2. The Risk Information in Industry [11].

Organizational status and executive limitations of the core maintenance programming

The reason for the island structures failure is the incorrect organizational position of the core maintenance management and the challenges in the actual acceptance of this unit.

According to the organizational chart available in most mother industries, the maintenance management section is in line with other middle managers and accordingly, the staff and maintenance programming subsets are at one or two lower levels in charge of developing the programs and establishing the maintenance system. In general, in such structures, the core maintenance programming does not have enough power to successful compile and implement maintenance and repair programs and because the structure is island-based, the maintenance programming section will not play a role in controlling the organization's maintenance affairs [11].

The need for implementation of maintenance and repair systems

In general, maintenance and repair costs account for the bulk of production costs. Depending on the industry in question, this cost is about 15 to 60 percent of the cost of the product. Research has shown that about 33 cents per dollar spent on maintenance is related to unnecessary maintenance.

In the literature of this field, maintenance strategy is introduced as a coherent and integral and integrative model of decisions in the elements of different strategies in line with production, company and business level strategies [12-14].

The maintenance strategy reveals the organization's goals and defines the nature of the economic and non-economic functions that the organization intends to perform in an integrated manner. However, the maintenance and repair process plays a critical and undeniable role in determining the level of competitiveness of an organization. In general, various analyzes related to this process can be examined in the four areas of cost, quality, flexibility and delivery capability. One of the main goals of modern technical inspection strategies is to minimize the risks for human and environment that is caused by the unexpected failure of a piece of equipment. Strategy must also be cost-effective. Such an approach uses the information obtained from the study of breakdown modes and their effects and consequences.

Risk analysis is a technique for determining, describing, quantifying and evaluating the effects of an event. The approach risk analysis analyzes reliability, impact analysis, outcomes and results at different stages. In qualitative risk assessment, the results are often presented in the form of a simple risk matrix which one axis of the matrix indicating probability and the other representing the result. If a value is given to probability and result, a relative value for risk can be calculated. It is important to note that qualitative risk is a relative number that has a quantitative meaning outside the matrix framework. Although these risks are subjective, prioritization is often debatable [15].

Process safety is a way to reduce risk

Process Safety Management (PSM) can be considered a confusing and misleading title with many specialized concepts and unique expressions. One of the more complex concepts is the issue of risk (actual risk) and how process risk is reduced to an accepted level [16]. For factory and production facilities, having a PSM program in place requires validation and verification so that their hazardous processes can be operated safely. A key requirement is to perform a process analysis and associated immunizations to estimate the likelihood of a dangerous event occurring. In other words, an operating company must certify the safety of the process. So how will you be able to reduce the risk and ensure that your process will work at an acceptable level?

Difficulty determining the distance between two overhauls

Determining an optimal time interval between two overhauls is virtually impossible. If this distance is shorter than the optimal amount required, then the cost of periodic repairs and the resulting damage will increase, and in fact the machines will be over-repaired, and if the distance between the two over-optimal repairs is chosen, there is a risk. Defects increase and the periodic repair method practically becomes the repair method in case of defects [17].

What is Risk Based Inspection (RBI)?

Risk-based inspection (RBI) is a zero-based approach; This means that in this method, in order to reach the desired decisions and strategies, the risk is measured at the same time and the results of previous risk assessments are not sufficient. This method enables engineers to identify the risk associated with the failure of fixed equipment (such as pipelines, material storage tanks, valves, pressure vessels, etc.). This equipment's are especially prone to corrosion and their corrosion management is the most important tool for managing the risk of failure of these equipment's.

RBI can be easily integrated with other risk management methods (such as RCM, RCA, etc.) to maximize the risk management capacity of the organization [18].

Risk-based inspection system, based on risk assessment, suggests appropriate inspection methods and correct time intervals for performing these methods. Without the use of risk-based inspections and using traditional inspection methods, shortening the inspection interval initially reduces the risk. But if the time interval between inspections is too short, the risk may increase; That is, more inspections do not always mean reducing the risk. It can also increase the risk of things happening, such as the possibility of errors or even damage to the equipment during the inspection (especially in aggressive inspections that require the opening of parts of the equipment).

Eventually, after the establishment of the Risk-Based Inspection (RBI) method, the risk will not be zero, but the residual risk will be mainly in the range of risks due to breakdowns imposed from outside the equipment (for example, due to natural disasters or other equipment failure). Using a risk-based inspection (RBI) approach will bring the following benefits to the organization:

- Equipment failure risk assessment
- Classify equipment based on the risk of failure
- Detailed description of the inspection plan to reduce the existing risk
- Detailed description of other measures required to reduce risk (such as replacement of parts, repairs or upgrading of safety equipment design)
- Determine the expected level of residual risk after performing defined activities

Damage caused by cessation of production

Periodic repairs are very time consuming. For example, an industrial gas turbine is out of service on average annually due to periodic repairs of one month. Damage resulting from the cessation of production, together with the profit from the sale of products that will not be produced, increases the cost of periodic repairs. For example, one of the most important reasons for the country's power outages is the periodic repairs of power plants, which cause extensive damage to the people of the country and Tavanir Company itself.

CONCLUSION

According to this article, in any modern society, engineers and technical managers are responsible for planning, designing, manufacturing and operating the simplest product to the most sophisticated systems. The failure of products and systems causes disruption at various levels and can even be considered a severe threat to society and the environment.

Today, maintaining and increasing the safety of the system and reducing maintenance and repair costs are the main priorities of the companies that make up the country's chemical production industry. Therefore, the use of new repair strategies that have already proven their performance in various industries is on the agenda of system administrators. Among the new repair strategies, maintenance and risk-based repairs as one of the most successful of these strategies.

The risk-based approach aims to increase the safety of system elements maintenance and repair by using a logical and structured framework and rely on the risk index to minimize the total costs imposed on the factory. Choosing a maintenance strategy is a multiple attribute decision making (MCDM) problem that depends on variables such as risk, value added and cost. In general, the risk management process consists of three main steps under the headings of risk identification, reduction to an acceptable level and finally evaluation however, these steps are examined in more detail in order to establish in the maintenance and repair chain. Risk management begins by setting goals and expectations in the maintenance and repair chain and goes through the following steps to suggest the best strategy for making the maintenance system effective.

The overall aim of the maintenance process is to increase the profitability of the operation and optimize the overall cost of the life cycle without compromising safety or environmental issues. Evaluation integrates risk with safety and environmental issues and so it can be used as a decision-making tool for preventive maintenance planning. Risk-based maintenance and repair planning reduces the likelihood of system failure and its consequences based on risk analysis.

Conflict of Interest

No conflict of interest was declared by the author.

REFERENCES

[1]. M. Karami, A. Samimi, M. Jafari, "*The necessity of risk management evaluations in petrochemical industries"*, 2(3), 151-158, 2020

[2]. I.V. Osinovskaya, Prinyatie upravlencheskih reshenij v usloviyah riska (Management decision-making under risk), *Economy and Entrepreneurship*, 8-1 (2015), 767-770

[3]. A. Domnikov, G. Chebotareva, M. Khodorovsky, Systematic approach to diagnosis lending risks in project finance. *Audit and Finance Analyses,* 2 (2013), 114–119

[4]. A. Samimi, S. Zarinabadi, A. Bozorgian, A. Amosoltani, M. Tarkesh, K. Kavousi, Advances of Membrane Technology in Acid Gas Removal in Industries, *Progress in Chemical and Biochemical Research*, 3 (1) (2020), 46-54

[5]. A. Domnikov, M. Khodorovsky, P. Khomenko, Optimization of finances into regional energy. *Economy of Region*, 2 (2014), 248–253

[6]. M. Karami, A. Samimi, M. Jafari, "*The Impact of Effective Risk Management on Corporate Financial Performance*", 2(3), 144-150, 2020

[7]. T. Shattuck, A. Slaughter, P. Zonneveld, refining at risk, Securing downstream assets from cybersecurity threats, *A report by Deloitte Center for Energy Solutions*, 2017

[8]. A. Trujillo-Ponce, R. Samaniego-Medina, C. Cardone-Riportella, examining what best explains corporate credit risk: accounting-based versus market-based models. *Journal of Business Economics and Management*, 15(2) (2014), 253–276

[9]. A. Domnikov, P. Khomenko, G. Chebotareva, A risk-oriented approach to capital management at a power generation company in Russia. *WIT Transactions on Ecology and the Environment*, 186 (2014), 13–24

[10]. M.Kh. Gazeev, N.A. Volynskaya, Sovremennye ogranicheniya i riski razvitiya gazovogo sektora ehkonomiki rossii Contemporary limitations and development risks in the gas sector of the Russian economy. *Bulletin of Higher Educational Institutions,* 3 (2012), 37-41

[11].A. Samimi, Risk Management in Information Technology, Progress in Chemical and Biochemical Research, 3 (2) (2020), 130-134

[12].A. Samimi, *"Risk Management in Information Technology",* Progress in Chemical and Biochemical Research 3 (2), 130-134, 2020

[13]. J. V. Rosenberg and T. Schuermann, *"A general approach to integrated risk management with skewed, fat-tailed risks,"* Journal of Financial Economics, 79, 569-614, 2006.

[14]. M. R. Walls, *"Corporate Risk Tolerance and Capital Allocation: A Practical Approach to Setting and Implementing an Exploration Risk Policy.,"* Society of Petroleum Engineers, 1994.

[15]. P. Delquie, *"Interpretation of the Risk Tolerance Coefficient in Terms of Maximum Acceptable Loss,"* Decision Analysis, 5, 5-9, 2008.

[16]. A. Ben-Tal and M. Teboulle, *"Expected utility, penality functions and duality in stochastic nonlinear programming,"* Management Science, 32, 1445–1446, 1986.

[17]. A. Street, *"On the Conditional Value at Risk Probability dependent Utility Function*," Internal Research Reports, 2009.
[18]. L. Andrieu, M. D. Lara, and B. Seck, "*Optimization under risk constraints: an economic interpretation as maxmin over a family of utility functions,*" presented at the Seminaire Louis Bachelier, 201

HOW TO CITE THIS ARTICLE
Ronak Rahimian, Risk Management with Maintenance and Repair Strategy in Industries, Ad. J. Chem. B, 2 (2020) 239-246.
DOI: 10.22034/ajcb.2020.114267
URL: http://www.ajchem-b.com/article_114267.html