Using the FMEA Method as a Support for Improving the Social Responsibility of a Company

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Abstract: The concept of Corporate Social Responsibility (CSR) is based on companies voluntarily respecting environmental and social needs while making business decisions and at the same time taking into account the expectations of stakeholders. The notion of CSR is well known nowadays and practised by businesses around the world. However, this concept is sometimes interpreted and implemented differently. It is important to realize that the concept of CSR should be considered from the perspective of manufactured products as well as all processes realized in the company. The focus in this paper is on company processes. Socially responsible processes are those that do not adversely affect the company stakeholders. Therefore, the need arises to assess the risk of potential failures that may occur in company processes, taking into account the subjects of social responsibility. The authors present the possibility of using Failure Mode and Effects Analysis (FMEA) for this purpose. This paper presents an example of using a modified FMEA method which it is hoped can on one hand provide inspiration for further development of tools dedicated to CSR implementation at the operational level, and on the other hand offer help to those companies which want to integrate CSR into company processes.

1 INTRODUCTION

The Corporate Social Responsibility (CSR) concept is receiving increased attention from the business as well as the academic community (Crifo et al. 2016; Dahlsrud 2008; Fifka 2013a; Rok et al. 2007; Du et al. 2010; Lin-Hi & Müller 2013). CSR can be defined as a concept that integrates, on a voluntary basis, social and environmental concerns into a business' operations and interactions with its stakeholders. Unfortunately, not so rarely the concept is considered only as a marketing or public relations tool to improve company image (Mahoney et al. 2013; Wolniak & Hąbek 2015). Whereas in reality it is only possible to achieve long-term benefits from CSR implementation if socially responsible behaviour is integrated into all the processes in an enterprise. However, even a company with deep involvement in the affairs of the local community is not responsible if at the same time it does not respect employee rights, does not care about the environment and does not ensure the safety of its products. The activities of socially responsible manufacturers should be focused on the creation of products and services that are safe for the customer and at the same time do not threaten the environment, in addition the production processes of these products must be conducted in a safe manner and with concern for the environment (Paliwoda-Matiolańska 2014; Bluszcz & Kijewska 2014; Ryszko 2015).

Many companies are currently implementing CSR and even publish reports disclosing CSR data, however, there are still few tools that focus on the implementation of this concept at the operational level and tools which can be applied to all processes functioning in the company. One method that has been modified for this purpose and can be used to make a company's processes socially responsible is the Failure Mode and Effects Analysis (FMEA). The aim of the FMEA method is to consistently and systematically identify potential defects/failures in the product, process or design and then eliminate them or minimize the risks associated with them. Through the subsequent analysis with the FMEA method we can continually improve our products, processes or projects.

The aim of this article is to present the concept of using the FMEA methodology to improve the processes of a socially responsible organization.

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The remainder of the paper is structured as follows. The next two sections provide an overview of the CSR concept and give a short description of the FMEA method. This is followed by a section dedicated to the modified FMEA method that can be used to implement social responsibility into processes. The paper ends with conclusions and recommendations for further research.

2 CORPORATE SOCIAL RESPONSIBILITY – THE CONCEPT

Changes occurring in the environment, such as globalization and changing societal expectations, have caused companies to become the object of increasing pressure from different groups among its stakeholders to ensure not only profit but also greater social value. Consumers are becoming increasingly interested in how the company whose products they buy treats its employees and suppliers, and if the company has a negative impact on the natural environment or whether it is involved in corrupt practices.

Corporate Social Responsibility (CSR) is a broad term which has been differently defined (Gaweł et al. 2015; Line & Braun 2007; Maignan et al. 2002; Vveinhardt & Andriukaitienė 2014; Elkington 1999). For example, the European Commission understand it as a voluntary inclusion by a business of social and environmental concerns in their commercial (economic) activities and their relations with their stakeholders (COM 2001). Guidance on social responsibility (ISO 26000: 2010) defines the concept as the responsibility of an organization for the impacts of its decision and activities on society and the environment, through transparency and ethical behaviour that: contribute to sustainable development, including the health and welfare of society, take into account the expectations of stakeholders, are in compliance with applicable law and consistent with international norms of behaviour, are integrated throughout the organization and practices in its relationship. Referring to the above definitions, it seems that a key aspect of the CSR concept is running a business based on building lasting and transparent relationships with all stakeholders (Hąbek 2009). Identification of and engagement with stakeholders are crucial in the implementation of social responsibility in a company (Maignan et al. 2002). We can define stakeholders as individual people and groups of people, inside and outside the organization, who are interested in the results of its operations.

In order to systematize the knowledge of CSR and clarify the values which should act as guidance for organizations in its activities, in the ISO 26000:2010 the following areas of social responsibility (which are called the core subjects) have been defined: organizational governance, human rights, labour practices, the environment, fair operating practices, consumer issues, commitment and social development. The core subjects of CSR should be considered holistically in an organization rather than concentrating on a single issue. Therefore, it can be stated that responsibility is managed when, for example, employee policies are developed, when customer relationship strategies are implemented, when supply chains are managed, when leaders are really committed to a quality culture, when firms manage processes to achieve quality improvement, and when firms use measurement systems to improve their activities (Tarí 2011; Cierna & Sujova 2015).

Only comprehensive implementation of this concept enables enterprises to achieve values in the economic, social and environmental dimension. For this reason, the concept of corporate social responsibility should be considered from the perspective of all of company processes (Paliwoda-Matiolańska 2014).

Unfortunately CSR in companies is implemented variously and good practices often show one-dimensional practices concerning, e.g., environment protection or philanthropic activities. In addition, for many managers CSR is seen simply as a tool to improve company image or enhance public relations. To achieve the long-term benefits of its implementation, socially responsible behaviour should be integrated into and refer to all the processes in an enterprise. Therefore, there is a need to develop tools for the operationalization of CSR throughout an organization. In this paper, the authors suggest using for that purpose the methodology of FMEA.

3 FAILURE MODE AND EFFECTS ANALYSIS

Failure Modes and Effects Analysis (FMEA) is a step-by-step approach for identifying all possible failures in a design, manufacturing or assembly process, or a product or service. “Failure modes”

means the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the customer, and can be potential or actual. "Effects analysis" refers to studying the consequences of those failures. Failures are prioritized according to how serious their consequences are, how frequently they occur and how easily they can be detected. The purpose of the FMEA is to take actions to eliminate or reduce failures, starting with the highest-priority ones. Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement (Tague 2005; Wolniak 2011).

FMEA first emerged in studies conducted by NASA in 1963. It eventually spread to the car manufacturing industry, where it aided in the identification and quantification of possible defects at the product design stage (Puente et al. 2002). FMEA is currently utilized in the automotive, aerospace, and electronic industries to identify, prioritize, and eliminate known potential failures, problems, and errors in systems during the design stage and prior to releasing the product (Stamatis 1995). Several industrial FMEA standards, such as those developed by the Society of Automotive Engineers, the US Military of Defense, and the Automotive Industry Action Group, employ Risk Priority Numbers (RPNs) to measure the risk and severity of failures (Rhee & Ishii 2003). RPN is an index that can represent the degree of risk that a product, process or design possesses. It consists of three indicators, namely, Occurrence (O), Severity (S), and Detection (D).

$$RPN = O \times D \times S \quad (1)$$

Where O is the probability of the failure, S is the severity of the failure, and D is the probability of not detecting the failure. FMEA consists of two stages. Potential failure modes are identified in the first stage, and the values of severity, occurrence, and detection are assigned. The manager makes recommendations for corrective action in the second stage, and RPN must be recalculated after undertaking such corrective action (Su & Chou 2008; Gajdzik & Sitko 2016).

The Risk Priority Number (RPN) can take the maximum value of 1000. In practice, established boundaries of this index are used, which can be defined as the level of acceptability of the risk. It is often assumed that the value of the RPN below 120 for the failure is an acceptable level of risk. In such a case it will not be necessary to make changes in the system. If the value of the RPN is in the range of 120-160, then corrective action should be taken which decreases the RPN value (Molenda et al. 2016).

Chen (2007) pointed out that FMEA provides a structured systematic identification of the potential failure modes in design, manufacturing, or management. FMEA provides a qualitative evaluation of the necessary corrective actions by studying the impact of failure on the system and by focusing on the problems affecting systematic reliability (Zasadzień 2014; Midor 2014). Failure modes and effects analysis also documents current knowledge and actions about the risks of failures, for use in continuous improvement.

The results of the FMEA analysis serve as a basis for the introduction of changes in the product design or production processes, aimed at reducing the risk of occurrence of defects identified as critical. If it is not possible to completely eliminate the causes of defects, action should be taken in order to enhance their capability to detect or reduce the negative effects of their occurrence. Implementation of the recommended corrective action should be continuously monitored and their effects subjected to verification (Wyrębek 2012; Skotnicka-Zasadzień 2012; Wojtaszak & Biały 2015).

4 FMEA FOR CSR – MAKING THE PROCESSES SOCIALLY RESPONSIBLE

In this section of the paper the authors present the procedure for social responsible risk assessment (see Figure 1) using the methodology of FMEA (FMEA for CSR/ FMEA4CSR). This method allows identifying problems and inconsistencies (weak points) that may occur during the process, taking into consideration the core subjects of the CSR concept. The similar concept was presented by Duckworth and Rosemond (2010).

The example presented in the paper applies to the process functioning in a production company. The authors are aware that conducting a risk assessment on one process will not ensure that the whole organization achieves improvements in social responsibility. The intention of the authors was to show an exemplary solution for the selected process.

The first step in the FMEA4CSR is to determine the process in the organization which should be studied. It is good to take a process-oriented approach which allows for the holistic analysis of risk on all aspects of social responsibility for that

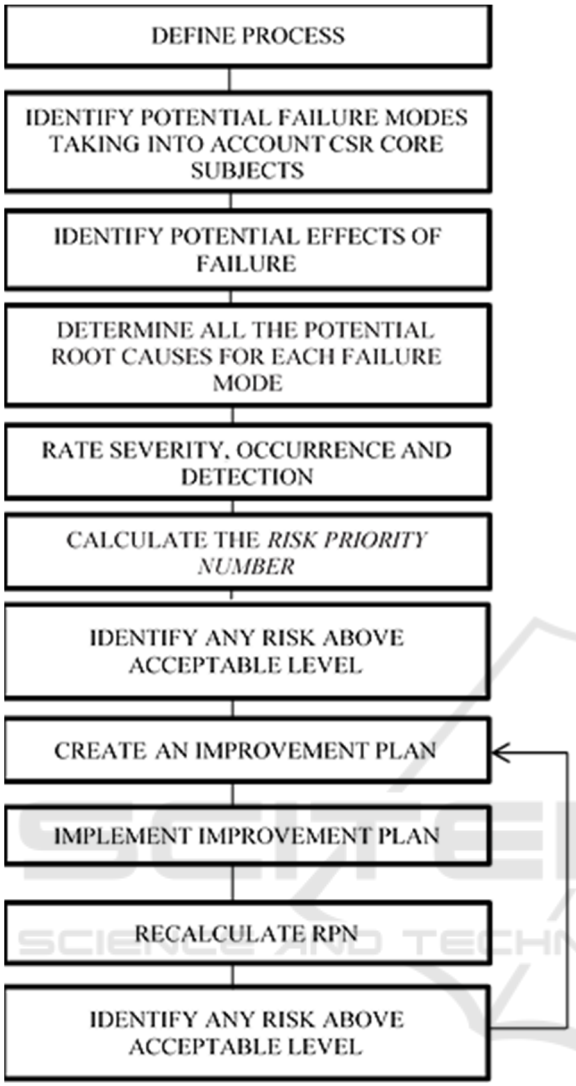

Figure 1: Stages of FMEA4CSR.

process. At this stage, a cross-functional team should be established consisting of the various groups involved in the process (engineering, purchasing, health and safety, human resources, new product development, etc.) which should be encouraged to complete the FMEA form.

The advantage of utilizing a cross-functional team approach is the varied experience and perspectives that each individual brings to the task. Although increased team diversity often leads to intense discussions when rating severity and occurrence, this difficulty in building consensus creates thoughtful debate about the organization's role in improving socially responsible behaviour (Duckworth & Rosemond 2010).

As an example, the maintenance process in a production company has been selected.

When the process for analysis has been selected and the team of experts set up it is necessary to identify the basis data about the process. To properly analyse the process, with accordance to the process approach, it should be determined the scope of the process, its suppliers, inputs as well as outputs. As the process has to be analysed from the perspective of social responsibility it is important to identify in the same time all the stakeholders involved in the process (see Table 1). It is good to present the information about the process in graphic form to enable a better understanding of the subject of the analysis. This phase is also dedicated to identifying the stakeholders (employees, customers, shareholders, community, government, local businesses, etc.) of the process whose needs and expectations will form the basis for further analysis. We have to bear in mind that identification of stakeholders is crucial to proceeding with the implementation of social responsibility in a company.

Table 1: Withdrawal of machines and equipment process identification.

SUPPLIERS	INPUTS	PROCESS	OUTPUT	STAKEHOLDERS
• company owners • maintenance department • machine manufacturer • health and safety department	• worn out, unnecessary machine • withdrawal order • plan for dismantling and removing from the plant • documentation of the machine (dismantling manual, design documentation) • instructions for safe removal and disposal of the machine	**withdrawal of machines and equipment (used, worn out, unnecessary)**	• dismantled and removed machine • records in the register about the machine removal • worn consumables materials (oils, lubricants, etc.) • emission of gases into the environment • registration and inventory of used parts and consumables materials • records of environmental hazardous materials	• company owners • employees working within the process • environmental inspectors • accounting department

The assessment of the severity of identified failure modes in FMEA4CSR should be done from the point of view of all stakeholders of the process, and not just from a customer's point of view as in the classical FMEA methodology.

After determining the stakeholders, all the outputs of the process should be identified, which may have an impact on these stakeholders. The next step is to identify all the process inputs (materials, energy, information, and human resources, etc.) required to conduct the process. The final task will be to identify the suppliers for the pre-defined inputs of the process. The goal of this analysis is to identify the potential social responsibility risks associated with the selected process. When the process is determined, we should focus on the critical function to that process. The functions constituting the maintenance process in an exemplary organization are shown in Table 2.

Table 2: Functions of maintenance process.

1.	Planning of investment for production resources
2.	Execution of the investment, the purchase of machines and equipment
3.	Installation and labelling of machines and equipment. Introduction to the register
4.	First commissioning and validation of machines and equipment
5.	Training for machine operators
6.	Planning of inspections and repairs
7.	Monitoring of the operations and diagnostics of machines and equipment
8.	Implementation of the plan of inspections and repairs
9.	Cost calculation of repair work
10.	Supply for maintenance (parts, consumable materials, etc.)
11.	**Withdrawal of machines and equipment**
12.	Diagnostics. Breakdown removal

For the further analysis we have chosen the process of withdrawal of machines and equipment (Table 5).

For the identified function in the selected process, all potential failure modes should be identified. At this stage we should use the knowledge of the team members as well as the data from the analysis of other processes or benchmarking studies. The next step is the analysis of all potential causes of the failure modes. At this stage we can use other tools such as the Ishikawa diagram. Because often the failures involve a cascade of effects, next we should analyse the impact of those failures. The direct effect or the consequence from the stakeholders' point of view should be taken into account (Kaźmierczak 2016). Another step of FMEA4CSR is to determine the Severity (S), Occurrence (O) and Detection (D) indicators. Each indicator can be a number between <1-10>. The ratios we determined are based on the data in Table 3 and Table 4. It should be noted here that the D indicator is fixed arbitrarily on the basis of knowledge about the possibility of detection of a failure. Number 1 applies when such a possibility is very big and number 10 when the failure is difficult to detect. Subsequently, we can calculate the Risk Priority Number (RPN) index. The RPN values allow us to determine the priority risks that can threaten social responsibility performance.

Table 3: Criteria of severity and occurrence ratings.

Rating	Severity [S]	Rating	Occurrence [O]
1	meaningless	1	negligible
2-3	low	2-3	occasional
4-6	moderate	4-6	moderate
7-8	high	7-8	high
9-10	very high	9-10	very high

Table 4: Criteria of detection ratings.

Rating	Detection [D]
1	very high
2-5	high
6-8	moderate
9	low
10	accidental

Then we can focus on ranking the failure from the most important, from the point of view of the stakeholders, when the number of RPN is the greatest, to the least important. Then we must fix the limit (a number RPN) between critical failures and other failures. For all critical failures we should determine the corrective actions, i.e., actions which enable eliminating the causes of the failures. After completion of these activities the RPN index should be re-calculated and if there are still critical failures, the introduction of corrective actions should be repeated to achieve an acceptable level of risk.

In our example, we established the limit for RPN between the critical and the other failure modes at

Table 5: FMEA4CSR example sheet for the selected process – part A.

PROCESS: WITHDRAWAL OF MACHINES AND EQUIPMENT							
CORE SUBJECT	SOCIAL RESPONSIBILITY FAILURE MODE	CAUSES	FAILURE EFFECTS	S	O	D	RPN
Organizational Governance	No systems for tracking and/or reporting on social and environmental results	Reducing the cost of bureaucracy and reduction of employment	No information on emissions and pollution which occurred during the dismantling and removal of the machines No information regarding the threats to employees during removal of the machines	7	8	3	168
	No organizational policy for the protection of property, which is to prevent the theft of technical resources	Lack of awareness of the top management of the risks of theft of the dismantled machines or their components	Material losses arising from theft of unprotected elements of the machines	7	7	4	196
Human Rights	Lack of clear message about the importance of human rights in the organization	Top management is convinced that at all levels of the organization human rights are respected	Performing activities that threaten health during realization of the process	9	7	4	252
	Lack of processes for resolving grievances	Information about complaints of employees are blocked by direct superiors	Carrying out the process under pressure beyond normal working hours	9	5	2	90
Labour Practices	Conditions of work do not comply with national law	Lack of training of middle-level managers in terms of the law in force concerning the implementation of the process	Working in conditions that threaten the health and lives of workers carrying out the process	9	7	1	63
Environment	Lack of system for tracking waste created by the organization	Adoption by top management policy, oriented only on the financial results. Reducing bureaucracy	No information on emissions and pollution caused by errors during the dismantling and removal of machines	5	5	3	75
	Lack of identification and action associated with protecting the natural environment	Lack of environmental policy	Uncontrolled pollution arising during the dismantling and removal of machines	8	7	4	224
Fair Operating Practices	Lack of identification of risk associated with corruption	Lack of awareness of top management associated with the resale of used machines undervalued	Company financial losses associated with selling the withdrawn machines undervalued	7	3	8	168
Consumer Issues	Unknown impact						
Community Involvement and Development	Unknown impact						

Table 6: FMEA4CSR example sheet for the selected process – part B.

PROCESS: WITHDRAWAL OF MACHINES AND EQUIPMENT						
CORE SUBJECT	SOCIAL RESPONSIBILITY FAILURE MODE	IMPROVEMENT PLAN	S	O	D	RPN
Organizational Governance	No systems for tracking and/or reporting on social and environmental results	The introduction of an emissions control system as well as system to keep track of accidents occurring during the removing of withdrawn machines	7	3	1	21
	No organizational policy for the protection of property, which is to prevent the theft of technical resources	The establishment of a special committee whose task will be to calculate the value of withdrawn machines	7	1	4	28
Human Rights	Lack of clear message about the importance of human rights in the organization	The introduction of documented organizational rules in the company, which include labour standards during the removal of withdrawn machines	9	2	4	72
	Lack of processes for resolving grievances					
Labour Practices	Conditions of work do not comply with national law					
Environment	Lack of system for tracking waste created by the organization					
	Lack of identification and action associated with protecting the natural environment	The adoption of environmental policies and the development of procedures for environment protection while removing machines that will secure the process from uncontrolled emission to the environment	8	4	2	48
Fair Operating Practices	Lack of identification of risk associated with corruption	The adoption of procedures to ensure the valuation and resale of the withdrawn machines and its components for the actual value	7	1	6	42
Consumer Issues	Unknown impact					
Community Involvement and Development	Unknown impact					

120. Thus, the RPN for the failure modes obtained above this limit need corrective action. In the present case we identified five critical social responsibility failure modes. For each we have proposed an improvement plan and re-calculated the RPN index (Table 6). After the implementation of the improvements, an acceptable level of risk was achieved. We can conclude that the FMEA4CSR method enables the identification of potential risks associated with the business processes and allows us to better understand the impact on society, the environment and economics. The added value of this analysis is increased awareness among managers, as well as the employees involved, especially in the analysed process. This raised awareness will influen-ce the development of appropriate organizational culture facilitating the implementation of the CSR concept.

5 CONCLUSIONS

The authors presented in this paper a method called FMEA for CSR (FMEA4CSR) that is used as a tool for risk analysis which identifies and prioritizes

actions for improving socially responsible processes. These prioritized actions allow us to rethink the types and volume of resources needed to minimize the risks associated with the specific failure modes. FMEA4CSR is based on seven core subjects of social responsibility defined in ISO 26000. Because CSR is a concept which is based on the stakeholders theory, identification and analysis of their needs and expectations is crucial for the implementation of this concept. Therefore, FMEA4CSR takes into account in the risk assessment not only the severity of potential failure modes for customers (as in the classical FMEA), but also for the other stakeholders. In the proposed methodology the significance of potential failure modes for all the company's stakeholders involved in the process is considered. Thus, it is reasonable to use the expert knowledge in the analysis as it is in the case of the FMEA method. Therefore, it is recommended to integrate the methodology with one of the participatory methods (e.g. Charrette, Syncon, Delphi, Groupware, etc.) in order to reach consensus between stakeholders or at least the justifications for the different opinions, scores, etc. and to make sure the results are clear to all of them.

The purpose of using this tool is the continuous improvement of socially responsible processes. Identification of the risks associated with each of the core subjects of social responsibility leads not only to determining the priority issues, but also improves awareness among employees. This improved awareness is an added value to this analysis and is invaluable in the implementation of CSR in a company. Summarizing, FMEA4CSR can be used as a practical tool for the continuous improvement of social responsibility within a company at the operational level.

We must bear in mind that we cannot always find the ideal solution. Social responsibility approach may sometimes conflict with the other company's goals (e.g. environmental protection goal and keeping production which pollutes the environment but simultaneously giving an employment for many people). It is not always possible to meet all expectations at the same time and the company must make a choice. Therefore there is a need for further discussion on this multi-criteria aspect of the problem. Future research may be concentrated also on the implementation of the core subjects of CSR in product or design FMEA. It could be also interesting to discuss other tools traditionally used in quality improvement and their potential benefits in social responsibility improvement programmes.

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