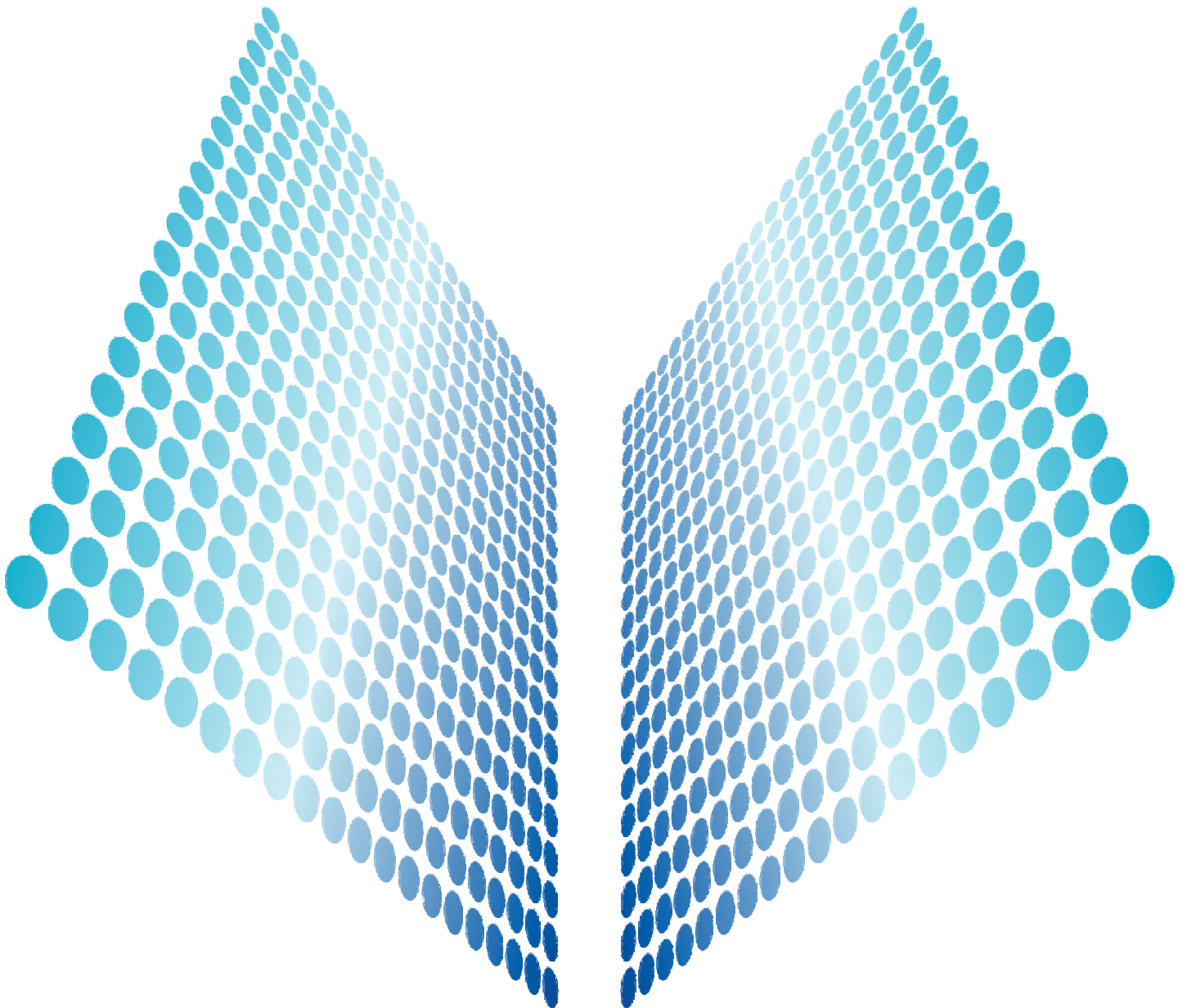


VOLUME 1 | 2017
ISSUE 1, MAY

ISSN 2545 - 4390



PUBLISHER: EURO STARTER

Street Address: Braka Miladinovi no. 406/6, Tetovo

Country: Macedonia

Phone: +389 70 616150

board@temel-ij.org

<http://temel-ij.org>

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IMPLEMENTING FMEA METHODOLOGY INTO INDUSTRIAL CAPACITY FROM MACEDONIA

Ivo Kuzmanov, Roberto Pasic, Oliver Slivoski

Abstract: *The basic aim of the paper is to present only a small part from an extensive research conducted into industrial entity from R. Macedonia, done into the period November 2016 – January 2017. The industrial capacity which was taken into consideration was from the metalworking industry and it's an capacity with a serious productivity of stoves and fireplaces on solid fuel. It's an entity with more than 300 employees and a production which is saled in the Balcans. The basic aim of the paper is to represent only a small part from an extensive research and application of the FMEA methodology into the entity, but also to represent some of the achieved benefits after a short period of time. Although the FMEA methodology is aplicated in all of the business processes into the business entity, the paper represents the process of cutting, shaping and drilling metal till getting a final piece – half product that is used into other processes during the production of fireplaces and stoves. The basic aim while doing the research and the implementation of the FMEA matrix was to get benefits in a short period of time, benefits that will improve the quality of the final product and the productivity into the industrial entity. It's worth full mentioning that while doing the FMEA processes a multidisciplinary team was included (persons from the science, person with previous experience while doing such FMEA implementations into industrial entities, persons from the factory, workers on direct work places and consumers into the next processes into the company). So the paper represents only a small part from the application, which if it's used on a daily base with a created procedure and a multidisciplinary team to implement and use the same one, brings benefits to every industrial entity.*

Key words: *FMEA, Quality Control, QMS, industrial entity from the metalworking industry, R. Macedonia*

1. INTRODUCTION

The basic aim of the paper is to present only a segment from a conducted research done into an industrial entity which works into a metal cutting industry and has a market share into Balkans more than 60 years. After the transformation of the capital from state to a private one, the business entity started to work with completely new production lines in the year 1996. But once more, the basic aim of the paper is to present only a segment from a conducted analyses considering the momentary state of the system and to be more precise about the processes of quality assurance and quality improvements through the implemented FMEA matrix, which in the processes of application gave us real information's about the potential problems, the potential solutions that could be implemented and could give the production system reducements of the non-conformities, problems reducement, quality improvements on one hand, and on the other achieving bigger and bigger profits through the processes of continuous reducements of the non-conformities in any stage of production.

One of the key elements which is worth of mentioning is to precise that the realization of the FMEA methodology is conducted with a precisely created multidisciplinary team conducted from persons from science (persons with a long term experience into the field of Technical sciences), persons with a long term experience into the processes of implementation of such methodologies, persons from the management team, workers from direct work places which are under review as well as workers from the following processes into the production system. Seeing the team, we could say that the same one is more than relevant to conduct such an analyses and to create real picture about the

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potential problems but also to create a solutions and ways which will bring the company to an improved situation, as well as a more quality final product. In the following part of the paper only a segment of the research and the created strategy based on the previously defined FMEA matrix.

2. PRESENTING THE METHODOLOGY THAT WAS USED

The methodology that was used while the research was FMEA methodology. The same one is known as a methodology which primarily is used for detection and analyses of potential non conformities, and is known as a method for systematically detection of potential non conformities, but also as a one that creates potential solutions. This method is worldwide knows as a FMEA (Failure Mode and Effect Analysis). The methodology most common is used for:

- Detection of potential non conformities, which has a crucial influence to the system productivity
- Evaluating the effects of each detected non conformity and its influence to the system, the influence over the functions of the elements and sub systems

FMEA is a world knows as a methodology which is based on team work and it's accepted as one of the most common methods for system improvements directly, but also as one of the methods which indirectly has an influence to the quality of processes, quality of final products, business performance and finally brings financial benefits to the entity. The same one as a method has influence to all of the production stages, with a final aim of improvements from a process to a process. Whit it's usage the same one brings the subject to a situation where all of the potential non conformities could be evaluated and could be segmented as primary, secondary ones and non-conformities as a result of human mistakes.

The methodological approach to the same one is based on a team work and created tabular views which are a multiplication of three common factors (the severity, the occurrence and the possibility for detection). Multiplication brings us to a created RPN number, shown in addition:

$$RPN = \text{severity (S)} \times \text{occurrence (O)} \times \text{detection (D)} \quad (1)$$

Each of the multiplication factors shown into the formula above are on a scale from 1 to 10, and could be exactly read from generated tables. Considering previous mentioned, the maximum RPN number could be 1000. One of the most important things to say at the moment is also the approach to the problems (solving approach). The same one is based from top to bottom considering the RPN number. The implementation of the method is developed considering several steps: team creation, defining time and place for implementation, creating structural, functional and non-conformity analyses after which the team approaches to a realization of a recommended steps and solutions after which there is an additional monitoring on the system.

3. REVIEW OF THE PRODUCTION PROCESS

Having in mind that the paper presents only a small segment from an extensive conducted applicative research with a real implementation of FMEA methodology into a real entity, and a one that brought the company real results, in addition of the paper only a one sub process is shown. The same one is a part from a production line which produces stoves, where the process is separated to the following sub processes:

- Buying raw materials
- Quality control – on the raw material
- Segmenting the raw materials into magacines
- Cutting on small and large scissors
- Making holes to the material
- Using hydraulic presses
- Delivering the final piece to magazine or to another process

While doing the analysis with an aim to detect possible non conformities, an reason – consequence

methodology was used. The same one brought the team identified, researched and graphical picture to all of the potential reason for defects. While creating the step, and before the FMEA methodology was actually created, the following characteristics of the process were also taken into consideration:

- Machines
- Methodology of work
- Material
- Human factors
- Measurement instruments
- Work conditions

Seeing things this way, the possibility to miss something is minimal. But there is always a possibility something to be missed, and that is the reason why this process is continued and improvements are aimed from a process to a process. In addition of the paper only a segment from the generated FMEA methodology is presented. In this case the presented part is the process of delivering and transporting the final piece to the magazine (or to other process if it's necessary), where the first hypothesis was that we would not find any non-conformities and there wouldn't be detected any problems.

4. PRESENTING ONLY A SEGMENT FROM THE FMEA TABULAR VIEW

In addition of the paper, only a segment from the research and segmented tabular view is presented. The same one is a presentation of the detected problems into the sub system – transferring final piece to the magazine or to other sub system (if it's necessary). Although in this part of production the expectation is to have only quality produced piece (in more than 99% of cases), some problems were detected. The tabular view is an excellent presentation of the detected problems.

| Process | Potential Failure | Nus – effects | S | Reason | O | Reason | D | RP N |
|---|--|--|---|---|---|-------------------------|---|------|
| Transferring the done pieces into the warehouse | Damaged piece | Replacement – time sequences which are long | 4 | Mistakes done by workers while transfer | 3 | Checking piece by piece | 4 | 48 |
| | Long time for transfer | Production delaiment, free work force with no activities to do | 5 | Transport equipment which is more than old | 7 | Checks on every piece | 2 | 70 |
| | Not appropriate conditions into the warehouses | Nus products | 3 | Mistakes made by the warehouse workers, and the transport workers | 4 | | 6 | 72 |

After detecting most of the problems (potential and real ones, and also problems for which the employees were aware), potential solutions and practical realization of the same ones were suggested. So, after a while the process of practical implementation started and after following the results, another tabular view was created. The same one is presented into the tabular view which is given in addition.

| Actions TO DO | Actions TAKEN | RESULTS FROM THE TAKEN ACTIONS – NEW RPN | | | |
|---|--|--|---|---|-----------|
| | | S | O | D | RPN |
| Motivation on work force – control of the materials, pieces | Motivation and TEAM BUILDING actions | 3 | 5 | 2 | 30 |
| Replacement of the transport equipment, as well as maintaining the ones that are already in use | Done maintenance on all of the machinery which is in use | 3 | 4 | 2 | 24 |
| New warehouses, and taking some measures to renovate the ones in use | Generating warehouses which are with appropriate conditions for the use. | 2 | 3 | 2 | 12 |

Seeing the second part of the table, result are more than visual if you see the RPN number and compare the same ones to the previous RPN numbers into the first table. But what is important to say is than the methodology could bring results to the business entity only if the same one is implemented in a long period of time. Such approach brings business and financial benefits to the entity.

5. CONCLUSION

Having in mind the previous mentioned, we could consider that the paper presents only a segment from a completely conducted applicative research from the field of quality control, or to be more precise in the field of quality assurance in this stage, into a real business entity. The basic aim of the paper is to present only a segment from the functioning of the FMEA methodology into real industrial entity, which works into Bitola's region, with an aim to present the real benefits from the practical implementation done by a multidisciplinary team. The industrial entity had some benefits in such short period of time, which could be seen into the tabular views presented into the paper. At the end we could say that the paper presents only a segment from the things which were done, and considering the fact that the same one is an ongoing process, we could say that more and more papers could be published from the practical usage of the method into the business entity.

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