

APPROACH TO RISK MANAGEMENT USING FMEA IN THE CONDITION OF SMALL SERIAL MANUFACTURING

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Abstract: This work presents the more commend potential failures of process by small serial manufacturing and propose for them defection. The stages by manufacture from inquiry to transport are described. As result is Process FMEA generated including the based potential failures, cause and necessary measures for defection. This Process FMEA can be used for all parts in the company and for comparing differently production processes.

1. Introduction:

The most common approach to risk management is Failure Mode and Effect Analysis. It's stated in DIN. An FMEA is a method of identifying and preventing product and process problems before they occur [1]. FMEAs are used in the product design or process development stages. Process FMEAs uncover process problems related to the manufacture of the product. When making a process FMEA we have to think of the five elements of a process: people, materials, equipment, methods, and environment. These five elements are the reasons for process failure affect (product, processing efficiency, or safety).

By FMEA we are looking for all of the ways a process can fail. A product failure occurs when the product does not function as it should or when it malfunctions in some way. Even the simplest products have many opportunities for failure [1].

FMEAs do take time and people resources. People which understanding/knew of the product or process need to be involved in discussion. The information from customers, suppliers and reclamation are important.

All product and process FMEAs have to follow ten steps. By review the process team should review a detailed description of the operation for a process FMEA.

By Brainstorm team members discuss the potential failure modes that could affect the manufacturing process. All ideas have to be written on table. The next step is to identify the potential effects of the each failure mode. For some modes there may be several effects. After that the team assigns a severity ranking for each effect, occurrence ranking for each failure mode and detection ranking. Each of these three rankings is based on a 10-point scale. The 7 step is determent the lowest ranking. Step 8 Prioritize the failure modes for action.

The last step is to take action to reduce the most risk modes and calculate the resulting.

For the companies developing retail sail manufacture isn't profitable sparing time on working out FMEA for every detail they manufacture. The results from one analyze would be very useful for quality assurance.

Ways in which a product or process can fail are called failure modes. Each failure mode has a potential effect, and some effects are more likely to occur than others. In addition, each potential effect has a relative risk associated with it. The FMEA process is a way to identify the failures, effects, and risks within a process or product, and then eliminate or reduce them.

2. Theory

The work presents a method for working out Process FMEA useful for the company's manufacturing small serial. The different stages that manufacturing is going through are planned.

The potential failures of a process are defined for every stage the reasons causing them are analyzed and are suggested actions for avoiding/preventing it. That's how is build Process FMEA which can be used for every detail manufactured in the company. Determent the based Process FMEA small serial manufacturing is divided in five steps:

1. Determent the stage of process
2. Description functional elements for every stage.
3. Determent potential failure modes, potential effects and

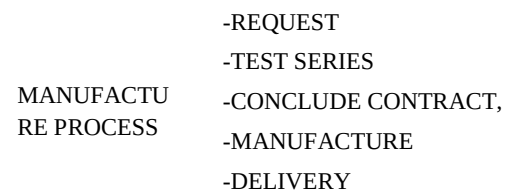


Fig.1 Stage of manufacture process

current state in company and analyze them and determent the lowest ranking

4. Actions to reduce the risk

3. Based Process FMEA for manufacture company

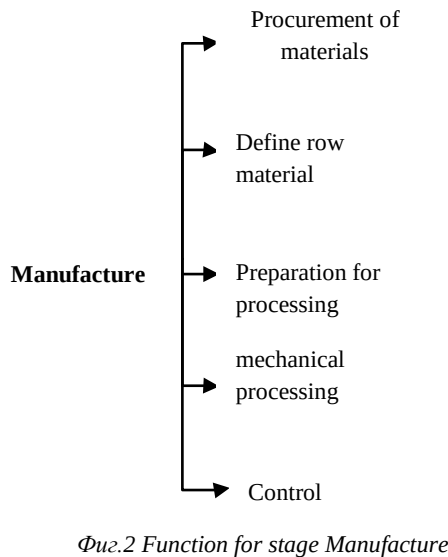
3.1. Determent the stage of process

First are defined the main stages that the company process is going through on which is used FMEA. They depend on how big is the company, on structure and activities. In our case we have the following stages: Customer order, trial, contract, manufacture and shipping of the product (Fig.1).

3.2. Description function

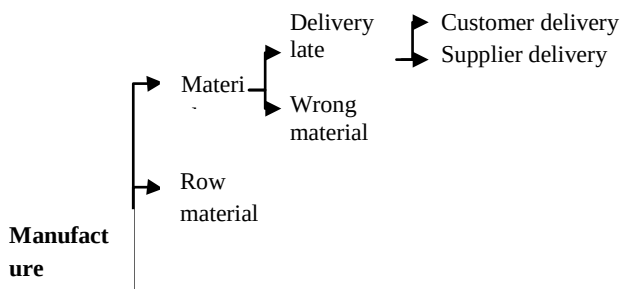
The functional elements – the processes that are made for every stage are defined. For the order we have processing of the order, defining price and deadlines. The technical requirements specification must be done on this stage because on the same stage are defined the price and are made the trial series and the technology. Bulgarian companies are working for foreign companies and they are receiving documentation and designs on foreign language German or English, the designs often contain very important text information referring with the manufacturing process. This information must either be translated directly on drawing or the notes must be numbered and there must be used register with the translated notes.

For each stage is made such functional method. On fig 2 is an example of such referring manufacture.



3.3. Determent potential failure modes, potential effects and current state

The next stage is to be determined potential failure modes, potential effects and current state in company for every functional elements of the stage Manufacture (fig. 4). After that analyzing if that is enough for our current process. Valuation is made through calculating of the lowest ranking for the specific process. This way we determine riskiest process.

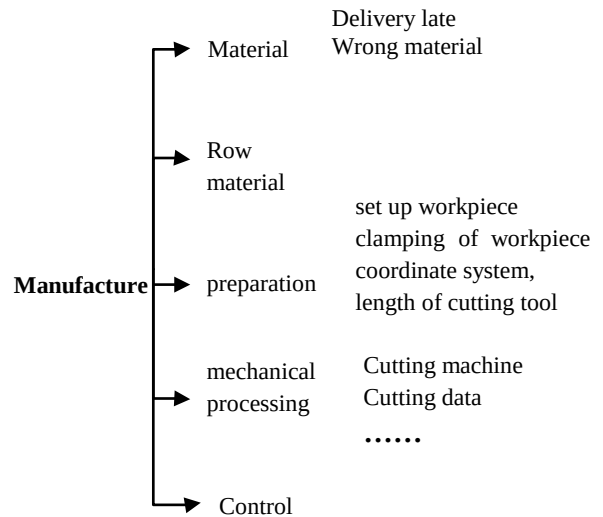


The first stage in manufacturing is buying the raw material. It's important the shipping deadline because from this depends the beginning of the manufacture and the material quality. The materials which are more specific i.e. materials which are alloyed can't be bought directly from Bulgarian supplier. There are cases in which the clients buy and deliver the material by themselves. The chemical compositions are also important for the machining quality, tool wear und acceptance of goods. Usually the companies are satisfied with quality certificate which is given from the company. But that is not enough.

The risks with material supplying are: shipment delay (client's or supplier's fault) and the shipment of wrong material (Fig. 4).

The first step of the technology process is defying a raw material. The importance parameters are dimensionment, raw material which provides the necessary machining allowance for tolerance insuring. When the billet is being cut it must be calculated it's length. It must be enough for processing and there mustn't be any material going to waste. Other than using reference book there is an option that we can use our past experience and documentation we can leave addition which is standard for the details.

Processing preparation includes set up workpiece clapping of workpiece stetting coordinate system and ect. It's been checked if we have settled the detail correctly and if we need to adjust the accuracy and stability of the working coordinate system. The current state in the company is variety of methods that guarantee that there won't be any human mistake. This documentation represents notes in the technology card or instructions in the running program.



Fast clamping of tools are also important. When cutting a thread tap isn't well clapping and the depth of the cut is getting 2mm deeper for 1000 details.

Common mistake i.e. is the wrong size of the tool, this can be avoided when every time the tool is used we have note in the program telling us what tools is being used and before its approach we have a visual check (Fig.5).

Quality control stage includes observation and determination of the sizes that will be controlled or the choice of control plan. Initial 100% control is made of the sizes, on which we have requirements for precision. Other approach even at the medium series manufacture is to be used control cards which control the size [2]. At the beginning its recommended control to be made on the free sizes which also cant or can be limited if any mistake occurs random or systematic (i.e. not well adjusted working coordinate system, mistake in foundation of the detail or weak tightening)

3.4. Actions to reduce the risk

When determining potential failure modes potential effects current state and calculating lowest ranking is suggested methods for lowering the risk. For every detail that is being made we can have different processes or stages with lowest ranking.

The first 3 stages are automatic and they are re-covered for each process. Depending on the technology and the technology operations we choose functional elements for stage Manufacture for our detail. This highly shortens the time needed for making Process FMEA. The final stage is most important, there are being suggested methods for avoiding of failure modes. This can be

done for every detail (last stage) it doesn't take much time and every time it can be suggested new approaches as the experience gained for every other detail will help us to find and suggest

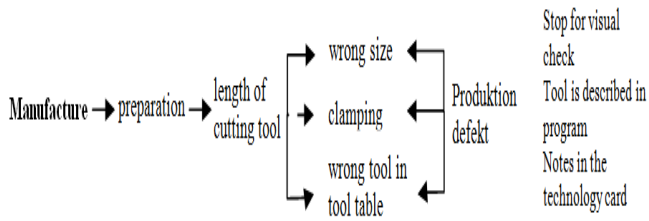


Fig.5 potential failure modes, potential effects and current state preparation for Manufacture length of cutting better methods. The FMEA cards is prepared in Excel.

4. Conclusion

In this article is being presented the methodology for applying on the Process FMEA in small serial manufactures. The main problem the time needed for the development of the process FMEA which require detailed specification of the processes, functions and current methods. Highly specific

1. General model including all stages of the process
2. Description of the functions which are being made in every stage
3. Potential failure modes, potential effects and current state
4. Determining the riskiest stages for the current process/detail
5. Suggesting methods for avoiding failure modes for specific process based on gained experience and the current state of the company.
6. Process FMEA developed in Excel.
7. Comparing differently production processes whit methods

5. Literature

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Regards

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