Bachelor Degree Project

A Model to Identify Failure & the Root Cause
Abstract

Through identifying failure manufacturing companies compete in today’s world to gain beneficial attributes. The purpose if this thesis is to develop a model towards identifying failure and the root cause. The model developed to identify failure and the root cause toward it, which should result it decrease in failure time (nonfunction machine). The developed model has tested and analyzed in a manufacturing company. The model has been established through studies based on preventive and predictive maintenance: FMEA & RCA.

**Keyword:** Failure Mode and Effect Analysis (FMEA), Root Cause Analysis (RCA)

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1 Introduction

*In this chapter, the reader receives an introduction of the given research. The background will be presented first, following that will be the problem presentation, formulation, and discussion. The relevance and limitation will be presented in this chapter, followed by the literature research.*

Through researching failure and elimination companies compete against each other to gain beneficial attributes (Nilsson 2015). In this study, preventative maintenance is defined as an analysis that determines and eliminates failure. Failure is an aspect that can appear in different forms; i.e. production station stops manufacturing, failing to communicate through different departments in the company, failing to reach the company's goals. In the modern world, companies research ways through determining failure and eliminating them.

The aim of this study is to find an appropriate method for the use of preventative maintenance for a manufacturing company, VäxjöFabriken. This will aid the company in determining and eliminating any future failure.

Background

Industries compete for improvements of the company on daily basis. Competition against other factors on the market is a necessary part in achieving company advantages. Companies focus most of their improvement of the crucial parts of the company. For each company, this means different departments with different aspects. Some of these aspects are: communication skills, economic growth, and the production area (A.J. Braaksma et al 2013).

Improving the communication skills within a company is a major part in achieving competitive advantages. This could be achieved by improving communication between the different departments within the company. Communication skills are defined as the process of transmitting information from one location to the other. Even though communication is an essential part of human behavior, in industries it generally refers to a variety of connection, especially within workers and different departments of the company (Kang et al 2013).

Economic growth is a crucial part of the company in economical view. Economic growth is connected all parts of the company, from the production station to employees hired by the company. The ending economical result sheet is one of the most important results for the company. (Nicolai. J &
Production station is a manufacturing part of the company. Where the specific details are constructed or production of the product is made. Production station can always be improved. Improving the production station is a critical part in quality testing. Improvement in the production station can be made through quality testing, eliminating time which is wasted, which can be given to the production time, and eliminating failure so the machine would not stop the production line. Preventive maintenance is a maintenance routine to help avoid failure or stoppage time, preventive maintenance also provided safety routine checkup so in case or a fault does not turn into a failure which can cause damage e.g. production station stops because the company to loses time. (Shahriar j et al 2015)

Using different methods through determining failure and preventing it from occurring can benefit the company greatly. According to (Feruer & Chaharbaghi, 1994)

Competitiveness could be different customs to achieving. One of the many mentioned ways that that is mentioned is viewing competitiveness is the ability to always improve and improving different aspects of the company, given this fact through determining failure and eliminating it is and can be a cause to achieving or gaining competitive advantages. Defining failure within a company is sensational, furthermore; though determine failure within a production station can benefit the company significantly.

Industries that have manufacturing stations can sometime have shortage or errors, which can cause stoppage time. It’s necessary to know which methods have resulted beneficial in determining failure. (Khanna et al. 2016) In the modern day, there are different tools through determine failure or shortages. E.g. Failure modes and effects analysis (FMEA) is an approach for determining failure or all possible error in the production station.

Failure Modes, Root Cause analysis aka (RCA), is a technique used for problem solving to see the root of the shortage or failure. (Iall, 1992).

Problem Discussion

Having the capability to advance your organization takes strategic planning. There are lots of different methods which tested and implemented, some resulting in failure and some in extremely beneficial. To improve an organization takes long term commitment for the result long period effect. (Serrano, 2010)

Using the wrong method can be a major decline within the organization, that why it’s important to know which method to use and how to use it for passing the knowledge through other workers and for capable experience. (Benson, 2008)
Having the knowledge is an important factor knowing which method have been tested and which are present to be used. Organization methods have the capability to improve industry. When an organization chooses to implement method to determine failure it’s important that all worker acknowledge those changes, meaning have an understanding and a firm knowledge of the system intended on being implemented through implementation determine failure improvement are made.

Presentation of problem

Companies implement method to improving companies. By improving different aspects within the same company is considered beneficial and may result it beneficial attributes. Implementing different method to improve the working areas can take time and have the possibility to result in failure. The difficult aspects when implementing system is knowledge, experience, and time there for all part of the company must be aware of the implementation and changes.

Problem Formulation

The focus of the study is based on developing and defining a method that can be used or mentioned within a manufacturing industry facing the problems such as determining failure within the company. The use of this method was developed to avoid time wasting for the employees and improving the working methods. (Tejubijuluw, 2015)

A question has been formulated to answer the following and to be brought up through the examination report. “Developing method to determine failure or shortage”

Purpose

The purpose with this report is to determine methodology towards determine failure or shortages. The objective of the methodology is to determine and eliminate failure, furthermore prove beneficial for the case company. The use of this method has been developed to avoid time.

The examination will include a literature study and interview with växjöfabriken production manager. Furthermore, the report will explain the given company way of determining shortages and other methods of defining shortages and eliminating them, and with comparison to each other.
1.2 Relevance

Having advantages over the competitors is an essential part in achieving competitive advantages; it's essential to research a beneficial method to determine and eliminating failure. Furthermore, defining method to determine failure and prevent it from occurring is valuable information. (March, 1991), there are different tools to implement for defining failure and improving the station are the work area. The author will research previous studies related toward the subject. On the table below shows previous searches brought up towards determining failure within industries. Other modules towards defining failure were found.

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Delimitation</th>
<th>Database</th>
<th>Hits</th>
<th>Relevant Articles</th>
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<td>Scientific articles, from 2015-2016, Fulltext</td>
<td>One Search</td>
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Figure 1: Literature Research

In the table 1 Literature research was conducted see table 1, to identify other articles based on preventive maintenance. Other models from preventing failure was found and studied, therefore this study has a scientific relevance. A literature research was conducted to find previous studies within the given area. In table 1, specified key was used to locate relevant articles.
1.3 Delimitation/Limitation

In the report, will be working with a given manufacturing company. The research includes researching different methods to determine shortages or failures, and defining those methods used by the collaborating company. The report will include defining those methods and the analysis used and compared to tools used by other manufacturing companies. This report will also include working with NL 2500, which is a specific machine that put the specified details to the components which are set by the consumers; the report will also include the method of determining shortage with the given company. The author will also execute the report through defining town methodologies to preventing failure and determining it from occurring. Information such as cost and implementation dates etc. will not be mention by the authors.

2 Research Methodology

This chapter is for describing the methodology that will be used to handle the problem addressed in the study. At the same time, it would be more convincing to describe briefly other applicable methodologies and tools and argue for why implementing just the one that was selected. This chapter is for describing the methodology that will be used to handle the problem addressed in the study.

2.1 Research Perspective

The hermeneutics perspective is the interpreting information through literature or text, although hermeneutics perspective is the interpretation of text such as biblical and philosophical. Recognizing human behavior through their action and comprehending the result of that action. (Thuren, 2007)

The positivistic perspective is the gathering knowledge through observation measurement. According to Patel & Davidson 2011, is a philosophical theory that states all knowledge to be verified and that the only given valid knowledge is the scientific proven.

In the process of the research the consideration of both positivistic and hermeneutic perspectives will be brought up. The hermeneutics perspective will not be used when gathering different information. Furthermore, the positive perspective will be approached when observation is made to gain knowledge and facts. These positivistic perspectives are essential in the process of gathering information.
2.2 Research Approaches

Inductive reasoning starts when observation is made and theories are brought up. Inductive reason is applied within the research when collective information is gathered through observation, though gathering scientific information and applying it to a scientific explanation.

Deductive reasoning is a research approach which begin by developing a hypothesis through previous existing theory or knowledge. In other definitions, deductive reasoning is explored when a theory is brought up in a given situation, and then it is the hypothesis either banned or accepted. Commonly, deductive reasoning is broken down in three of the following step:

- Research theory
- Formulate your own hypothesis, through collecting information
- Examine the hypothesis with comparison to given finding, which will result in either rejection or acceptance.

(Patel & Davidson, 2011)

Abductive reasoning is associated with inductive and deductive approaches, meaning abductive reasoning is a mixture of inductive and deductive reasoning, through observation being made a theory is brought which is accounted for, given the observation factor (inductive approach). Furthermore, then are the theory tested to already existing theory which are either accepted or rejected (deductive approach)

(Patel & Davidson, 2011)

Through the research, both inductive and deductive reasoning will be approached. Inductive reasoning will be considered when basic observation is being made. Deductive reasoning will be considered when the author formulates a hypothesis through previous existing theory. Therefore, abductive reasoning will be considered by the author. Through observing previous existing knowledge, then formulating a own hypotheses through observation, and finally comparing them to see result is accepted.

2.3 Research Method

Qualitative research is an investigative form, understanding fundamentals basics e.g. motives & opinion. Especially used when trying to get a better understanding of a given. This research is gathered through interview, meeting, and information gathering e.g. (articles).

Quantitative research
Is a way to measure the problem through measuring information in a form of numerical or statistical technique. Quantitative approach is brought up to measure attitudes, behavior, etc. with comparison to a larger population. Quantitative research is an approach used in the modern world commonly i.e. online survey. (Bryman and Bell, 2011)

The execution this report the qualitative research will be brought to attention. Through qualitative reasoning the author will make use of basics fundamentals e.g. interviews. No measurements toward behavior through online survey will be considered, though quantitative researching will allow the use of articles and books.

2.4 Observation

Observation is method that allows the gathering of information through observing and a certain behavior. Although observation is a method for information gathering, it has it limits. Information gathering by observation may only be introduced through behavior only.

Observations allows for information about the given by looking on the environment and person behavior for responses. (Patel & Davidsson 2003) Within observation method, there are two methods to observer and obtain information through:

Structure: is also known as systematic observation, in this method the author has prepared a specific subject which will cause a reaction, by observing that reaction structured observation is made. This method is beneficial when wanted to gather information than is considered unexpected.

Unstructured: in this observation method, the process of having a prepared subject is eliminated, and the process of gathering information and information, in other words defined as spontaneous observation. (Patel & Davidson, 2011)

Through this study observation will be considered during the research, the author uses observation when gaining information through in the specified subject area. The method chosen to execute the report is unstructured, spontaneous observation is used in the report, recording information through spontaneous observation.
2.5 Validity, Reliability, & Generalization

Reliability states if there was an ongoing study, and the study has been researched previously, then the given results of the research should be equivalent to each other. By researching the same subject and comparing the result to be equal them the study is considered reliable.

When improving the reliability of the study. There are two types of ways;

Rater reliability: is the mutual relation of two observers, through their observation toward the same action, also known as parallel observation. (Patel & Tebelius 1987)

Validity of a research refers to the trustworthiness of the study. According to (Wallen 1996), validity of a study states that the given study or measurements of the study, will work on or solve the specified problem if the chosen study.

There are two types of validity in researching method: internal validity and external validity.

Both types are method towards strengthening the thesis research method.

internal validity is the tools and instruments used in the study, work toward the problem of the research.

external validity states if the given result of the findings can be used toward other subjects. External validity also answers the question towards if the research can be used actual life.

Constructed validity is the base of the findings, although constructed validity is not used.

The quality of a research is determined through the validity and reliability of the findings (Patel & Davidson, 2011). According to Bell (2006), to improve the validity and reliability of the research method is essentials, given the fact that other researcher use the same tool or methods to research the same study.

Generalization is an important factor within scientific researching.

Generalizing means the ability to use the theory or model in further investigations (Patel & Davidson, 2011). In order to generalize a case study to another situation is depending on the similarities between the studies. A detailed description is necessary in order to provide the reader a possibility to evaluate if the research is applicable or not (Lincoln & Cuba, 1985).

According to (Patel & Davidson, 2011)
Generalizing in research methodology state that the instrument used to solve a study can be used within other studies, although the studies need to be similar.

The execution of this report the author will research to ensure a high validity and reliability. To ensure a high reliability, these studies have previously been researched and results shall and will be compared with the authors. To ensure a high validity of the report, the author will make use external validity and internal validity. This report will be examined by professors & case company managers. Generalization will be used, given this subject has been previously studied, the author will compare the report to other similar one.

3 Theory

This chapter will show the theory needed required by the author to support his model development. We will work with defining the FMEA, preventive maintenance, lean manufacturing and RCA, and we will compare their analysis. In today's industry, preventive maintenance, companies use different method to determine any errors throughout the company. At the same time, it would be more convincing to describe briefly other applicable methodologies and tools and argue for why implementing just the one that was selected.

Bring out the theories from the relevant working areas you think are necessary to consider in your study. In this section, you should do your own sub-sections to sort out logically the theories, tools and methods that you believe are important to be incorporated in the study. This section can, in general, be updated gradually during project/study performance. During writing the first three chapters you should not be influenced by the case company. You should discuss and handle the problem from the wide perspective and the case company will be an application of the theoretical results being achieved.

Preventive maintenance

Preventive maintenance is a routine maintenance which provide safety for equipment and keep it functioning, preventing maintenance keep any unplanned accidental stoppage time and unnecessary costs from equipment failure. It needs scheduling and planning of the maintenance to hinder a failure before occurring. While, keep past records. Preventive maintenance includes inspection of equipment particularly in given areas were potential failure located and investigating it to hinder it from becoming actual failure. (Mikael et al. June 2015)
Lean manufacturing

Lean manufacturing is a systematic method used to reduce unnecessary waste and increase the performance. The implementation of lean manufacturing is a process that includes a valuation of the given station, although altering and designing the given station built on lean manufacturing. There are classic types of company waste mentioned "A FMEA-based approach to prioritize waste reduction in lean implementation": waiting, overproduction, transportation, inventory, motion, over processing & defects. mentioned (R. Souza & L. Carpinetti, 2014)

The ability to decide which types of the given waste should be reduced first and foremost is a fundamental factor in the planning and scheduling during the implementation of lean manufacturing. (Jaiprakash et al, 2014)

![Figure 2: FMEA Phases Analysis](image)

3.2 FMEA

FMEA:
Failure modes and effects analysis (FMEA) and root-cause analysis (RCA) in the present day are the most implemented failure analytical methods, used by different industries around the world. These techniques are used to determine failure from happening and explain the root when the problem has occurred. FMEA is a technique used by manufacturing companies, FMEA works with
determining elements of failure before the actual failure occurs, FMEA starts from the bottom of the company and researches after specified elements related toward failure (Geum, Cho, and Park 2011). Eventually, the ending result includes a list of error or failure in the entire system and their consequence to the specified system. Usually the faults are arranged in a form of criteria toward which is more harmful toward the company. The information provided allows company the repair the mistake, and provides further information in future.

FMEA is often considered as a reliability instrument for determining possible mistake or errors before the actual failure occurs. Through the given instrument company have the possibility of minimizing the failure throughout the industry. (Papadopoulos et al. 2011). Basically, the function of FMEA is to determine and minimize errors and failure before they occur.

3.2.1 FMEA Analysis

FMEA Analysis
The step of FMEA analysis
· Identify the process it was set to.
· Researches any possible risk
· When the risk is identified, FMEA estimates the risk possibility to reach failure. (1-10, 10 being very serious.)
· Then assessments are made about how often the identified risk occurs. (1-10)
· Can the identified risk be prevented should it happen occur once more. .

(T.Carrington. 2007)

3.2.2 FMEA Benefits

Benefits of FMEA
· Reduces stoppages time
· Fewer last minute changes
· Early identification of encoded errors
· Documented information of errors
· Improvement of production station, quality, and reliability. (R, Keith 2002).

The failure mode effect analysis is a highly effective way to evaluate the given processes products. It is as valuable for finding areas needed for
improvement and reducing cost. However, FMEA identify early factors failure and system failure issues that can hinder success. FMEA is valuable when identifying area where lacking performance, customer satisfaction. (Chee-Cheng Chen, 2013)

3.2.3 FMEA Disadvantages

Disadvantages of FMEA

- FMEA works with prioritizing failure elements based on their risk priority numbers, eliminating the failure is an additional process needed to be done.
- Identifying failure modes is a team brainstorming activity; if the team forgets the list of failure, they can forget certain elements.
- The process of FMEA to implement takes up much time.
- The possibility of not adding all aspects of the company happens rarely.
- Might miss a failure mode or an effect outside the experiences of the company.
- Education towards understanding FMEA should be considered by all employees if the company.

Some of the limitations of FMEA ranks failure mode to their risk, which is valuable, although the system will not eliminate mode only prioritize by list of most hazardous. Nevertheless, FMEA only works as sufficient as its team operatives, if the team operative doesn’t have annual listing difference elements of failure and analysis of the FMEA. FMEA also needs the annual system update. Time, although FMEA is a full-functioning business system, it takes up the whole company awareness with education toward the system and time for a successful implementation. (A.J.J. Braaksma et al. 2013).

3.3.1 RCA

RCA:

Failure Modes, Root Cause analysis aka (RCA), is a technique used for problem solving to see the root of the shortage or failure. (Luca. D, Sjoerd. D, Pete. A, 2010) Root cause analysis (RCA) is a specialized technique for analyzing failure before it occurs, through defining elements of failure, RCA manages to keep manufacturing companies from achieving complete failure.
The analysis usually starts with going through all collected information. (Chee-Cheng Chen, 2013)

Figure 3: RCA Analysis inspired by, R.Keith Mobley Root Cause Failure Analysis (1999)
3.3.2 RCA Benefits

- Improve reliability
- Identify possible errors
- Improve performance
- Quality control

(R, Keith 2002).

Root cause analysis (RCA) is a methodology used to solve problems at their root, rather than just fixing the obvious. RCA is often equated to a kaizen improvement process, and rightly so, as it often digs into possible organizational change, rather than localized optimizations. The benefits of using RCA that it identify causes and signs of failure, handles discovering root itself RCA is a process that introduces organizational improvements and providing those improvements. (R, Keith 2002)

3.3.3 RCA Disadvantages

Disadvantages of RCA

- RCA involve not only technology but organizational influences.
- Not all resulted are helpful, one might receive surprising results.
- Unexpected behaviors should be expected. Meaning a small change in the beginning might have catastrophic results.
- Awareness of RCA, and understanding the concept and the meaning of result should be considered by all employees of the company.

(R, Keith 1999).

In a company operative of RCA must not only include themselves but, awareness of the whole company. The involvement of the company is a beneficial attribute in achieving a full/functioning root cause analysis. Furthermore, root cause analysis results in different cause towards failure, some of the results are which is considered thinking required. This is the reason needed for the company to teach the operatives about the system. (R, Keith 2002).
4 Empirical finding

Växjöfabriken is a private company that manufactures cast components, where they collaborate with customers such as Scania, Volvo and Perfekta. The production takes place according to the customer’s standards through following the specific drawings and measurements as per the customers’ demands. Each customer has its own standard for details that company must follow. Company uses tools such as 5s to reduce losses and increase effectivity in production. This report primary focus on the production station/machine NL 2500 which produces product 562 (a component that it sends to Volvo).

5 Model development

During this chapter, the model Root Cause & Failure Analysis (RC & FA) is presented, following the explanation of the model and its description about the phases.

Introduction of the model development

The development of this model was established through gathering different methodologies and philosophy. Root cause analysis and Failure mode and effect analysis, through studying different aspect of these given subject, failure we developed a model which defines failure the root cause.

RCA & FMEA

Failure modes and effects analysis (FMEA) is an approach to identify failure. FMEA numerous choice for risk is identified & a higher confirmation for changes. (T.Carrington. 2007) Manufacturing companies implant FMEA for the purpose of eliminating all element of failure. RCA will improve reliability and identify any possible errors & will improve company performance. (R, Keith. 1999).

In today’s manufacturing industry implementation of failure detecting system are conducted. Failure is a loss, although being able to detect the element of failure before it the actual stop could be beneficial to the company. When failure is announced then losses are the result. (T.Carrington. 2007)
5.1 RC & FA analysis

**Phase 1: Defining the RC&FA**

It is very important that before the implementation, that the system is defined to the whole company, and most important factor is defining the operatives in charge of the system. In case of emergency only the operatives in charge of the system can the situation, nevertheless, it essential that the whole company is aware, the system is eventually gone over through the whole company.

During the implementation if the system, it's vital to define the system in the areas where the service or product are most important.

**Phase 2: Review through the Process**

Once all the implementation is done and set in the area were its most vital. The system will start review the process area. During this process, all information and information will be set to the system by the operatives, it's sufficient to assign rate of importance to factor, this
information will the system to reminisce the product/service areas which is most important to the company. Then the system will always review the most important area first.

**Phase 3: Brainstorming for Elements of Failure**

Then, all areas of the company have been defined and reviewed by the system and the operatives. The system will start brainstorming for element of failure or problems. All previous information has been stored, the system will brainstorm the most important areas first for problems.

**Phase 4 I:** If no elements were found the system will eventually record all information and notify the operatives, then the operative will move on to the other second important area.

**Phase 4 II:** If elements were found the system by the end will notify the operatives, then analyzing the failure, whether the failure is noticeable by the operatives or if the system should run the next step was the system will run the root cause of the specified problem.

**Phase 5 I:** Finding the root cause, once the operatives have decided to allow the system to continue into analyzing the root cause for the problem.

**Phase 5 II:** After the system analyze the root cause of the problem, and then the system will report it and record the information for the upcoming future.

6 Interview with Production

_An interview was conducted with the production manager about how the system will be implemented and handled_

**How would a new system be introduced into a company?**

Weekes before the actual implementation occurs announcement of the system should be introduced. Allow workers to get ready for change, so that change would not result negatively.

**Is it important that all workers understand to handle the system?**

Having the system studied and understood by all workers of the company will prove beneficial i.e. No operatives of the system available: Normally the system function alone after operatives assign date, although the machine sometime stops due to deciding to find the root cause, when this occurs if
there is no operative available some workers of the company understand the system. Single Operative of the system: Even though a single operative of the system is available sometime encoded error occurs and the operative will be assigned worker who have knowledge of the system to help and find the reason towards the stop.

(RC&FA has a risk rank importance) How would the important area of a company be decided for the given system, is planning and scheduling crucial?
Operatives of the system assign the information, the reviewing does not take up time, although the machine is running during the process, the machine will review the information set to know which parts of the company to go through. Although a planned scheduling of rank of station or equipment should have been complete. “Planning and scheduling is an important factor”, given the fact risk ranks must be decided.

When failure is found how is it handled?
When the root cause of the failure is identified then operative try to identify and solve the given issue and record the information for future experience within the system and the company

How is encoded failure handled?
Once encoded failure is found the machine will stop brainstorming through the company for elements, and report the encoded to the operatives. operatives will wait until the machine runs again, and the operatives will try to find as much evidence about the encoded error for historical information.

Is recoding of past events important, and why?
Question has been answered in previous questions
7 Discussion & Result

In this chapter, the result of the analysis about the models and its phases is discussed.

**Phase 1: Defining the System**

Having defined the system proved beneficial and a very important aspect, which took up time and the whole company attention, toward the implementation time the case company introduced the given system and its operatives, all workers within the company received an introduction towards the system. As read in the analysis even though this process took up time and efforts it provided very beneficial, when no operative of the system is available.

**Phase 2: Review**

Through discussion with the case company, the information that is needed to review will be introduced to the system. This process did not have much time. The given information was already known and listed from most important to least.

**Phase 3: Brainstorming & Phase 4 I: if no elements were found the system will eventually record all information**

As the system started running, operative of the system followed the brainstorming, to make sure all information needed is introduced. Once the first area was finished searching for failure, the operative saved all given information and moved on to the second most important area. As we read in the analysis, the system alerted for an element found in one of the production machinery.

Once the alert was made the operative decided to move on to find the root cause of the failure. The system will focus on finding the root cause and stop other part of the brainstorm; although one the root cause is analyzed the system can return to brainstorming.

**Phase 5 I: Found**

When the root cause of the failure is identified then operative will solve it and record the information within the system and the company. Eventually return to other parts of the brainstorm all parts were needed to be done.
8 Conclusion & Future research

In this chapter, the problem formulation is answered and the author conclusion concerning issues about the model. The author’s mention ideas concerning future research and recommendation about the model.

“Developing method to determine failure or shortage”

The development of RC&FA was conducted through the studies of root cause analysis and failure mode and effects analysis. Through applying RC&FA improves chances of finding failure before major error occurs. Given the fact the model contains searching for failure and root cause toward it, the model assist company in their production station through determining failure. The model enables companies to keep high communication throughout different department through the company. The given model should generally be used by company with manufacturing department, although the model is needed to be operated by operatives of the machine.

RC&FA is a tool implemented to identify failure, although time is an issue with the given system, much of the time taken by RC&FA is introduced during Phase1: defining the system, defining a new knowledge to all workers of the company take effort and time, nevertheless this has to be achieved to receive the full-function of the RC&FA. For companies trying to get the system implemented rapidly, RC&FA could have some circumstance and therefore be a disadvantage.

Having considered implementing the method into a manufacturing company, and the implementation into other industry which will raise the validity and generalization, we recommend manufacturing companies that have problems with identifying failure to use the RC&FA. An important factor if considering implementing the given system, to receive best possible aspect, is to inform the company to study the system before phase 1 is being introduced, this is the company to have studied the system, this will decrease the time of phase 1, given the fact it takes up much time and effort.

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9.2 Literature

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9.3 Figures:

Figure 2: R.Keith Mobley (1999). Root Cause Analysis chart.
Figure 3: (F.Lolli, R.Gamberini, B.Rimini, F.Pulga, 2016). FMEA Step Analysis.