



# **The elimination of quality deviations and process interruptions on the Adient front seat assembly process**

Less interference means better quality

*Bachelor's thesis in Mechanical Engineering*

Shaniar Ali  
Lass Abdelkarim

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## **PREFACE**

This thesis work was done as a part of the Mechanical Engineering program at Chalmers University of Technology. The Mechanical Engineering program includes 180 hp and 15hp has to come from thesis work and report. The supplier for the thesis work that was carried out was with Adient and in the Adient factory at Torslanda, Gothenburg. Thanks to Simon Lindell the project manager for supporting and helping this thesis work and also Peter Hammersberg, examiner and guide in this area and type of work.

## **ABSTRACT**

The present 8D project deals with a quality issue that involves the Automotive industry. The issue was to eliminate waste of scrap and process interruptions on the Adient front seat assembly process. The group managed research to discover the problem and developed a plan to get rid of the problem.

First, the problem went through an analysis by the collection of data and doing a fairly deep investigation. Through this analysis, the team was able to find the problem that is the cause. The defect seems to have been caused by a combination of incorrect training received from the fitters and an angled fixture. The team then made straight away contact with the production manager and took pictures of the surroundings to ensure that they were aware of this problem.

After the root cause had been found, the team developed a plan with the help of the 8D methodology. This included improving communication, identifying and resolving any issues that may have arisen, and having the regulatory body report on progress to the board.

## **SAMMANFATTNING**

Temat med projekten är att med hjälp av 8D-metoden minska kvalitetsavvikelser i produktionen och försöka effektivisera kvaliteten i fabriken. Det som är känt är att det sker kvalitetsavvikelser i produktionen som kan förbättras för att spara på pengar och resurser. Detta gjorde så att ingenjörs team fick en bättre inblick i vad som behöver förbättras för att företaget skall nå nya höjder.

Först genomfördes en grundläggande analys genom insamling av data och genomförande av en grundläggande utredning. Genom denna analys kunde teamet ta reda på problemets orsaker. Problemen verkar ha orsakats av en kombination av felaktig utbildning från produktionen och en nyligen tillsatt vinklad fixtur. Teamet tog direkt kontakt med produktionschefen och tog bilder av omgivningen för att säkerställa att ledning vet om detta.

Efter att roten till problemet hade identifierats utvecklade teamet en plan med hjälp av 8D-metoden. Detta inkluderade att förbättra kommunikationen, identifiera och lösa eventuella problem som kan ha uppstått och att få organisationen att rapportera om framstegen till ledningen.

# 1. INTRODUCTION

## 1.1 Background:

Adient is a global leader in automotive seating, supporting all major automakers in differentiating their vehicles through superior quality, technology and performance. The company is driving a high-performance culture to improve the experience of a world in motion of seats manufacturing in automotive seating and beyond. This thesis work will be carried out in Adients factory in Torslanda which is a subcontractor to Volvo Cars in Gothenburg.

Main purpose of the project is to eliminate waste of scrap and process interruptions on the Adient front seat assembly process, working with Adient standard 8D problem solving method and focus on trim damages that can generate high cost and process interrupts for Adient Torslanda.

According to Adient and with the manager explaining the group he says that process: "Interruptions can be a problem because it slows down the production and extra maintenance personnel must be included and that is costly for the company."

Therefore the company is trying to work out a cost effective solution to save money and to increase the quality of the product.

Adient builds Volvo Car's Front seat against their SPA platform. The SPA platform includes the following Volvo cars: V60, V60CC, XC90, V90, V90CC and XC60. Since the trim is one of the first details a new Volvo customer notices, there are strict requirements on how it should look. Adient uses "Photobooks" to know the level of wrinkles and other defects.

## 1.2 Lean production

Toyota Production System (TPS), which was developed by the Japanese automobile manufacturer Toyota in 1950, is where lean production first gained traction. TPS was a response to the post-crisis economic scenario in Japan, where resources were limited and businesses needed efficient ways to manufacture currency. TPS concentrated on removing bottlenecks and increasing productivity while also raising the caliber of the products produced.

Eliminating waste is a key component of lean production. Waste is defined as anything that doesn't work to create security for the customer. This might range from overproduction, unsafe deliveries, and storage conditions to defective goods and unsafe staffing levels. Businesses can save time, money, and resources by getting rid of wasteful practices while simultaneously increasing the output and quality of their products.

Some methods that are very normal in lean production are for example:

5S - 5S is a method for organizing the workplace and enhancing the working environment. It consists of five steps: sort, set, standardize, systematize, and self-discipline. By following these steps, businesses may eliminate disorder, increase productivity, and reduce the risk of injuries and accidents on the job site.

Poka-yoke is a method for eliminating errors and flaws in manufacturing by utilizing various tools and techniques. It may involve using specialized tools and measuring instruments to ensure proper mounting and quality, or using visual controls and indicators to alert operators to potential issues.

Kaizen is a philosophy that emphasizes continuous improvement. This means that businesses and organizations are constantly working to improve procedures and work methods in order to increase output and product quality. Kaizen typically means that businesses concentrate on small, incremental improvements that result in significant long-term changes.

### **1.3 Aim**

The project is aimed at the trim part, which is a synonym for the upholstery bag, or the appearance of the car seat. To meet the customer's requirements, Adient has several options of trim such as Agnes leather, Moritz leather, Vinyl as well a lot of different textiles. As the trim is one of the first details a new Volvo customer notices there are strict requirements on how it should look. Adient uses "Photobooks" to know the level of wrinkles and other defects. What is never allowed is direct damage to the trim created during the supply chain or in the factory production process itself.

Adient uses a standard for problem solving called 8D. The 8D structure is common in automotive as it covers not only the solution, but problem description, temporary solution, root cause analysis, permanent solution, follow-up of permanent solution and preventive measures in the form of control document management. The project will report using this structure.

## 1.4 Boundaries

This project is limited to 5 failure modes that create scrap and rework activities at Adient.

These 5 failure modes are:

1: Damage around the headrest.



Picture 1

2: Damage to the back of seat



Picture 2

3: Damage to the bolsters inner side



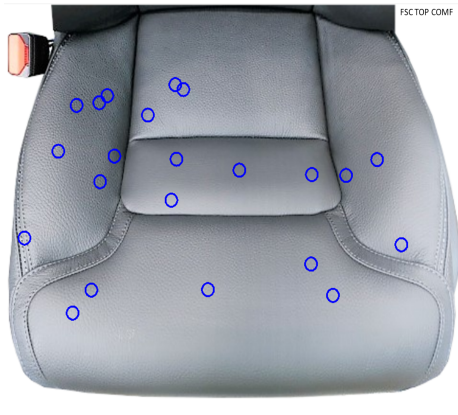
Picture 3

4: Damage to bolsters outer side



Picture 4

## 5: Damage to the cushion:



Picture 5

## 1.5 Specification of issue under investigation

Questions that will be investigated throughout this project are:

- Are there similar quality errors that occur multiple times on a daily basis?
- How can these quality errors be prevented in the future?
- Is there a technical solution to gain a higher quality without compromising the factory process?
- Is there any malfunctioning in the factory equipment that makes errors occur more frequently

## 2. Theory

In this chapter there will be a walkthrough about the different types of seats this group will encounter when working on this project and this type of quality work. But also the different characteristics of leather and wool seats, what qualities they have compared to each other in general will be walked through to get a deeper understanding for the project.

### 2.1 Types of seats

To meet the customer's demands, Adient has several trim options that Volvo customers can choose from. Since the car seat trim is one of the first details a customer notices, there are strict requirements on how it should look. Below are the trim variants used in Adient:

#### **LEATHER MORITZ:**

General information:

- Variants produced from Leather and Vinyl combination
- Bigger ergonomic effort due to lather point of view
- 3 variants of Front seat cushion



**Picture 6&7:** Showing Leather Moritz trim

#### **LEATHERETTE ARIANNE**

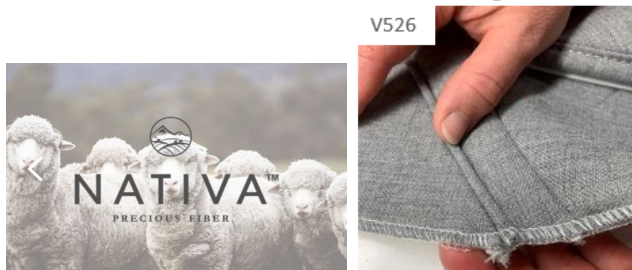
General information:

- Variant produced from Leather (few parts) and two Vinyls combination
- Difficult sewing based on ergonomic effort because of VINYL ARIANNE SUPERIOR (toughness)
- COMFORT SE

## TAILORED WOOL BLEND

General information:

- Variants produced only from FABRIC material
- FONIO NATIVA material with certified wool
- Surrounding overlock due to material fraying
- SPORT SEATS

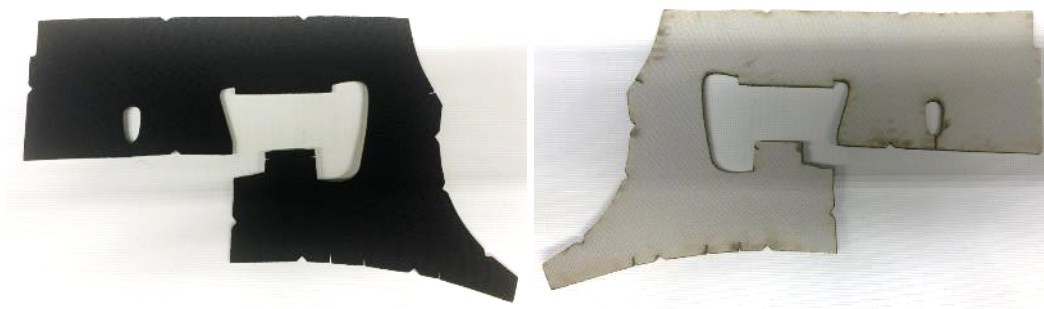


**Picture 8&9:** Showing Tailored Wool Blend trim

## TEXTILE

General information:

- Variants produced only from FABRIC material
- Laser cut technology due to material fraying – SPORTS UNI

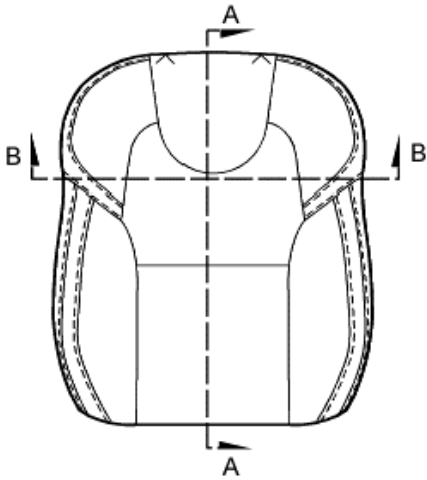


**Picture 10&11:** Showing Textile trim

## TEXTILE/VINYL – ONLY V54X

General information:

- Variant produced from Leather, Vinyl and FABRIC combination
- Mostly used for comfort seats

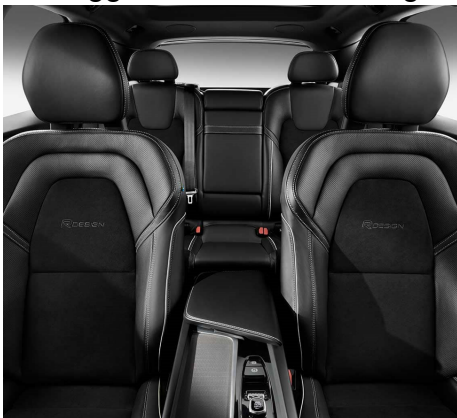


**Picture 12:** Showing Textile/Vinyl trim

## R-DESIGN LEATHER

General information:

- Variants produced from Leather and few Vinyl parts combination
- Bigger ergonomic effort due to leather point of view
- Used for sport seats
- Bigger duration of sewing due to design, chamfers, design seams.



**Picture 13:** Showing R-Design Leather trim

## R-DESIGN LEATHER/TEXTILE

General information:

- Variants produced from Leather, Vinyl and OPEN GRID combination
- Leather piping only on Front sea

## **2.2 The problem with dressing seats**

The general problem that rises with dressing seats is often how the material will adapt to the foam and how well it stretches in the process without getting wrinkles.

Many companies do not want to share their exact standards procedures for their process and makes it harder to find information about exact standards but from what is understood by talking to the quality personnel in the company the most important aspects are that they have quality material to begin with so that the company can utilize that to make a high quality product.

## **3 Methodology**

An extensive body of research on lean production and its fundamental methodology, as well as a variety of tools and methods for analyzing producing systems, putting improvements into place, and identifying root causes, are needed to be able to respond to the study's questions. Additionally, having a foundation in organizational psychology is crucial because motivation and forces at play inside organizations affect employees' desire to pursue high-quality work.

All these methods that are mentioned in this chapter is an important part of production to understand and basic knowledge that the company uses on a daily basis to its production.

### **3.1 8D method**

The method that is used for this project is called Adient standard 8D problem solving method. 8D stands for 8 disciplines that need to be complied with. The 8D method is a commonly used method in the car industry to solve problems and its root causes. The first step of this project is to scope and make plans, but also to know the condition of the project before starting. After this step is done and the plans are clear on how big the project is you form a team which in this case is Shaniar Ali and Lass Abdelkarim.

The next step in the 8D is to define the problem which is done by gathering data given from the company and see where the actual root causes are and where in the process they can be found. In addition to looking at data available, one needs to go in the process and verify the data given and check if it is correct because in some cases an operator reports a problem that is not the correct place for that particular problem. The quality error may be in another area but is reported the wrong way because insufficient tools.

The next step in the 8D process is to identify root causes to why the problem started in the first place and to evaluate with the help of five why's or for example a fishbone diagram. Then it is time for the last steps of the process, which is what solutions should be implemented and choose the right solution so the company can save money and these kinds of problems do not appear again.

A step-by-step procedure called TOPS 8D (team-oriented problem-solving-eight-discipline) can be used to validate that an improvement is long-lasting and to swiftly protect against developing difficulties. According to Krajnc (2012), "Ford Motor Company" created 8D, which is made up of the following 8 principles: 8

D1: Work as a team: Describe the composition of the team that will work to solve the issue. To complement one another and work efficiently, the team members should be knowledgeable about the system and the product.

D2: Write the issue down: Specify the nature of the issue. Verify the source of the issue by speaking to those involved in the product/process. To clarify the issue, you can also speak with internal or external customers. Additionally, it is crucial to examine statistics on problem frequency, cost, and severity. To estimate the scope of the issue, statistics on problem frequency, cost, and other factors must be considered.

D3: Put temporary containment measures into action and confirm them: Make and put into action a plan to separate the issue from the client before it is fixed. To assess the efficacy of the procedure, it is critical to gauge how well the problem has been defined through the delineation process.

D4: Identify and confirm the root cause(s): Identify and confirm the issue's underlying cause. Read the root cause analysis portion in section 2.3.

D5 Pick and confirm PCAs (Permanent Corrective Actions): Choose the PCA that addresses the issue the best. The chosen PCA must be reevaluated and confirmed to have a beneficial effect.

D6: Execute PCA: The phase-out of the temporary solution must occur concurrently with the implementation and evaluation of the permanent solution. The index used to describe the issue in D2 can be used to assess how well the problem was solved. The system and document that regulate the procedure must be changed in order to normalize the change.

D7: Prevent recurrence: Review the long-term solution to identify areas for improvement and important support services that must be preserved.

D8: Congratulate the team by rewarding their accomplishments, such as with extracurricular activities.

## **3.2 5 why**

The 5-why method is a popular approach for identifying root issues. Inside Toyota's structure, the approach was concretized, and it has since spread as an easy-to-understand approach to problem-solving. The procedure starts with the inquiry "why" in a problematic circumstance during a chat with a system expert. There will be reasons found, and for each argument that is presented, you take note of it and reexamine why. The cycle keeps going until what appears to be a clearly identified root cause is discovered. (2005) (Liker & Meier). It's not necessary to use precisely five reasons while using 5-Why. Occasionally a primary cause is discovered before or after providing five different answers. Moreover, the identical query can be answered in the analysis in Questions and answers can be answered in a variety of ways, which allows for the identification of numerous underlying reasons. It is advised that you pick the factors that are significant to you in order to carry on the improvement process. The rotor elements must be isolated and handled independently in order to be handled as effectively as feasible. The improvement work chapter describes the problem-solving procedure that can be used to address the isolated root cause. (2005) (Liker & Meier)

## **3.3 Ishikawa Diagram**

A fishbone diagram or ishikawa diagram is used to identify the root cause of a problem and this is a common tool used by many companies in the industry to help identify and find problems. The structure diagram is structured like a fish skeleton and thus got the name fishbone diagram. This is good brainstorming at the beginning of a project to get an overview of how many main problems there are and to start the problem solving process.

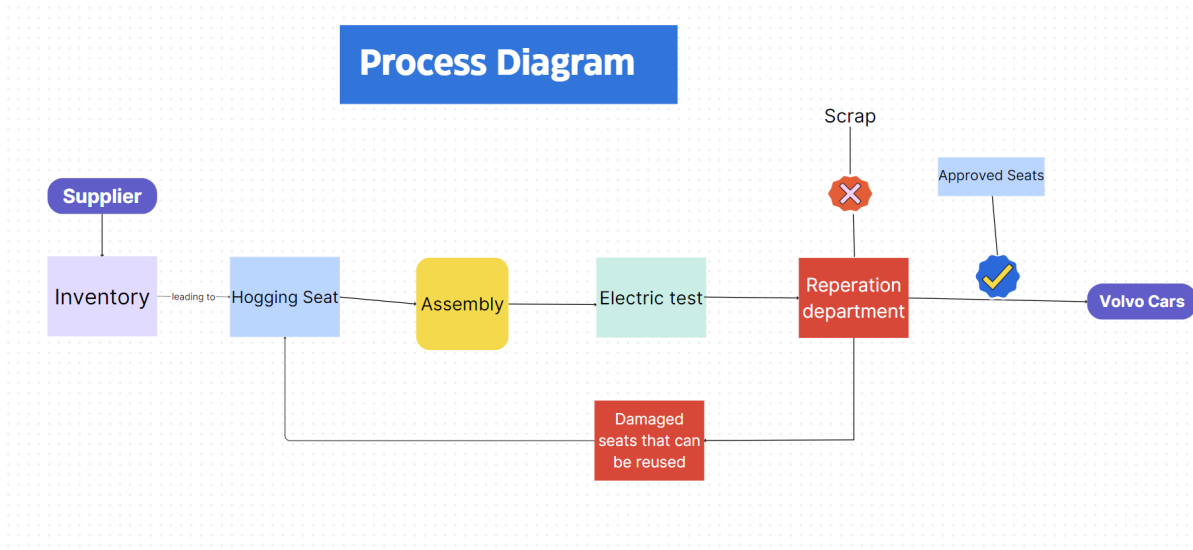
Work is usually done from right to left on this diagram. This can be started by drawing a line in the middle and from there you form branches with main problems and small sub-problems can be included on these main problems that go down to the line that finally comes to the head which is the root cause of all these problems.

## **4 Data Collection and different methods**

### **4.1 Walkaround in the factory and current state**

The project started with a tour around the factory, specifically around the different departments and the assembly stations that were relevant to this project. The department that was the most relevant was the front seat assembly lines that manufactures front seats. When the trim arrives in the factory it first lands in the kitting department of the factory. A truck driver separates the trims by where in the factory they will be sent to. This project's aim was to find and reduce quality errors in the front line assembly which consists of a couple of assembly lines. Front seat trims arrive in the front seat line where they are matched with seat foam and assembled together by the operators. When the seats have been assembled they are sent to the control/reparation assembly line. There they are being checked by control operators to detect any quality errors before being shipped to Volvo. Some of the assembly stations in the front seat department are pretty new and there have been a couple of new assembly tools introduced in this department recently. These tools require a new work method, operators must receive an education to be able to operate the tools.

Below is a flow chart diagram of the process:



**Picture 14:** Showing process diagram of the front seat assembly line

When the seat trim arrives from the supplier, it arrives in the company inventory. Then the trim has been sorted, it is delivered by truck to the front seat assembly line together with the set foam. Operators hog together the trim with the foam using a nail gun. When the trims have been nailed it is sent to be assembled together by another operator. The finished seat is then assembled together with the cushion of the car seat and then sent to the reparation department for quality checks and control. Seats that are cleared for shipment are sent directly to Volvo. Seats that did not pass the quality checks are handled in two different ways.

- If the quality errors can not be reminded, the seat trim is scrapped
- If the quality error can be fixed, it gets handled by the reparation operators and then sent back to the production line to be assembled again.

## **4.2 Collecting different data**

A majority of the data used in this project have been collected from a program that the company is using called Qfit. Qfit is a program that records every quality error that has occurred over the past couple of years. These errors can be found by the team leaders on the assembly lines or by the control operators in the reparation department .When quality errors are found, the team leaders in charge put in the data into Qfit that day and time. Assembly stations that produce the most quality errors were identified and closely looked at. About an hour was spent standing by each of these assembly stations to document the available tools and the operator working. Each assembly station has its own work instruction which the operator must follow. A review was made on each of the stations to ensure if the operators really were following the work instructions to the full.

## **4.3 Interviews with Quality engineers and people in the factory**

Our supervisor in Adient was able to identify the specialists that should be spoken with for this assignment. Every interview was conducted in the Adient factory in Torslanda without being recorded. The interviews were one-on-one because the goal was to have a personal interaction with the person and learn precisely what he or she knows and has on their minds in order to gather as much information as possible from these particular individuals.

## **4.4 Investigate different leads at the factory**

In this process the most important thing is to investigate the different leads that are gotten from talking to people working on the line but also from the people working in the office. During this job the objective was to follow different leads and to see if that particular lead was in fact the right path. This is a very hard step because you can follow a certain lead for a longer period to find out it was not the right path when later on talking to quality engineers and checking the data in Qfit.

## **5 Results and findings**

### **5.1 Finding the root cause**

The most important aspect in the scope was to find the D4 step as mentioned before in the chapter about theory and the 8D method. This step was to find the root cause of the quality issues with the front seats of the line but when investigating using the qfit program it is sometimes hard to see the real data and quality personnel suggested that we should check the scrap box that is available in the reparation department at the end of the line to what actually happened to the seats.

When going through the box of scraps one day at the factory over 30 pieces of trim were checked and it was noted that almost 50 % of these were burnt. The trim Leather that was burnt was all in the same area so the attention was turned to why this leather burns so easily.

We can see some of the findings that were made in the but deeping on what leather it is it may burn more easily than other leather sortiment.

### **5.2 Investigating the root cause**

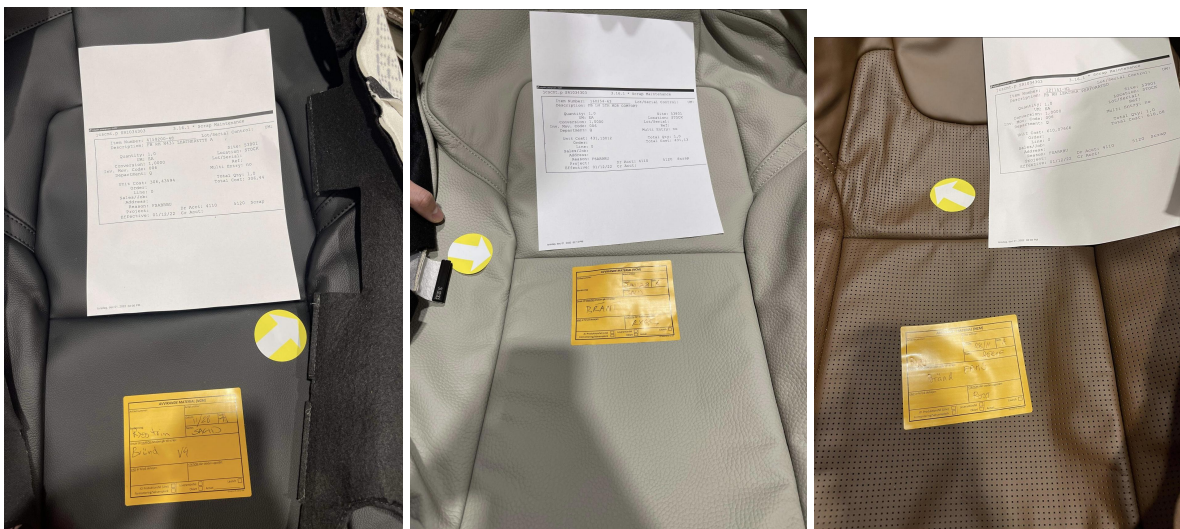
The root cause of burnt seats comes originally from the hogging station at the beginning of the assembly line. The hogging station is a crucial assembly station to maintain a good quality. The operator hogs the trim together with the back lumbar. There is a work instruction in place for the operator to follow. An inspection was made at the hogging stations to see if the operators followed the work protocol.

Some operators as noticed did not follow the work instruction. Operators sometimes tend to lose focus or get distracted by other operators and it led to that the protocol was not always followed. Deviations often follow further down the assembly line when the car seat is not probably hogged together. The seat trim gets moved on the assembly line with wrinkles that the assembly operators have to deal with.

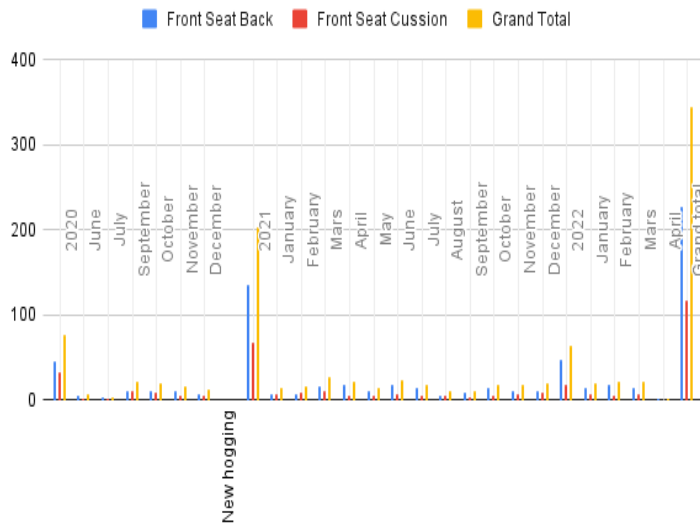
### 5.3 Correlating with data

When the car seats come further down the assembly line with deviations such as wrinkles, the assembly operators have to use a heat gun to eliminate the wrinkles. The heat gun is a very tricky equipment that takes training before using it. If the heat gun is held too far from the seat there will be no effect at all, if the heat gun on the contrary is held too close to the seat, it will burn it. The heat gun must be held at a medium range and the operators have to vibrate it for the best effect. It was discovered that some of the operators never got a heat gun training before being placed at the assembly line, and sometimes the team leader was occupied with other tasks so the assembly operators tended to burn the car seat and send it down the line without informing their supervisor. It could be that the operators want to avoid scolding.

Occasionally damaged trim can either be reused in production or be scrapped depending on the level of severity. The majority of times the burning damages can not be repaired in the factory and have to be scrapped. Down below are some examples of burnt seats that come from the effect of the heat gun.



Picture 15&16&17: Showing Damaged trim



**Picture 18:** Showing diagram of deviations from June 2020 - April 2022

The table above shows data of the number of burnt seats in the production line from June 2020 to April 2022. As seen in the graph, the quality level became much worse in 2021 and 2022 compared to 2020. This can be because of many causing factors. One of the causing factors is that a new hogging fixture was introduced in production at the end of 2020. This new fixture was slightly bent compared to the previous one. A new equipment in production can be difficult for operators to deal with if they were comfortable with the previous in.

## 6. Discussion

Results from the research questions posted are discussed and evaluated in Chapter 6 in relation to the findings in Chapter 5.

## **6.1 Evaluating the process and method that was used**

The 8D methodology is an organized and systematic process that helps the Adient company in solving problems in a well organized structure. This helps to make sure that no steps or details of the problem are missed and that the solution is understandable. The 8D method is a standardized problem-solving methodology that assists this project in supporting a high standard for the quality department.

For the 8D methodology to really find the root cause issues, the problem must be thoroughly investigated. By finding and removing the root causes, the group and company can prevent the problem from happening again in the future.

Better quality, by making the most out of the 8D methodology, the company can improve product quality by eliminating issues and preventing future problems from arising. This can result in stronger marketing and better customer service and also the 8D methodology can assist the company in increasing their value adding time by enhancing the production process and eliminating waste.

When using the 8D methodology, the company can learn from the mistakes that happened and make sure that they do not happen again in the future. This can also result in a continuous improvement culture within the company. By removing issues and improving product quality, businesses can also reduce costs for quality products and marketing.

## **6.2 Obstacles along the way with the quality work and method**

The 8D method is used to recognize, correct, and advance persistent issues. Even while this method has many benefits, there are also some potential drawbacks that need to be addressed.

Time-consuming: An 8D analysis process can be time-consuming and requires participation from multiple people. In order to concentrate on the issue that has to be solved, it may also be necessary to put on hold work on other projects. For a group that is new to these kinds of works the learning curve may take longer so it was important to take the time to learn it properly.

Complexity: The 8D methodology can be extremely complex, and it requires that the people managing the process have knowledge of and experience with the tools used to identify problems, analyze data, and develop solutions.

But also obstacles that came along the way for the project was to learn how to communicate with team leaders in a proper way without putting pressure on them.

### **6.3 Advice for future work within these projects**

A great advice for future work within these projects would be that collection of data is the most important aspect of them all. The mistakes that were made in the beginning of our project was that there was no data collection, only observation. Changes are made with the help of collected data, without it it is difficult to improve in an assembly factory.

Also advice for the company is to try to monitor the stations randomly once in a while just to collect some real data so you can compare with the data that you have on Qfit, so that these types of error may not happen or decrease by time.

### **6.4 What savings and profits the company makes when the problem is gone**

Exact data can not be shared in this report because of the company policy and the sensitivity of these data. After discussions with the company's management and quality engineers, applying this method will save the company millions that would otherwise have been spent on correcting deviations and training personnel.

## 7. Conclusions

*Chapter 7 presents conclusions of this study on waste of scrap and process interruptions on the Adient front seat assembly process*

The aim of the study was to eliminate waste of scrap and process interruptions on the Adient front seat assembly process. This was done with the methodology presented in chapter 3. The research group presented their conclusions of the project to the boss of the company and it was discussed which actions they could implement if the company wanted to improve the quality with actions.

Answering the research questions:

***Are there similar quality errors that occur multiple times on a daily basis?***

Yes, there are multiple errors that occur on a daily basis, but not all of them make it all the way to the reparations department. In many cases, the deviations are fixed using the heat gun by the operator/team leader.

***How can these quality errors be prevented in the future?***

It is of course impossible to prevent all production errors in the future but there are methods to heavily minimize quality errors when it comes to wrinkles on the car seat.

One improvement method could be that The team leader once a month gathers the working team and goes through the work instructions for the hogging stations so that the operators are always well informed and remember them clearly. The human factor has a big part to play when it comes to deviations in production. The team leader can maybe even show how the work is done on one or two seats in these meetings, in this way the operators can implement these methods on a daily basis on these workstations.

Another method to minimize these types of errors in the future that was also discussed with management was to have a focus station where the workers each have their own focus station that they are responsible for. This can motivate the

worker to minimize quality errors and involve the worker more and he or she feels more part of the quality development in the factory.

***Is there a technical solution to gain a higher quality without compromising the factory process?***

There is necessarily no technical solution to implement to reduce quality errors, but there are ways to reduce human error. Human error is the most frequent reason for quality errors in the factory. According to the studies done in this report, the deviations that accrue in production is from the operators. The operators every once in a while have tendencies to deviate from the work instructions, for example using the heat gun that requires a courtin type of precision and knowledge.

***Is there any malfunctioning in the factory equipment that makes errors occur more frequently***

There is no malfunctioning factory equipment that leads to quality errors. There have been equipment that have broken down or were in the way of production causing quality malfunctions, but these equipment have quickly been fixed by the engineering team in the factory. It is common that operators use some of the factory equipment in a wrong way that leads to errors, but the equipment itself is not malfunctioning. The operator errors can depend on lack of training or lack of concentration.

**Sources:**

[1] Liker, J., & Liker, M. (2005). The Toyota Way Fieldbook. Häftad. Engelska. McGraw-Hill Education.

[2] Krajnc, M. (2012). With 8D method to excellent quality. Revija Za Univerzalno Odlicnost, 118- 129.

[3] Lean Manufacturing Tools. (n.d.). Retrieved Mars 15, 2023, from <https://leanmanufacturingtools.org/>

**Pictures:**



**Picture 1: Damage around the headrest**



**Picture 2: Damage to the back of seat**



**Picture 3: Damage to the bolsters inner side**



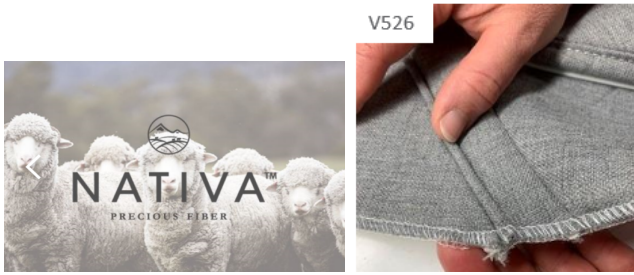
**Picture 4:** Damage to bolsters outer side



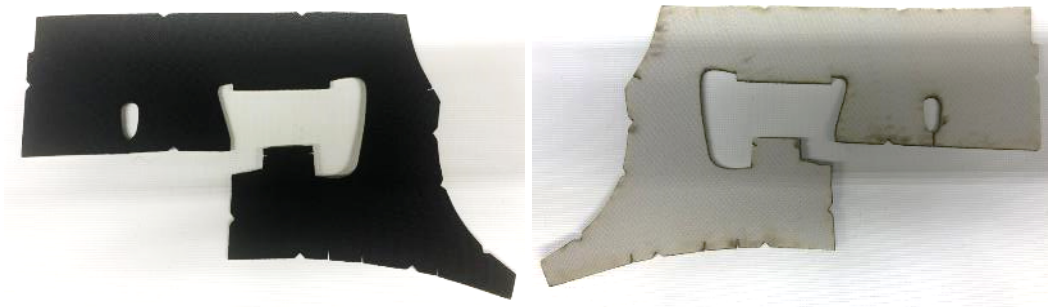
**Picture 5:** Damage to the cushion:



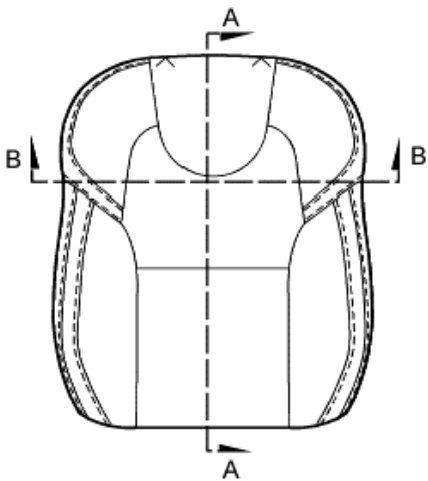
**Picture 6&7:** Showing Leather Moritz trim



**Picture 8&9:** Showing Tailored Wool Blend trim



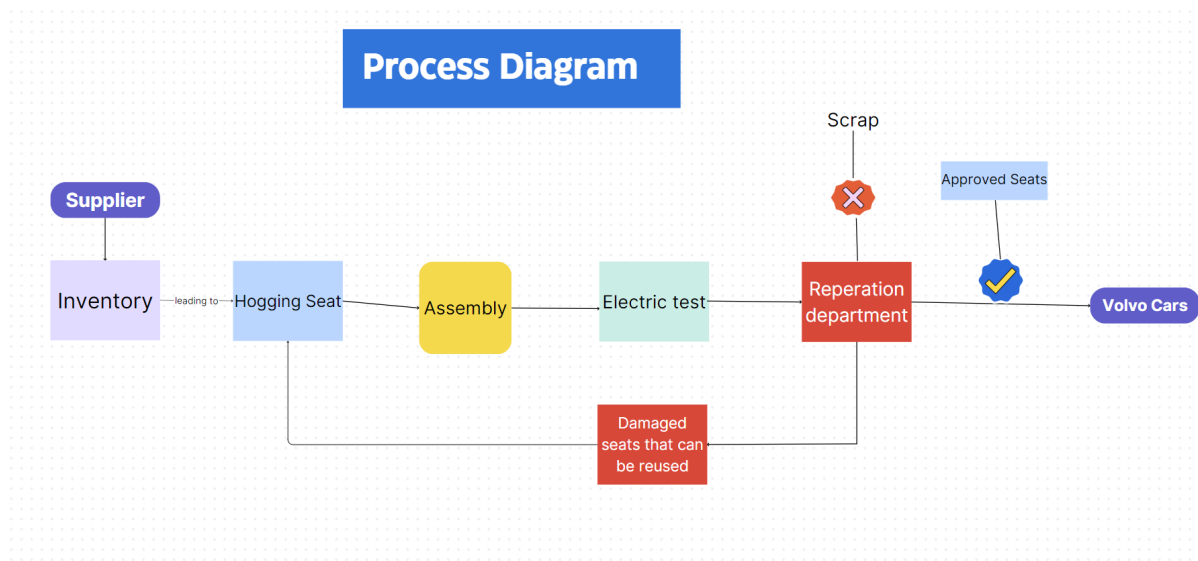
**Picture 10&11:** Showing Textile trim



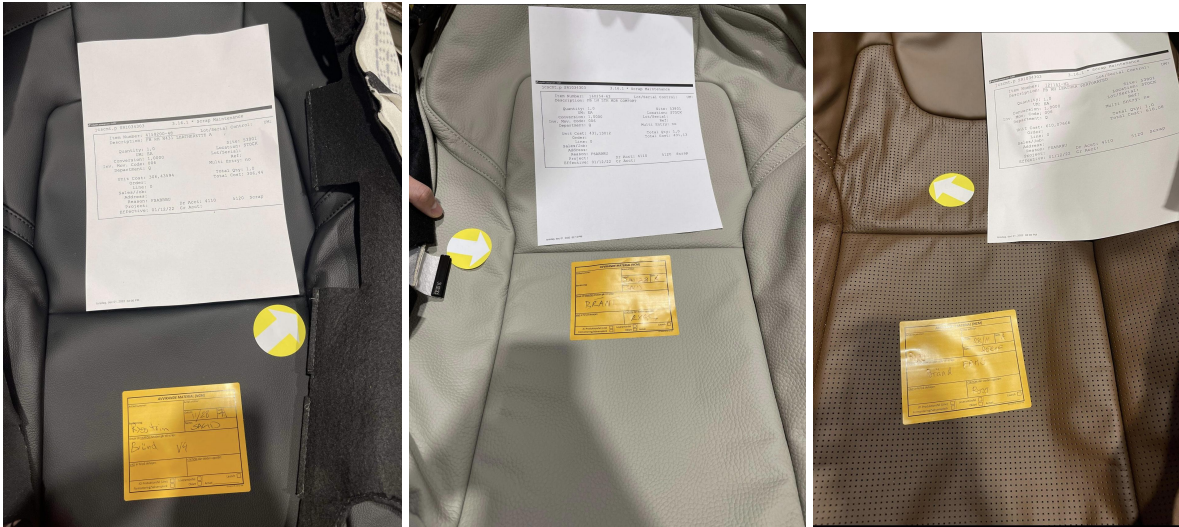
**Picture 12:** Showing Textile/Vinyl



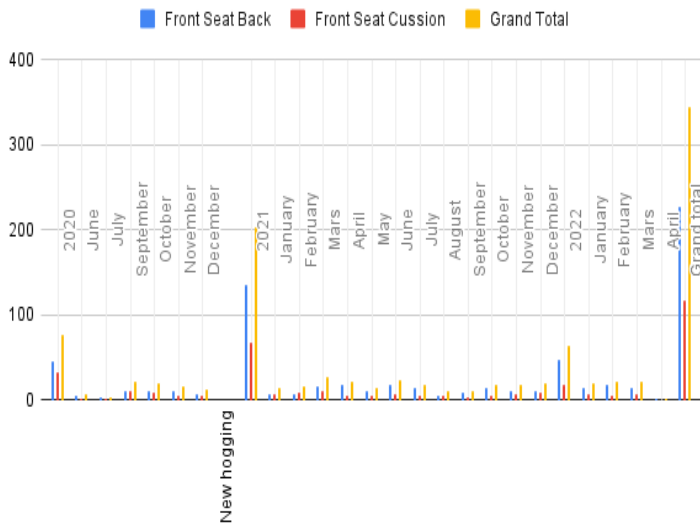
Picture 13: Showing R-Design Leather trim



Picture 14: Showing process diagram of the front seat assembly line



Picture 15&16&17: Showing Damaged trim



Picture 18: Showing diagram of deviations from June 2020 - April 2022