SPAR-ring with a broken system

Graduation assignment focusing on redesigning the SPAR process for MTEE and its suppliers

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Preface

Before getting into the graduation process and assignment, I would like to take a moment to preface this report by thanking those who've helped me to complete this assignment.

First of all, I would like to thank everyone from the Purchase, Quality and Engineering departments who have given me a lot of useful information and just generally made me feel like I was an equal, and not just a student doing a project.

In particular, I would like to thank my company supervisor, Paul Soetens, for his helpful attitude towards me, without actually telling me what to do. I was free to do whatever my research required, and because of that I was able to show that I could work well on my own, and for that I am thankful.

I also want to thank my school supervisor, Henk Reijntjes, for providing me with useful feedback on my products and process.

Because of everyone involved, I was able to complete my assignment, but moreover I was able to have fun and feel like I was no longer a student, but a working professional.

Now that I've thanked everyone I wanted to thank, I will start my actual report on the next page.

Summary

The student executed his graduation assigment at Mitsubishi Turbocharger and Engine Europe B.V. (MTEE) within the Purchase department and more specifically the SQDE (Supplier Quality Development Engineering) team. This team is responsible for all matters related to suppliers, and with one of those matters there is a problem: SPAR (Sample Part Acceptance Report).

SPAR is documentation used to show MTEE that the sample parts (prototypes) the supplier delivers are of the required quality, so that they can be used for testing. However, the problem MTEE is having, is that SPAR is rarely ever done and in those cases where it is done, the quality of the supplied documentation is not as MTEE requires it. Therefore MTEE has asked the student to (re)design the SPAR procedure, so that it fulfills all demands and is feasible to perform within the supply chain.

In order to do this the student performed his research in two ways: deskresearch and fieldresearch. For the deskresearch, the student analysed all available data and found that in 85% of all cases SPAR is indeed never even sent. The reasons for this were examined by means of fieldresearch, more specifically interviews. The student interviewed several people from the Purchase, Engineering and Quality departments in order to get a complete picture of the entire process. From these interviews, the following could be concluded:

1. The requirements are not always clear or too steep for suppliers
2. No-one feels responsible to check the documentation
3. No-one follows up with suppliers

In those interviews, a future state was also examined. As a future state, it was defined that SPAR should always be done whenever MTEE requests it, requirements are always being met and that everything is checked within MTEE to see if it is up to par, after which suppliers will be informed. From this future state, it is clear that there is a GAP to close. In order to close the GAP, the student determined the following had to be done:

- There needs to be more clarity about SPAR contents for suppliers
- There needs to be more clarity about the SPAR process within MTEE

In order to do this, the student did the following:

- Design a standard form that is both clear and easy to use
- Design a process flowchart to indicate what steps need to be taken and who is responsible
- Design a new document to track all the changes to SPAR as well as inform employees of the new situation

After designing those items, the student discussed it with all parties involved one more time, to ensure what he had come up with was what they had in mind. And all agreed that the newly designed situation is a big improvement over the current one. All that is left, is to initiate a trial period during which the new situation will be tested.

After the trial period, the student recommends regularly examining the procedure to see if it is still functional. As situations can change, that also means the systems have to change with them to accommodate the changes.

Table of contents

List of abbreviations

In alphabetical order, the following abbreviations are used:

CSR	-	Customer Specific Requirement
OEM	-	Original Equipment Manufacturer
MHI	-	Mitsubishi Heavy Industries
MHIET	-	Mitsubishi Heavy Industries Engine and Turbocharger
MTEE	-	Mitsubishi Turbocharger and Engine Europe B.V.
PMP	-	Project Management Plan
PPAP	-	Production Part Approval Process
PQE	-	Project Quality Engineering
SPAP	-	Sample Parts Acceptance Procedure
SPAR	-	Sample Parts Acceptance Report
SQDE	-	Supplier Quality Development Engineering

List of figures and tables

List of figures

List of tables

1 Introduction

Before before going into detail on what was done, first an explanation will be given on what the student was meant to do. Therefore, a short introduction will be given to the student's assignment, as well as some general information about the company where the student executed this assignment.

1.1 Assignment

1.1.1 Background

Customer Specific Requirements (CSRs) are unique for each OEM (Original Equipment Manufacturer) and every OEM has their own requirements when receiving sample parts, also called prototypes. One commonality OEMs have is related to the demand of having quality confirmation papers sent along with the shipment of each physical sample turbocharger.

OEMs need these papers because of:

- Traceability in case of validation issues
- Capability studies using sample parts
- Ability to select most suitable parts for validation tests (e.g. min/max parts)

As a result, the supply base of Mitsubishi Turbocharger and Engine Europe B.V. (MTEE) is also requested to send a report that informs MTEE about the quality of each provided part, along with the delivery of the physical components themselves. The process of sending those documents is referred to as the Sample Parts Acceptance Report (SPAR) process.

1.1.2 SPAR

Before going into detail about the problem and the assignment, first an introduction to the subject will be given: SPAR. SPAR is used to prove that the suppliers' sample parts are of the required quality. SPAR can consist of a number of smaller reports, for example a complete measurement report of all critical dimensions. But it can also contain information like the chemical composition or the mechanical properties. There are a lot of topics, which will not all be listed here, as they are not relevant at this time. They can all be summarised as "product characteristics".

The SPAR-process, as it is also called later on in this document, concerns the process of compiling, sending and reviewing the documentation. The compiling and sending is done by the supplier and the reviewing by MTEE. This SPAR-process is a part of the larger SPAP-process. This is the Sample Parts Acceptance Procedure. This SPAP is a lot bigger, as it also contains re-measuring the parts and dealing with possible deviations. SPAR is only a small part of that, which precedes a lot of the SPAP. SPAP will not be considered for this assignment, as was established in the Project Management Plan.

Now that SPAR has been explained, the problem definition will be examined.

1.1.3 Problem description

The SPAR process as it is currently being used at MTEE is not functional, and not effective: oftentimes, suppliers do not send the SPAR documents to MTEE or in cases where it is being sent, the quality of the documents is below the required level. This in turn leaves the engineers in the dark: they do not know which parts they can use for testing, since they do not know how these parts perform. For example, it makes a lot of difference if the sample part is more towards the upper tolerances or towards the lower ones. Since the required documentation that is used to explain how the parts perform is not being sent, it can lead to some time-intensive problems if the sample parts are not good. If the parts are good, often it does not lead to problems, but also no-one is doing any follow-ups with suppliers.

1.1.4 Assignment

The student is tasked to (re)design an effective SPAR procedure that is:

- Fulfilling the minimum demands of MTEE and OEMs
- Feasible for the supply chain
- Easy to control by the SQDE department in MTEE

1.2 Company information

In order to better establish an image of the student's assignment, it is also important to understand where the assignment took place. Therefore, a short section of this report will be dedicated to some general information of MTEE and in what department the student did his assignment.

1.2.1 MTEE

MTEE, which is a subsidiary of MHIET (which in turn is a subsidiary of MHI), is one of the larger turbocharger manufacturers in Europe for passenger cars. They make turbochargers for most of the larger car manufacturers in Europe, for example BMW and Volkswagen, but also more exclusive brands, like McLaren. Every year, around 3.5 million turbochargers leave the assembly lines, which results in a market share of almost 20% in the European market. This puts them on more or less the same level as their biggest competitors like BorgWarner, Garrett (Honeywell) and IHI.

In the figure on the next page, the organization chart of the organization is given to give the reader an impression of the size of MTEE. In all of the departments combined, a total of nearly 900 employees with over 40 different nationalities make sure the factory keeps running.

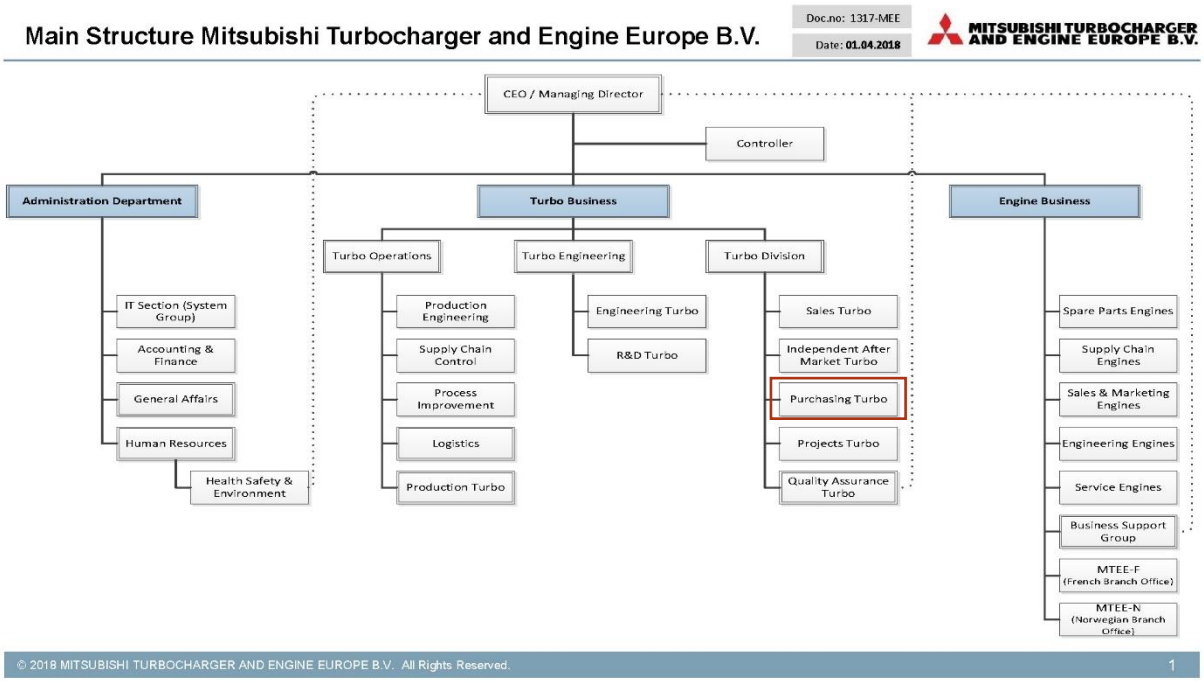


Figure 1: MTEE organisation structure (MTEE, sd)

1.2.2 Placement of the student

The student executed his assignment within the SQDE department, which is a subgroup of Purchase (highlighted with red in the figure above). SQDE is responsible for making sure suppliers perform to meet MTEE's demands. This means they are responsible for audits, approving production parts (PPAP) and helping suppliers develop their processes and organisation when things are not up to par.

1.3 The goal of this document

This document is meant to give the reader a complete picture of the things the student did during his time at MTEE. Later on in this report, the research will be examined and explained in the order it took place, to make it a logical story for the reader.

It will start with the research setup, i.e. what the aim of this project was and how the student reached that goal. After that the research itself will be shown. Note that only the most important details that are crucial to the storyline throughout this report will be listed. Any additional information (should there be any), will be given in the appendices.

After the research, the results will be presented. Based on these results, the student has created a couple alternatives. These alternatives will also be given and then compared to eachother in order to select the best option. This best solution will then be further explained upon.

2 Research setup

Now that the reader knows the necessary background information with regards to this assignment, the student will now explain how he set up his research. In order to do that, the student will first list the goals he had to reach and the research questions he needed answered.

2.1 Goals

The main goal of this assignment, as agreed upon in the student's Project Management Plan (PMP), is:

"Before June 2020, a new standard working procedure has to be developed to guide the SPAR-process by only the required steps, ready to be used."

Of course, there are also some subgoals to accompany the main goal, which, on their own, are also very valuable to MTEE:

- Knowledge as to why the current process does not work
- Knowledge of what the absolute minimum requirements are for SPAR for OEMs, MTEE and suppliers

2.2 Research questions

In order to guide the process in the right direction, the student has listed some research questions, which can also be found in the student's PMP. The main question is as follows:

"How can a new standard working procedure be developed for the SPAR-process?"

Besides the main question, there are also some subquestions that have to be answered in order to make sure that all the necessary steps are taken to succesfully finish this assignment:

- What does the SPAR-process look like now?
    - What are the steps?
    - Who is involved?
    - Where does it go wrong?
- Why is SPAR often not done?
- Why is there sometimes no follow-up?
- What are the minimum requirements for SPAR?
    - What are requirements of MTEE's customers (OEMs)?
    - What are requirements of MTEE?
    - What are requirements of suppliers?
- What are possible options for a new process?
- What is eventually the best option?
- Is to be expected that the chosen option will work?
    - Is there a consensus about the chosen solution?
    - How can the chosen solution be implemented?

2.3 Research methods

Now that the reader knows what will be answered in this report, the student will establish how he answered those questions. This will be done by explaining the research methods used and why the student chose to do his research in this way.

2.3.1 Researching the current state

First of all, the current state had to be described. It is important for the student and MTEE to know how big the problem actually is. In order to do that, the student had been given access to a specific SPAR-mailbox and some additional information in a folder on an internal server.

To get the information the student needed, he had to analyse the data that was available to him. This was just some basic deskresearch. Since the amount and variety of data that was available was very limited, there was no possibility to perform a statistical analysis of the data, also in part due to the lack of a clear target. Therefore, the student chose to look at as much data as possible and then make a general conclusion. The data itself was not that important to the assignment anyways, since it only establishes the scale of the problem, not possible causes. Therefore, the chosen way to research this was more than sufficient.

What is important to the assignment, however, was the way people perform (or rather: not perform) SPAR. The student had to know the reasons why SPAR failed before, and to do this fieldresearch was necessary. In this case, the student chose to do interviews with the people involved. A survey could have been done as well, but the student decided not to do that. Since the amount of people involved is very limited, interviews do not take that much more time than a survey. And interviews have the additional benefit of being able to ask another question based on the answer given.

2.3.2 Establishing the future state

After the current state had been researched with some deskresearch and mostly fieldresearch, a future state had to be created. In order to do that, the student needed some input.

First of all, he needed to know what the root cause was of the current problems. He got that during the research into the current state described above. What was also needed was a list of the minimum requirements needed to effectively perform SPAR. As this list was not able to be put together through deskresearch, the student needed to go back to the people involved to see what they needed out of it. A survey would have had the same effect in this case, but was not chosen because of the same reasons as in the current state research.

With all the necessary input, the student was able to compile some options for a better process, taking into account all of the previously mentioned requirements. After compiling this list, the student had to decide which solution was best. Of course, he could not do this on his own, so he went back to all the people involved again. They helped select the best option and that solution was then further elaborated upon. After that was done, a final check with everyone involved was done.

Summarising: a lot of fieldresearch, which was to be expected when a process has to be redefined.

3 Current State analysis

Now that the reader knows how the research was executed, a summary of all the results will be given. First of all the Current State (CS) will be examined. The CS gives an accurate depiction of the current SPAR situation at MTEE, including supporting data and interviews with involved parties. Firstly, though, the SPAR process will be explained in a bit more detail than in paragraph 1.1.2.

3.1 The current SPAR situation

First of all, an overview will be given of what SPAR looks like in the current state. To make it more clear, the student has included the current SPAR form in Appendix B. When the student first started his assignment, it became clear that there was no real process in place. Therefore, this could not be analysed. The reasons for this will be given in paragraph 3.3.

3.2 Data analysis

For the data analysis, the student looked at all SPAR documents requested and received in all of 2019. These documents have to be requested by a Purchase Order (PO), along with the sample parts themselves, so any order for SPAR is logged into the system. Based on the SPAR mailbox and server-folder the student had access to, he was able to estimate in how many cases SPAR was actually submitted by the supplier. Since there are also some duplicate files and additions to files, it remains an estimation. It also was not possible for the student to look at every file to see if it is a duplicate or addition, since there are over 1,000 files and that would simply have taken too much time. As stated before, this analysis is not that important to the assignment, because MTEE already knew their SPAR-process was not functional. This analysis is just to give an impression of the scale of the problem.

Out of approximately 1300 sample part POs sent, a little over 200 SPAR documentations (of which some are still duplicates or additions to the same SPAR) were received and stored. This makes SPAR a rare occurrence, compared to the total amount of POs. 1300 may seem like a lot, but considering there are about 60 components needed for a turbocharger, it is for approximately 20 turbochargers. Although some may also be repeats of previous ones. It is unknown if some people save their SPAR documentation locally only, but if that is the case, they did not inform the student when he asked them.

So, in conclusion, it can be stated that roughly 11 out of 13 requested SPAR documentations are never sent. This amounts to around 85%. This means that in 85% of all the cases, SPAR documentation is not sent. However, because the student did not take into account all of the possible duplicates and/or additions to other SPAR files, the number is probably higher than that.

Summarising, it can be stated that the SPAR-process was, indeed, not functional. The question still remained, however, as to why so much documentation was never sent.

3.3 Root cause analysis

After identifying the magnitude of the problem (which is significant at 85%), it was important to figure out what the root cause of this problem was. As stated, the student did this by means of interviews with all the people involved. In total, the student performed 9 initial interviews: 4 with Engineering, 4 with SQDE/Purchase and 1 with PQE. Note that these are only the information-gathering interviews, there were additional conversations in later stages. In this paragraph, the student will list a summary of results he got from each of the groups. First of all, however, the used questionnaire will be discussed.

3.3.1 Questionnaire

In order to get the right information from the meetings, the student first of all drafted a questionnaire based on what he needed to know. In the meetings, the student followed these questions and was therefore able to get the desired results in an as efficient way as possible.

The questions used are as follows:

- (SQDE/Purchase only) Do your suppliers always send SPAR documents when you ask for them?
    - If no, then do you know why not? And do you follow up on this later?
    - If yes, why do you think your suppliers do, but other commodities' suppliers don't?
- Why do you need and ask for SPAR?
    - How important is this to you?
    - What do you want to get out of it?
- What do you then do with the documents?
    - Do you send them somewhere else?
        - If no, what do you do with them then?
        - If yes, where to and what do you hear back from them?
    - Do you give feedback to the supplier?
        - If no, why not?
        - If yes, both negative and positive?

Note that this was just the generic questionnaire meant to guide the meetings. Of course, in an interview, there are also some improvised questions the student came up with based on the answers given. The student asked if it was possible for him to record the meetings, so that he could listen to them again if he forgot something, but most people did not want that. Of course, the student did not mind. This just meant that he had to write down everything that was said. As a result of that, some improvised sections can be missing from the summary of results later on. The student did make sure that the most important parts were included, however.

After asking all the relevant questions and noting down the answers, the student quickly summarised with the interviewed people to confirm that what the student had written down was correct.

Now that the setup for the interviews has been discussed, the results from the interviews themselves will be listed. This will be done per group, as previously stated. First of all, SQDE/Purchase will be discussed.

3.3.2 SQDE & Purchase

Introduction

The student first of all talked with most people from the SQDE/Purchase department. This was not done coincidentally, because SQDE/Purchase are the first line of contact with suppliers. Anything to do with suppliers, goes through them. Therefore, if the student wanted to know the reason why so many SPAR documents are never sent, SQDE/Purchase was the most likely source to get good information.

There are 5 commodities within this department. These commodities are responsible for their own component types. Each commodity is therefore a bit more specialised in some areas than other commodities and vice versa.

In total, there are around 60 components per turbocharger, which are spread out over the commodities. Rapid Protos is an exception to this rule, because they deal with all components necessary to make a prototype really quickly. Also, since there are 60 components, not all are listed, since this is mostly unnecessary information. Some examples are given to give an impression, though.

The commodities are as follows:

- Rapid Protos: these are prototypes that have to be done quickly and seamlessly
- Actuation & Electronics: example components are actuators or electronic bypass valves
- Aluminum: example parts are the compressor covers, basically anything aluminum casted
- Iron & Steel: examples are the turbine housings and exhausts
- Stamping & Forging: these are the smaller components like nuts and bolt

Now that the reader has an idea of how SQDE is built up, a summary of the interviews will be given. The full summaries of the individual commodities can be found in Appendix A.

Summary

The summary of the interview results from SQDE and Purchase is as follows:

- Aside from Rapid Protos, SPAR is often not done and almost never explicitly requested (a few times over the past years), even though it is always listed on the PO as a requirement. This is why most of the commodities have stopped asking for SPAR, since nothing is done with it anyways, unless there is something wrong with the parts
- Some commodities indicated that the requirements for SPAR are not always realistic for suppliers in such an early stage, hinting at a “SPAR Lite” to make it easier for suppliers to compile, while still fulfilling the minimum requirements of MTEE
- They also stated that the requirements are also not always clear to suppliers
- Most commodities indicated that SPAR is important: it is needed to prove to MTEE that the supplier’s parts are of the required quality for testing and it also informs MTEE of the current quality levels
- Some have mentioned that there should be a check to see if SPAR documentation is present and complete before there are problems, which could be done by SQDE when the documentation is sent to MTEE

Now that SQDE and Purchase have been discussed, the student will continue with Engineering.

3.3.3 Engineering

Introduction

After discussing SPAR with Purchase, the student moved on to Engineering to discuss it with them. The reason for that being that Engineering is responsible for the testing of the parts and thus needs to know if they are of the required quality or not.

In order to get some reliable information from Engineering, the student sat down with the individual Team-leaders of the department at the recommendation of the Purchase commodities, as they usually have the most experience and have been in the company the longest.

The student also looked at information from the Sample Shop, a subgroup of Engineering that is responsible for assembling the prototype turbochargers for testing. They are the first ones that know if a part is not correct, because it will not fit or perform up to standard.

Now that a short introduction has been given to Engineering, the student will list the summary of the results from the interviews. The entirety of the results can be found in Appendix A.

Summary

The summary of the interview results from Engineering is as follows:

- In most cases, SPAR is not even looked at; only in the cases where there is something wrong with the parts do they, sometimes, need the documentation
- When, in those cases, there is no documentation, it can cause a lot of delays
- They agreed that there should be a check to see if the documentation is present and complete, as stated by SQDE & Purchase
- When there is some documentation, it usually is not of the best quality
- They were also confused by the lay-out and contents of the SPAR form as it is currently being used, mentioning that this could be the cause of confusion at suppliers, leading to sub-par documentation
- No-one knew there was a SPAR-mailbox, they always get their documentation directly from Purchase (for Rapid Protos at least). When they do not get any, they also do not follow up on it, because they usually forget as well. It is not routine to check for SPAR documentation, that is usually only done by the inspectors when they notice it is not there
- They also agreed that the requirements could be narrowed down further, as they only need to know if the parts comply with the specifications and dimensions on drawings. If, for example, there is some discoloration, that is not a deal-breaker if the parts are good to use
- Lastly, they believe Engineering is not that important to the setup of the process itself. They do benefit from SPAR in the sense that they know the parts are good to use or not, but they do not care what the process looks like, only that their requirements are met. They believe Quality should be responsible for designing the process right, since they have to follow up with suppliers anyways.

3.3.4 PQE

Introduction

PQE (Project Quality Engineering) is a part of the Quality department and is responsible for guaranteeing quality towards customers (OEMs). They also make sure the quality of certain supplied parts is OK, namely for the cartridge. As the cartridge is mostly manufactured at MTEE itself, this was interesting to discuss. This way the student could see if the internal suppliers behave the same as external ones or if they behave differently. This is the main reason why the student interviewed PQE.

The student sat down with the Team-leader of the PQE team, as the team itself is not that big (8 people) and this person had the most experience with and knowledge of SPAR.

Summary

The following is a summary of the interview with PQE, the complete report can be found in Appendix A.

- They experience the same situations as SQDE/Purchase:
    - No-one is/feels responsible to check it
    - No-one follows up with suppliers
    - Documentation is almost never sent
    - If it is, the quality is often not good
- They also agreed with Engineering that the process itself is mostly meant for Quality, while the results are more important to Engineering
- All that PQE needs to know from SPAR is:
    - G-levels of the cartridge (input for an NVH – Noise, Vibration, Harshness – analysis)
    - A visual check to see if there are any inconsitencies
    - Dimensional results
- They also stated that the timeline for suppliers has to be re-evaluated: sometimes there is no time to do a SPAR with all the requirements. It is therefore important that the requirements are clear and only ask the minimum of suppliers, as sample parts are usually rushed and needed quickly. Any delays caused by missing or insufficient documents are therefore considered extremely unwanted. They also think it could be possible to re-assess when SPAR is supposed to be sent to MTEE, in order to make sure it is where it needs to be on time.
- They also believe the ownership of the process should be changed. Officially, the responsibility lies with Quality, but they believe Purchase should take this over, considering Purchase is the first line of contact with suppliers, even with PQE related suppliers. After all, a PO (Purchase Order) still has to be created by Purchase for the sample parts.

3.4 Conclusion

Now that the data has been analysed and both SQDE/Purchase and Engineering have been discussed, the student will draw a conclusion from all the summaries. Note that the conclusion is also based on the full interviews, which can be found in Appendix A. In the past paragraphs, the following research questions were answered:

- What does the SPAR-process look like now?
    - What are the steps?
    - Who is involved?
    - Where does it go wrong?
- Why is SPAR often not done?
- Why is there sometimes no follow-up?

The answers to these questions, which can be found in the previous paragraphs, as well as results found in the data analysis, has led to the following conclusions.

From the data analysis, the student can conclude that SPAR in its current form is not effective, as it is simply not being used in 85% of all cases. The reason it is not being used has a number of different causes. The student estimated the importance of them in order to prioritize:

1. The requirements are not always clear or too steep for suppliers
    - This sometimes causes suppliers to not send anything at all
    - This sometimes causes suppliers to submit sub-par documentation: it is below the requested quality levels
2. No-one feels responsible to check the documentation
    - This causes the missing of the documentation to be discovered at the Sample Shop, which is too late, because they probably need it at that point. It also makes it so that follow-ups rarely happen
3. No-one follows up with suppliers
    - This causes additional confusion at suppliers as to why they are even doing it or even worse: the idea that there is nothing wrong with the way they are doing things

Now that the main causes of the problem are discovered, it is clear that there has to be a redesign of the SPAR procedure. There also clearly needs to be a change in mindset, because at the moment no-one is doing it, even though everyone states that it is, in fact, an important process. As a change in mindset is not going to happen overnight, the student is not going to focus on the mindset side of things. He will, however, make suggestions later on as to how the newly designed situation can be sustained. But first of all, the new situation has to be designed. What it should look like will be explained next.

4 Future State design

Now that the CS has been thoroughly examined, the student will present the way the Future State (FS) should look. This was done by talking to the involved parties, in order to get an idea of where they want to go with SPAR. Note that this is not yet based on the contents of SPAR, only a high-level depiction of what SPAR should be.

As the student was given an assignment, the FS was already partly clear: (re)designing a SPAR process that is functional and effective, yet fulfills all the demands of MTEE and OEMs and is easy to compile and check. This was used as the baseline for the future state. Based on what the involved parties said to the student, he was able to compile the following scenario for the FS:

"SPAR is used to indicate to MTEE that the supplier's parts are of the required quality. In order to do this, the suppliers receive a form from MTEE, stating what MTEE deems necessary and realistic to be submitted to MTEE. Based on this form, the supplier knows exactly what they need to do and can compile their documentation the way MTEE requires it. Together with sending the parts to MTEE, the supplier submits the SPAR documentation to MTEE digitally, to inform them of the quality of the parts. The supplier then also sends their parts to MTEE with the SPAR documentation, confirming that their parts meet the specifications on the drawing and comply with any other additional requirements MTEE has. Within MTEE, the SPAR documentation is checked to see if it is all there and then it is sent to Engineering and the Sample Shop for further analysis. Following the defined procedure, after the SPAR parts and documentation have been checked, the Sample Shop will inform the others of the status and those responsible will then follow-up accordingly with the supplier to let them know if everything was okay or if something still needs some more attention, now or in the future."

5 GAP-Analysis

Now that both the CS and FS are known, a GAP-analysis can be performed. A GAP-analysis is used to indicate what steps need to be taken to reach the FS from the CS, based on the differences between them. It is customary to describe this in a summarizing *"Ist-Soll"* format, which means *"Is now – Should be"*. Based on these descriptions, the necessary steps can be defined.

5.1 Ist

The SPAR process as it is currently being used at MTEE is not functional, and not effective: in well over 80% of all cases, suppliers don't send the SPAR documents to MTEE. This is not a surprise to most people: SPAR is very rarely explicitly requested, even though the POs always list it as a documentation requirement, so they stopped asking for it from suppliers. In the cases where SPAR documentation was actually submitted, the quality was sub-par. This is mostly due to unclear or unrealistic requirements and responsibilities.

5.2 Soll

The SPAR process in the future state always gets the documents when asked for. This means in 100% of all cases where they are required. The requirements are always clear to suppliers, but most of all realistic, so they can actually send high-quality documents within the set timeframe. Within MTEE, there is full clarity about responsibilities regarding SPAR. Especially with regard to the checking of the documents and the accompanying process for following up on it.

5.3 Closing the GAP

In order to close the GAP between the above situations, a number of steps is necessary:

- There needs to be more clarity about SPAR contents for suppliers
    - They should not require any explanation
    - They should be realistic to ask suppliers to compile/send
- There needs to be more clarity about the SPAR process within MTEE
    - Someone needs to be responsible to check the documentation
    - The entire process should be better defined
    - There should be some sort of follow-up and feedback loop added

Based on these requirements, the student could get to work on defining the new process and its contents. This will be discussed in the next chapter.

6 Defining solutions

The steps to reach the FS can be seperated into two distinct categories: contents and process. Based on these categories, the student came up with some alternatives, which he then compared by means of a decision matrix. This chapter will answer the following research questions:

- What are possible options for a new process?
- What is eventually the best solution?

In order to properly weigh the different solutions, the student defined some criteria. These criteria will be discussed first.

6.1 Decision criteria

The criteria the student used to weigh the solutions are based on the conversations and interviews with the involved parties, as they will be the end-users of the to-be-defined process and product. The criteria are also prioritized by means of a ranking, where 1 is the lowest ranking and 3 is the highest ranking. This ranking was done in order to make a calculation at the end, to quantify which solutions are best, relying on the highest scores. The criteria are as follows, with the accompanying ranking:

1. Completeness: does it contain all necessary information / process steps?
2. Feasibility: how feasible is it for all involved parties?
3. Effectiveness: does it provide the right information?

The ranking is based solely on logic: it is more important to get some correct information in an efficient way than getting all the wrong information in an inefficient manner. So first and foremost, the right information needs to be there. Secondly, it needs to be feasible, as samples have to be done quickly, so time is of the essence. In third place is the completeness: only after getting the right information in an efficient way is it important to get all the information in that way.

The different solutions will all be given a score of 1-5, where 1 is the lowest and 5 is the highest, based on how well they fit the criteria. The higher the score, the better they fit. For example: a 5 on effectiveness means it is assumed to be very effective. The student purposefully avoided using a scale of 1-10, even though it is more accurate, as with that scale there is a lot more vagueness when it comes to deciding if, for example, it is a 3 or a 4. Thus, a scale of 1-5 was used, as the differences between a 3 and a 4 are more clear. The scoring was done together with some of the people involved in order to get a couple different points of view and not just the student's.

Now that the criteria and scoring system are known, the different solutions will be listed, before getting into the scoring itself. Any scores that will be given have been given, as discussed, in consultation with others.

6.2 Possible solutions for the contents

First of all, the possible solutions with regards to the contents will be listed. This will be more generic, not containing specific requirements, but more examining a certain structure or type of content, based on the requirements listed in paragraph 5.3. The full detailing will be done when the best solution is chosen. A full description of each option will be given after the initial list.

The options are as follows:

1. Only asking and explaining the bare minimum by means of a tailored form
2. Using a standard format file for suppliers to use per item that is needed

6.2.1 Option 1: a tailored form

An option to fix the confusion of SPAR is to only send a form to the supplier that is based on their situations, with the requirements for that specific SPAR. This would result in only the right information and in most cases also all the necessary information, unless some requirement was still unnecessary in the end. Therefore, it scores a 5 on effectiveness and a 4 on completeness. Also, this way it is possible to assign a form to a specific part. For example: for part X, specifications Y and Z are required, but for part A specifications B and C are required. This also makes it easier to compile, resulting in a feasbility score of 5.

6.2.2 Option 2: standardized formats per item

Another option is to develop and use standardized formats for suppliers to use. For example, when X is required, MTEE sends the file for X to the supplier and the supplier fills in the requested information. This way, MTEE always gets the information they want in the way they want it from suppliers, resulting in an effectiveness score of 5 and a completeness score of 5. However, developing formats is a difficult and tedious process, as every part has different specifications. Therefore, the feasibility is estimated at a 3: once it is there, it is extremely easy to do, but it has to be set up first, which is going to take a lot of time and effort to get it right.

6.3 Possible solutions for the process

For the process, there are also several different possible options. As with the contents, these will not include full details yet, as that is not necessary for the weighing of the options. These options are once again based on the requirements in paragraph 5.3. The full detailing will follow later, after the best solution is chosen.

The options are as follows:

1. A new flowchart indicating responsibilities and process steps
2. Full, step-by-step, written instructions based on the steps to take

Additional options were not considered, based on MTEE's organisation. Within MTEE, flowcharts and instructions are the only methods used to detail processes. This is the reason why the student decided not to come up with different solutions, as the goal of the assignment is to design a feasible situation. Introducing new methods decreases the feasibility, so that was not an option.

6.3.1 Option 1: process flowchart

A new flowchart would indicate the necessary steps to take in the process and who is responsible for it. This way, a full overview of the process can be given, as well as the possibility to more easily spot where things go wrong in the future. It is also easy to compile and use, which is why feasbility is scored as a 5. If it is defined properly, the effectiveness can also be a 5, but the completeness can be no more than a 4, since there is limited room available in a flowchart to further explain steps.

6.3.2 Option 2: step-by-step instructions

Full step-by-step instructions can guide the process in a more detailed way, as everything can be explained, leaving no room for interpretation. However, this manner of guiding the process does take more time, both to compile and use, as people will always have to read large sections of text in order to understand certain steps. Therefore, on feasibility it scores a 2. The effectiveness is also a bit lower, at a 4, considering it takes time to find the right information, but it does provide the most detailed information. Which is why, for completeness, it scores a 5.

6.4 Alternative solutions

Besides improving the current situation, there is also a possiblity to remove SPAR entirely. SPAR is almost never done anyway, and MTEE is still in business, so one can wonder if SPAR is truly that important. However, everyone at MTEE did indicate that SPAR is in fact a very important piece of quality documentation, which should not be neglected as it is now. And besides that, the student was tasked to improve an existing situation, not delete it from existence. Removing SPAR in its entirety is therefore not a real option, but it had to be considered nonetheless.

6.5 Choosing the best solutions

Now that all options have been examined, it is useful to view them in a more visual way. This will be done my means of a Pugh-matrix, which is a very clear decision matrix. Putting in all the options and criteria gets the following result:

		Criteria	*Effectiveness*	*Feasibility*	*Completeness*	*Totals*
Solutions		**Weighting**	3	2	1	
Content	*Tailored form*	Score	5	5	4	
		Weighted score	15	10	4	29
	Specialized formats	Score	5	3	5	
		Weighted score	15	6	5	26
Process	*Flowchart*	Score	5	5	4	
		Weighted score	15	10	4	29
	Instructions	Score	4	2	5	
		Weighted score	12	4	5	21

Table 1: Pugh-matrix of solutions

In the above table, it can be seen that there are two solutions with the highest scores: using the tailored form for the content and the flowchart for the process. Both had a score of 29. However, the specialized formats are not far behind at 26, so it is also worth investigating the possibilities for such a solution in the future.

Note that it is entirely possible to mix-and-match the given solutions, should the client so desire. The student will make a design for what is, in his eyes, the best situation. However, the client is free to choose, should they want any other options implemented instead.

For his assignment, the student focussed on developing the chosen solutions with the highest scores:

- Tailored form
- Flowchart

7 Developing the chosen solutions

In the previous chapter, the selection was made to focus on developing a tailored form for the SPAR contents and a flowchart for the SPAR process. This chapter will show the new designs. The designs are based on a list of requirements that was compiled together with the people involved, so the student could take their requirements and requests into consideration. First of all, these new requirements will be discussed.

7.1 List of requirements for the new SPAR

Based on the conversations with the people involved, the student was able to compile a new list of requirements for SPAR. This list, although the requirements are not unexpected based on the previous chapters. will be given here to give a clear overview of what is needed, based on the MoSCoW method. This method separates the requirements into four different categories:

- *Must have*: these demands have to be met; miss one, the project fails
- *Should have*: these demands are desired, but missing them makes little difference
- *Could have*: these demands are bonuses, only when there is time for them
- *Will not have*: these demands are not relevant now, but maybe in the future

MUST HAVE	• A tailored form for each product type / commodity • A set process flow, indicating process steps and responsibilities, especially a feedback loop to suppliers
SHOULD HAVE	• Detailed explanations for suppliers on what is required
COULD HAVE	• Specialized formats for each desired item
WILL NOT HAVE	• Detailed requirements for each individual part, as there are 60 different components. In most cases, a general list of requirements per product type / commodity is sufficient, but in the future it can be beneficial to specify further details per part

Table 2: List of requirements for SPAR

In the above table, it is specified that there should be a tailored form for each product type / commodity. As each type is unique, these requirements need further elaborating, based on input from the different people involved, which was gathered by means of more conversations.

The specific requirements will be an input to design the new forms, as these requirements can be translated directly into the form. The full list of specific requirements, categorized based on product type / commodity, can be seen in table 3 on the next page, which will answer the following questions:

- What are the minimum requirements for SPAR?
    - What are requirements of MTEE's customers (OEMs)?
    - What are requirements of MTEE?
    - What are requirements of suppliers?

Product type / commodity	Requirements
Small components	• Full lay-out results for min. 5 parts • Material certificate • Process and tooling information
Compressor Cover	• Full lay-out results for min. 5 parts • Material certificate • Porosity check (incl. X-ray) • Process and tooling information
Turbine Housing	• Full lay-out results for min. 5 parts • Material certificate • Identification and traceability information • Process and tooling information
Actuator	• Full lay-out results for min. 5 parts • Functional tests based on specifications in RFQ • Process and tooling information
Cartridge	• G-level results for min. 5 parts • Full dimensional results for min. 5 parts • Visual inspection for inconsistencies

Table 3: Specific requirements for SPAR per product type

In the above table, it can be seen that there are quite a lot of similarities between the different parts and commodities, but there are also some items that are different.

7.2 The new SPAR-procedure

The student took into account all the previous requirements and designed a new process and contents for SPAR. The following is a list of changes the student made to the SPAR situation:

- Added a section “Process information” to the SPAR form – This section can be used for traceability purposes, indicating what tools and processes were used to make the parts
- Added a section “Part commodity” to the SPAR form – This section is a list of options; selecting the appropriate option determines the minimum requirements later on in the form; this is therefore the tailored section of the form
- Removed the information with regard to what was required in the section “Submission level”
- Added a section “Requirements” where all possible requirements are listed – In this section, the necessary requirements can be selected on top of the minimum requirements
- Added a reference to the “Global Supplier Manual” in the new section “Requirements” – This reference is to a manual that goes into full detail for all possible requirements
- Added a signature requirement for “Quality Engineer check” – This is to make sure the Quality Engineers check to see if all required information is there and complete
- Removed the requirement guidelines on page 2 of the form as they are now obsolete
- Added a section “Deviations guideline” on page 2 of the form – This section indicates the differences in some requirements for different commodities and situations like repeats
- Designed a new process fowchart to guide the process.

All mentioned changes will now be shown, to illustrate what exactly has changed.

7.2.1 Changes to identification parameters

Before

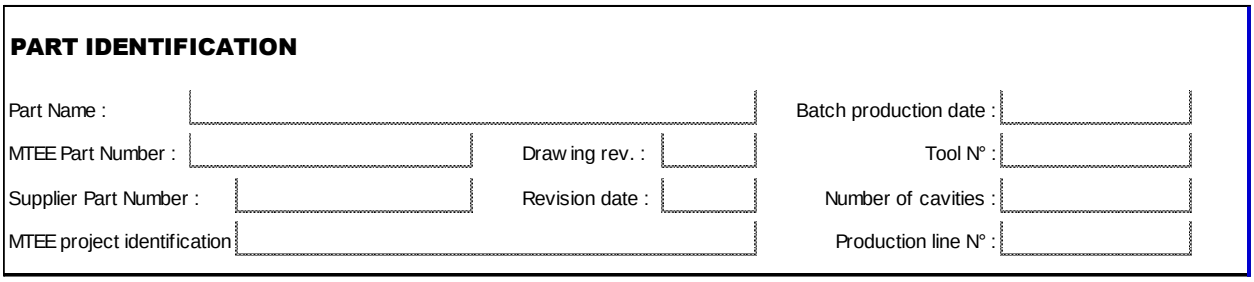


Figure 2: Original identification parameters (MTEE, 2016)

After

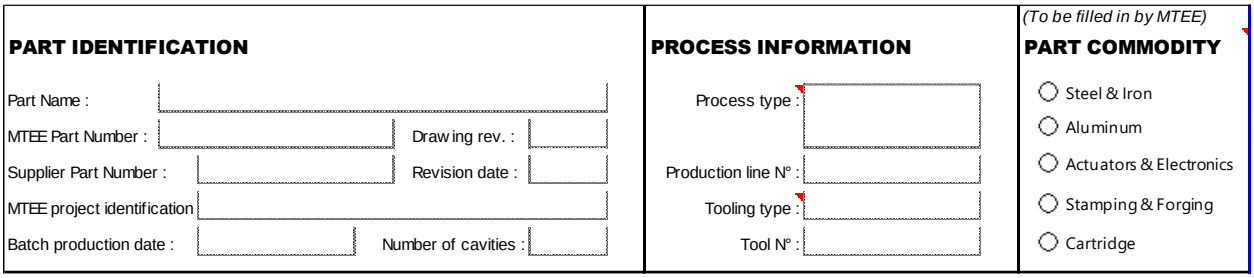


Figure 3: New identification parameters

The student added the "Part Commodity" section as a way to determine minimum requirements. Selecting the right commodity will also automatically select the right requirements.

7.2.2 Changes to requirements

Before

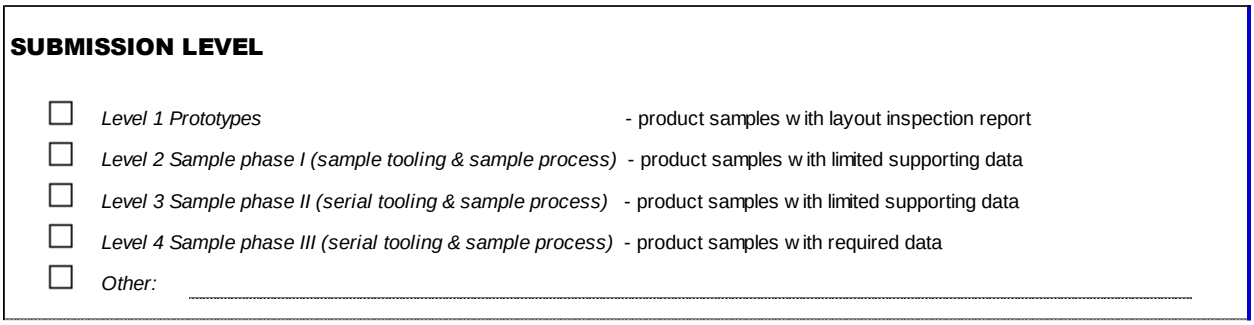


Figure 4: Original requirements (MTEE, 2016)

After

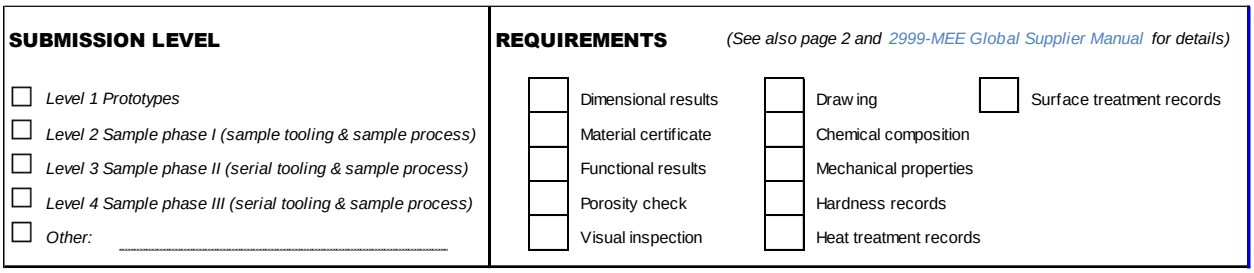


Figure 5: New requirements

As mentioned for the Part Commodity: selecting the right commodity will automatically select the right requirements in this section.

7.2.3 Changes to signatures

Before

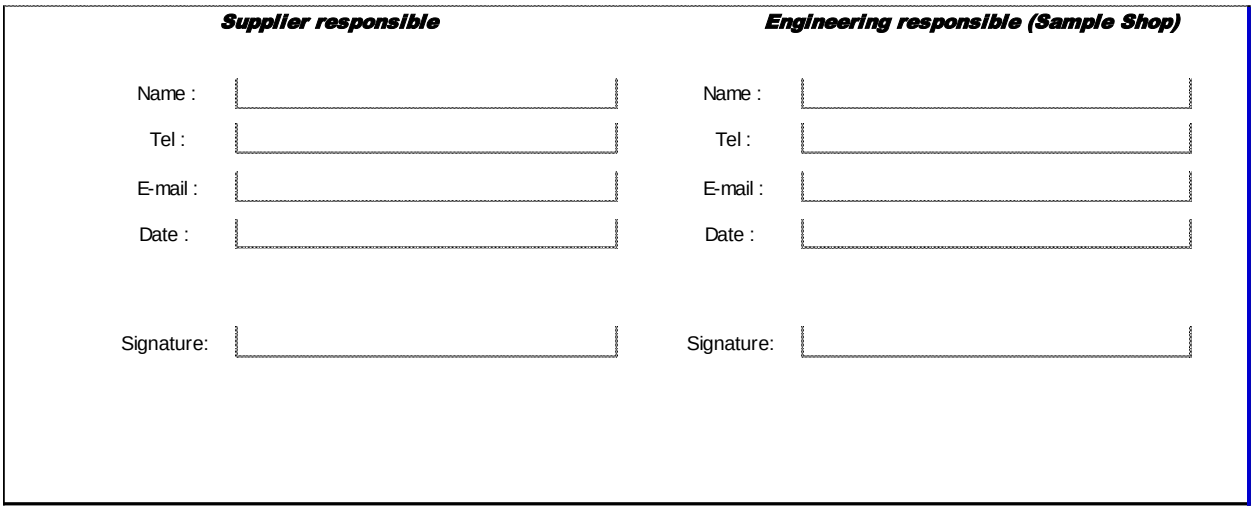


Figure 6: Original signature requirements (MTEE, 2016)

After

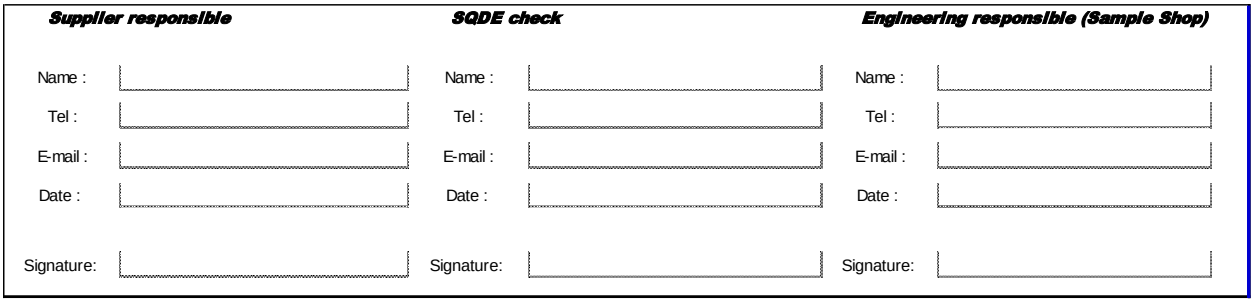


Figure 7: New signature requirements

Note that in the above figure SQDE will change to PQE whenever the Cartridge commodity is selected.

7.2.4 Changes to guidelines

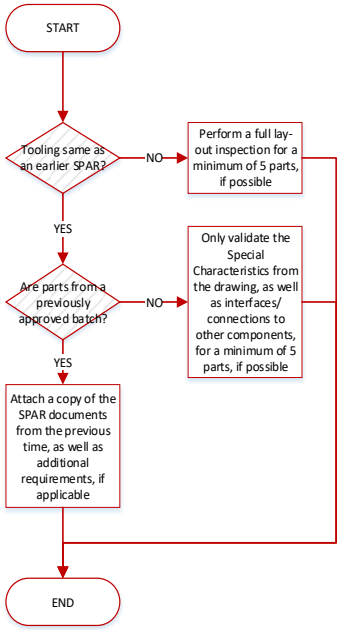
Before

Table 1: Requirements per commodity		
Commodity	Min. requirements	Additional requirements*
Steel & Iron casting and machining	Material and dimensional report	1) Visual appearance 2) Drawing 3) Full layout dimensional results for minimum 5 samples 4) Chemical composition 5) Mechanical properties 6) Hardness (if applicable) 7) Heat treatment record (if applicable) 8) Surface treatment records (if applicable) 9) Internal porosity check for casted parts (X-ray, color check etc.)
Aluminum casting and machining	Material and dimensional report	
Actuators & Electronics	Functionality and dimensional report	
Stamping/ Forging	Material and dimensional report	
Molding	Material and dimensional report	

Figure 8: Original guidelines (MTEE, 2016)

After

Dimensional results



Functional results

Part	Min. requirements*
Cartridge	• G-level results only
Actuator	• Sensor feedback in hardblock positions CW & CCW • Sensor linearity • Hardblock position in degrees CW & CCW • Input voltage • PWM duty cycle • Output torque • Response time t90 • PID or constant duty cycle • Actuator speed
Bypass valve	• Leakage over valve • Initial opening current • Fully open current • Coil resistance
All other parts**	• As agreed upon / specified

Figure 9: New guidelines

7.2.5 New SPAR process flowchart

The student designed a new flowchart for the process, that includes all the necessary steps, as well as a feedback loop to suppliers.

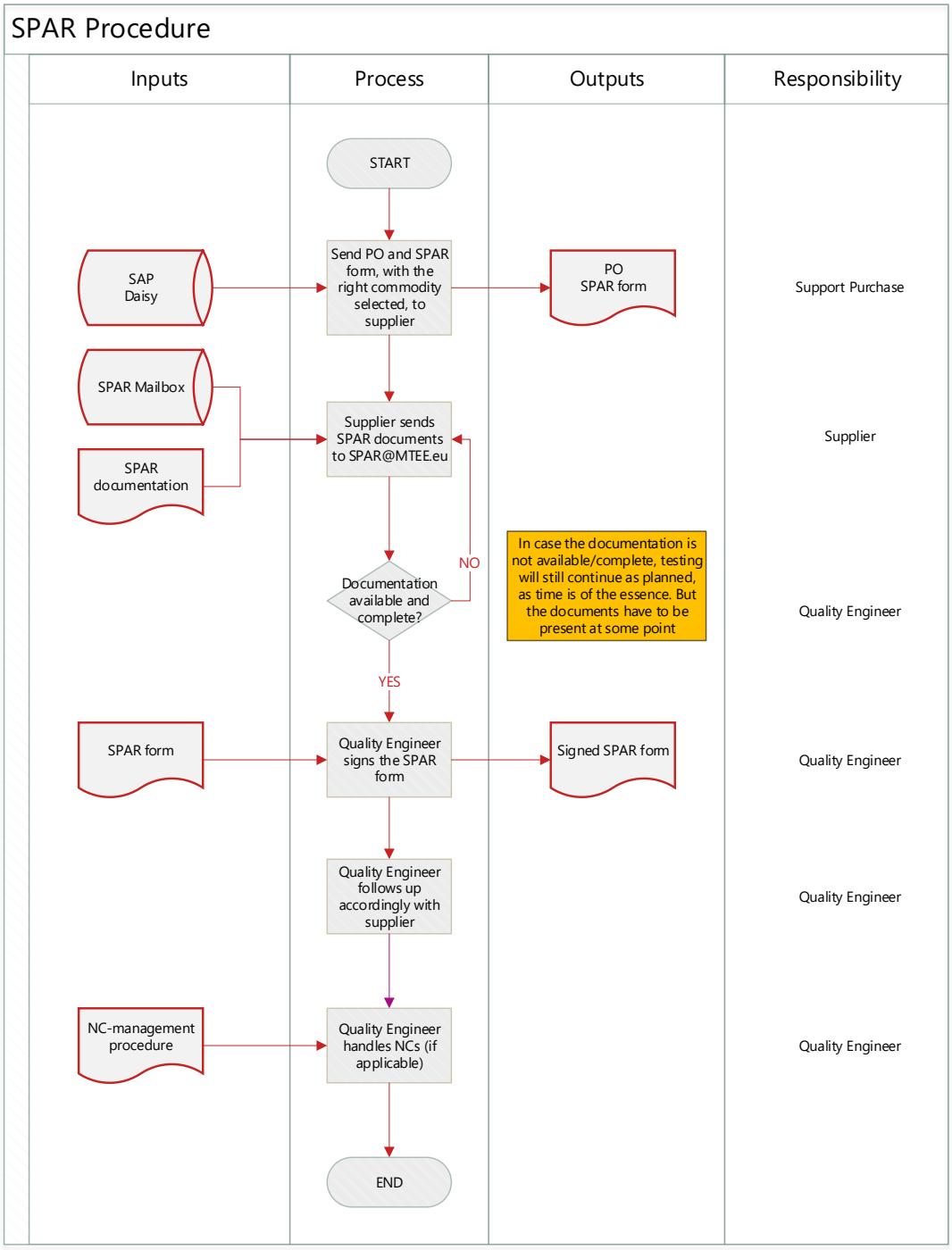


Figure 10: New SPAR process flowchart

7.2.6 New document: SPAR Guideline

The student also drafted a document that includes all the necessary information with regard to the new process, as well as instructions to get into the SPAR mailbox. This document was compiled in order to make the process official within MTEE and thus the student also used the official template for new process instructions.

This way, MTEE can choose to implement the process immediately, or make a few changes here and there to optimize it within other processes.

The full document will not be shown here, as it is too big, but can be found in Appendix D.

8 Validating the new design

Now that the new design is completed, it also had to be validated to make sure it actually achieves what it should. In order to do this, the student showed all relevant people within the organisation – the SQDE department and manager, PQE team-leader, Quality manager and Purchase manager – and discussed with them if it was what they had expected and if they thought it could work like this. This chapter will therefore answer the following questions:

- Is to be expected that the chosen option will work?
    - Is there a consensus about the chosen solution?
    - How can the chosen solution be implemented?

The feedback the student received was mostly positive: all agreed that the new form is much better than the old one, and having a document that shows how SPAR should performed from now on is really useful, as something like that did not exist before.

However, all parties agreed that there is no way to know if this will work without testing it. Which is why the student suggested using a trial period. The student suggested the following take place:

1. The suppliers will be informed about the changes to SPAR by MTEE
2. The suppliers will use the new form format for at least the first 3 SPAR deliveries
3. After these, MTEE shall ask the supplier for feedback to see if any changes need to be made
4. If the new SPAR design gets MTEE the results they need and want, then it is deemed effective. If not, then there needs to be more finetuning.

This trial period is scheduled to go into effect at a later date. It is currently unknown how long the trial period will last, as some suppliers are not working because of the COVID-19 pandemic. This is also the reason why the student can not fully validate his improved design.

9 Final recommendations

Now that a new design has been made, and testing is about to begin, the student also has some recommendations in order to sustain the new situation. These are as follows:

- Make sure everyone that needs to has access to the SPAR mailbox by using the provided instructions
- Make sure to actively follow-up with suppliers after they have sent SPAR documentation, whether it is good or bad. In order to effectively work together on this, there needs to be more communication to and from suppliers
- If suppliers still do not adhere to the SPAR requirements, it is possible to incorporate the SPAR request as a full-blown requirement on a Purchase Order, in which case the supplier will not be paid if there is no SPAR documentation available. This should only be done if all else fails, as they are drastic measures. It is, however, a way to force the supplier to do it right.
- This design is not going to be final, so if it does not work 100%, change it. The student was only able to look at the current situation to make the best design possible, but the situation constantly changes. It is therefore important to keep evaluating the systems in place to see if they still match the situation.

Bibliography

Unless otherwise stated, all figures and tables are made by the student

MTEE. (2016, December 5). *SPAR Form.* Retrieved February 10, 2020, from Intranet.

MTEE. (n.d.). *Organisation*. Retrieved February 10, 2020, from Intranet.

Appendix A: Results from interviews

SQDE & Purchase

For SQDE & Purchase, the student interviewed each of the commodities separately, so in this section they will individually be listed. This way differences can become clearer between them.

Rapid Protos

This commodity does not have any problems with SPAR. They do not even have to ask for it, their suppliers just send it to them. And when they forget, which happens seldomly, they usually send it anyways when MTEE asks for it. In those cases, they have the documents, but just forgot to send it. They think the big difference with other commodities is, that they have always requested SPAR. This way the suppliers are used to it. They do, however, still feel that not much is done with SPAR internally at MTEE, since they only occassionally get a specific request or follow-up from Engineering and the project teams. They also do not really give any feedback to the supplier, except if there is something wrong. They just see SPAR as a requirement that the supplier has to meet.

They do think that SPAR is really important. A turbocharger is not a simple product like a trash bin (their example), where a centimeter added thickness is not going to make the product fail. With turbochargers, tolerances are really small, so everything has to be as required. Which is why they think the suppliers should prove that their parts are of the required quality and thus have always asked for SPAR. Up until the point where they did not even need to ask anymore, and suppliers just sent it automatically.

Actuation & Electronics

Some suppliers send the SPAR documents when asked for, others do not. The most likely reason why they do not send it is because nothing is done with the documents at MTEE. Therefore, the commodity stopped asking for SPAR documents, except for when the measurement room found a deviation in one of the samples during testing. When something is wrong, they want to look at the documents to see what exactly is causing problems. When everything is alright, nothing is done with the documents. The documentation is important to have in some cases, because it can help you define your tests. But in other cases the documentation is less important.

Also, sometimes the requirements for suppliers are too much to handle. Some parts are really uncomplicated and therefore full dimensional reports, for example, are too much to ask for. This is also because a lot of the sample parts are made of plastic, which means they are in this case injection moulded. Measuring every part is therefore too complicated and time-consuming.

Summarising: this commodity would like the procedure to change, so that only the necessary documents are asked of suppliers, making it easier to compile for the suppliers.

Aluminum casting

Within this commodity, there are relatively few suppliers in the sample phase, so there is not a lot of SPAR documentation being sent anyways. However, when asked for it, the suppliers do send it. But the last time that the project teams asked for it, was almost a year ago, as far as they can remember.

They also stated that the current process is difficult to understand. And if it is difficult for people within MTEE, then it is certainly difficult for suppliers. The requirements are, in most cases, not entirely clear, which is why some suppliers also do not send documentation.

They also said that SQDE should at the very least check the SPAR documentation to see if everything is there. If that is not the case, they can instantly follow up on it, instead of finding out when the documents are actually needed. Also, SPAR can be important to SQDE, because it can indicate the initial quality levels and it allows for those to later be compared to newer quality levels. If the quality is really bad, then SQDE can follow-up accordingly in order to get that fixed before the PPAP phase.

Iron & Steel casting

This commodity has also stopped asking for SPAR documentation, because nothing is done with it at MTEE. In the past years, only a couple times was SPAR explicitly requested. Considering the amount of POs being sent every single year, this is an extremely small amount. It is however always listed on the PO as a documentation requirement.

They let the student know that maybe a “SPAR Lite” had to be defined, because the current SPAR requirements are too steep for most of their suppliers. Especially for sample parts, where time is of the essence. Compiling documentation for a couple days that no-one is going to use anyways is then a crucial waste of time.

SPAR can be important in some cases, for example when dealing with really crucial components, but in most cases the importance is negligible and SPAR is mostly unnecessary. Of course it does still inform MTEE about the current quality levels, which is useful to know from a development point of view.

Stamping & Forging

Within this commodity, it is basically the same as the others: when they ask for it, the suppliers do send the SPAR documents. However, there is a lot of confusion within the commodity itself as to what SPAR should actually be used for and what should be included in it. They also stated that, since they do not even know what is meant to happen, how could the suppliers know? Which is a recurring theme with all the commodities.

They firmly believe that SPAR should be redefined to match the requirements MTEE has as well as to be more clear, so that everyone understands what is asked of them. They agreed that SPAR is important to do, as it is both a matter of traceability and liability: they need to know which parts are suitable and they also need to know the parts are okay before they accept them.

They also stated that no-one checks to see if it is there, but they do agree that there should be someone who checks the SPAR documentation. Like with PPAP documents, they believe SQDE should be responsible for this.

Engineering

In the interviews, they told the student that SPAR is usually not looked at: only in case something is wrong with the parts. And in most of those cases, when they look for SPAR documentation, it is usually not there, which can cause delays in the sample process. This is because sometimes, if the problem is too severe, they need new parts. The SPAR documents could have helped in that case to transfer the costs to the supplier, as they delivered faulty parts. But, since there is no documentation indicating defects, there is no possibility of relying on the supplier's responsibility.

What stood out to the student is that none of the Team-leaders knew of the existence of the SPAR mailbox. Not that that mailbox is used very often: there are only 100 e-mails in the last year, but there were over 200 SPAR documentations accounted for. When the student asked how they received the SPAR documents then, they mentioned that they usually get them from Purchase directly. This explains the difference in SPAR numbers, as they apparently not all come in through the SPAR mailbox.

When the student asked what they thought of the SPAR form, they said that it is relatively simple. Perhaps even too simple, since nothing is explained on the form. To their understanding, this is also why some suppliers do not know what to send and end up not sending anything at all. Or, in other cases where they do send the documents, the quality of them is so bad that they are barely usable.

This was interesting to the student, as they also mentioned that their requirements are not that steep: they only need to know if the sample part complies with the dimensions and specifications listed on the drawings. That is all they need to know, because the part needs to fit and it needs to work. For example, they do not care if the part is blue or bright pink, as long as it functions alright. There are some cases where they request additional information, but this is very rare.

They also mentioned that they believe SPAR is more useful to Quality instead of Engineering. Yes, Engineering needs to know if the parts are OK, but the documentation itself is more useful to Quality, as it informs of the initial quality level. And by having this documentation, Quality can follow up accordingly with suppliers to improve this quality level if necessary. They therefore think that Engineering should not really be involved in the design of the new process, but their requirements for the documentation should be used as input.

PQE

The student also interviewed PQE: Project Quality Engineering. In the interview, they let the student know that PQE is basically only responsible for the C/R (Cartridge) component of the turbocharger with regards to SPAR. But the situation is no different: SPAR is often not done here as well. And when it is there, the quality leaves room for improvement.

This was odd to the student, as the cartridges are still produced at MTEE (this is not going to be the case later). But even for internal suppliers, SPAR is not functional. PQE thought the main reason for this is that nothing is defined. SPAR is just a requirement that is listed on the PO (Purchase Order), but there is no follow-up, because responsibilities are not properly defined. For instance, the documentation is only checked for presence, but if the parts are OK, no-one really does anything about it. The same goes for the requirements for the supplier: it is often unclear what exactly is asked of them. Basically, they had the same issues as SQDE/Purchase, so the student will not repeat those exact words again, the reader can refer to earlier on in this appendix if they want to know more.

They also stated that the ownership of SPAR needs to change: now, officially it is Quaility's responsibility, but they do not do much with it, only for the cartridge. And even then, the POs go through Purchase. So, their reasoning is that Purchase should be responsible for SPAR. Not necessarily with regards to the content, but definitely for the process.

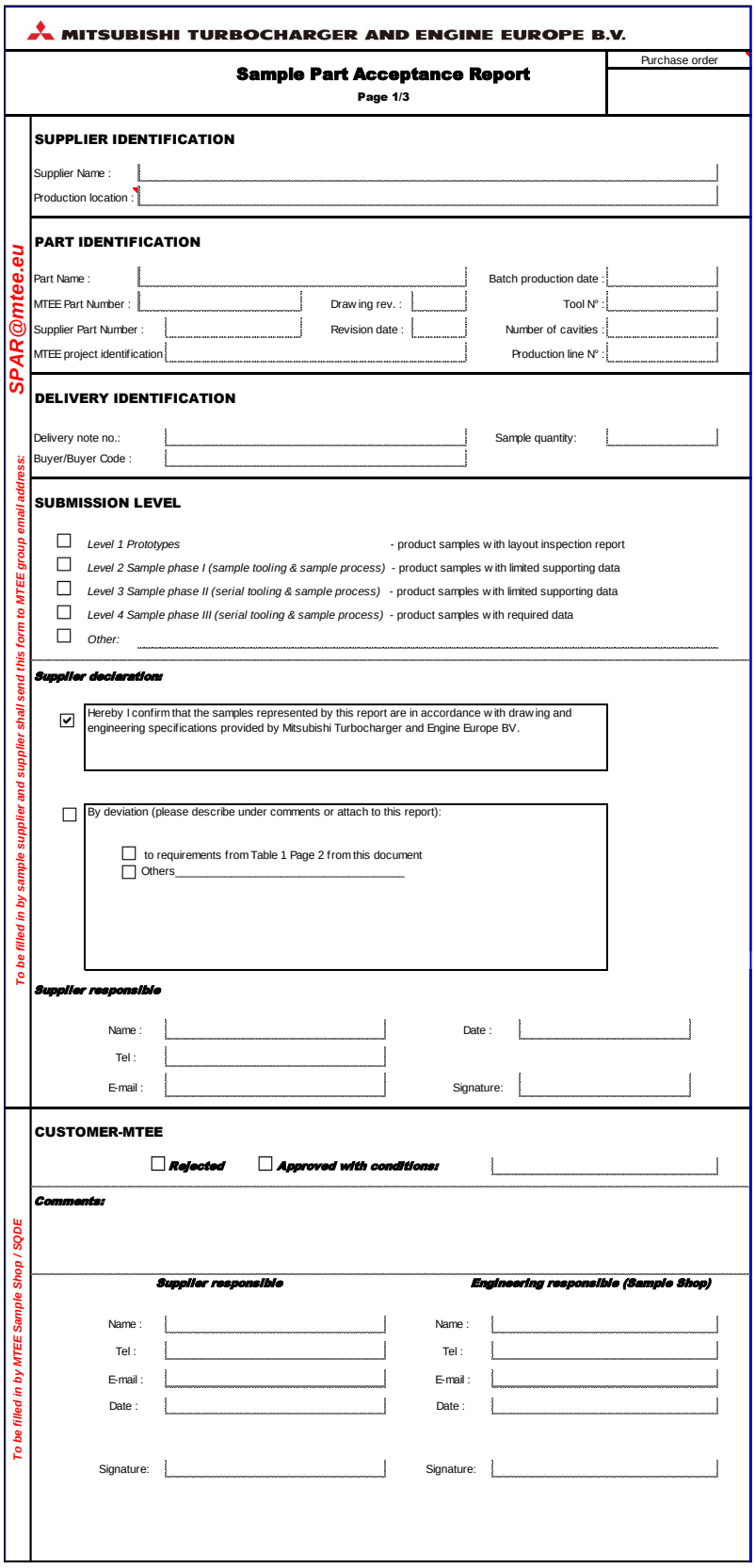
With regards to requirements, PQE does not need a lot. They only need to know what the G-levels are (this serves as input for the NVH), a visual inspection of the part to see if it is OK and some dimensional results for the wheels of the turbine and compressor, as those tolerances have to be spot on. All other requirements are exceptions and are very rarely asked for.

PQE suggested this needs to change: there should be a set structure / process flow for SPAR, indicating responsibilities and requirements. When the student suggested to maybe put the SPAR at a different moment, namely as a requirement for shipping approval, they agreed that would probably help solve the problem, since it has to be checked then, otherwise there are not going to be any parts. But they also stated that this is a more reactive solution and not a preventive one, which the student agreed with. PQE mentioned that the whole issue with SPAR is caused by MTEE themselves, because of a lack of a proper mindset. They stated that no-one really cared, even though SPAR is really important, and that that lack of caring has led to the situation MTEE is in now with regards to SPAR.

The student agreed with this, as this is exactly what he had concluded from the other interviews as well, but also let them know that changing a mindset is not going to happen overnight. So there may be a need for reactive solutions first, whilst working on preventive ones, just to get SPAR a bit more into the routine of the people. PQE agreed with this and let the student know they were excited to see what he would come up with for the Future State.

Appendix B: Current SPAR Form

Page 1:



MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Sample Part Acceptance Report

Page 1/3

Purchase order

SPAR@mtee.eu

To be filled in by sample supplier and supplier shall send this form to MTEE group email address:

SUPPLIER IDENTIFICATION

Supplier Name :

Production location :

PART IDENTIFICATION

Part Name :

MTEE Part Number :

Drawing rev. :

Supplier Part Number :

Revision date :

MTEE project identification

Batch production date :

Tool N° :

Number of cavities :

Production line N° :

DELIVERY IDENTIFICATION

Delivery note no.:

Buyer/Buyer Code :

Sample quantity:

SUBMISSION LEVEL

☐ *Level 1 Prototypes* - product samples with layout inspection report

☐ *Level 2 Sample phase I (sample tooling & sample process)* - product samples with limited supporting data

☐ *Level 3 Sample phase II (serial tooling & sample process)* - product samples with limited supporting data

☐ *Level 4 Sample phase III (serial tooling & sample process)* - product samples with required data

☐ *Other:*

Supplier declaration:

☑ Hereby I confirm that the samples represented by this report are in accordance with drawing and engineering specifications provided by Mitsubishi Turbocharger and Engine Europe BV.

☐ By deviation (please describe under comments or attach to this report):

☐ to requirements from Table 1 Page 2 from this document

☐ Others_____

Supplier responsible

Name :

Tel :

E-mail :

Date :

Signature:

To be filled in by MTEE Sample Shop / SQDE

CUSTOMER-MTEE

☐ ***Rejected*** ☐ ***Approved with conditions:***

Comments:

Supplier responsible		***Engineering responsible (Sample Shop)***	
Name :		Name :	
Tel :		Tel :	
E-mail :		E-mail :	
Date :		Date :	
Signature:		Signature:	

Page 2:

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Sample Part Acceptance Report
Guideline

Purchase order

Page 2/3

Table 1: Requirements per commodity		
Commodity	Min. requirements	Additional requirements*
Steel & Iron casting and machining	Material and dimensional report	1) Visual appearance 2) Drawing 3) Full layout dimensional results for minimum 5 samples 4) Chemical composition 5) Mechanical properties 6) Hardness (if applicable) 7) Heat treatment record (if applicable) 8) Surface treatment records (if applicable) 9) Internal porosity check for casted parts (X-ray, color check etc.)
Aluminum casting and machining	Material and dimensional report	
Actuators & Electronics	Functionality and dimensional report	
Stamping/ Forging	Material and dimensional report	
Molding	Material and dimensional report	

*Additional requirements will be added if required by Customer.
Supplier shall submit all the documents to MTEE group email address:
SPAR@mtee.eu

Appendix C: New SPAR Form

Page 1:

MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Sample Part Acceptance Report

Page 1/3

Purchase order

Page : 1/3

To be filled in by sample supplier and supplier shall send this form to MTEEgroup email address: **SPAR@mtee.eu**

SUPPLIER IDENTIFICATION

Supplier Name :

Production location :

PART IDENTIFICATION

Part Name :

MTEE Part Number : Drawing rev. :

Supplier Part Number : Revision date :

MTEE project identification

Batch production date : Number of cavities :

PROCESS INFORMATION

Process type :

Production line N° :

Tooling type :

Tool N° :

(To be filled in by MTEE)

PART COMMODITY

- ◯ Steel & Iron
- ◯ Aluminum
- ◯ Actuators & Electronics
- ◯ Stamping & Forging
- ◯ Cartridge

DELIVERY IDENTIFICATION

Delivery note no.: Buyer/Buyer Code : Sample quantity:

SUBMISSION LEVEL

- ☐ *Level 1 Prototypes*
- ☐ *Level 2 Sample phase I (sample tooling & sample process)*
- ☐ *Level 3 Sample phase II (serial tooling & sample process)*
- ☐ *Level 4 Sample phase III (serial tooling & sample process)*
- ☐ *Other:* _____

REQUIREMENTS *(See also page 2 and 2999-MEE Global Supplier Manual for details)*

☐	Dimensional results	☐	Drawing	☐	Surface treatment records
☐	Material certificate	☐	Chemical composition		
☐	Functional results	☐	Mechanical properties		
☐	Porosity check	☐	Hardness records		
☐	Visual inspection	☐	Heat treatment records		

Supplier declaration:

☑ Hereby I confirm that the samples represented by this report are in accordance with drawing and engineering specifications provided by Mitsubishi Turbocharger and Engine Europe BV.

☐ By deviation (please describe or attach to this report):

Supplier responsible

Name : Tel : E-mail :

Date : Signature:

To be filled in by MTEE

CUSTOMER-MTEE

☐ ***Rejected*** ☐ ***Approved with conditions:***

Comments:

Supplier responsible	***SQDE check***	***Engineering responsible (Sample Shop)***
Name :	Name :	Name :
Tel :	Tel :	Tel :
E-mail :	E-mail :	E-mail :
Date :	Date :	Date :
Signature:	Signature:	Signature:

Page 2:

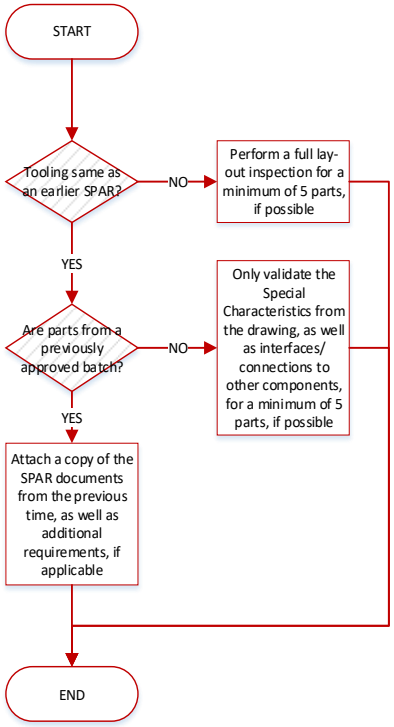
MITSUBISHI TURBOCHARGER AND ENGINE EUROPE B.V.

Sample Part Acceptance Report
Requirement deviations guidelines

Purchase order

Page : 2/3

Dimensional results



Functional results

Part	Min. requirements*
Cartridge	• G-level results only
Actuator	• Sensor feedback in hardblock positions CW & CCW • Sensor linearity • Hardblock position in degrees CW & CCW • Input voltage • PWM duty cycle • Output torque • Response time t90 • PID or constant duty cycle • Actuator speed
Bypass valve	• Leakage over valve • Initial opening current • Fully open current • Coil resistance
All other parts**	• As agreed upon / specified

For all other requirements, the supplier shall refer to document **2999-MEE Global Supplier Manual**

***Requirements apply for min. 5 parts. If the order quantity is less than 5 pcs., MTEE and supplier shall determine substitute amount.**
****For all other parts suppliers shall refer to RFQs or other agreements**

Supplier shall submit all the documents to MTEE group email address: SPAR@mtee.eu

Appendix D: New SPAR Guideline Document

1. PURPOSE

The purpose of this document is to inform all those involved with SPAR about the new guidelines concerning SPAR. SPAR is the Sample Part Acceptance Report and is used in order to validate the quality of the sample parts arriving at MTEE for use in testing. This document is meant to further detail the SPAR component of document 4057-MEE Sample Part Acceptance Procedure.

2. SCOPE

This document is applicable for the Turbo Purchasing and Turbo Quality departments

3. RESPONSIBILITIES

Department	Functions	Responsibilities (optional)
Turbo Purchasing	Support Purchase	PO and SPAR selection
Turbo Purchasing	SQDE	Checking SPAR concerning SQDE related parts
Turbo Quality	PQE	Checking SPAR concerning PQE related parts (C/R)

4. DEFINITIONS AND EXTRA INFORMATION

Daisy	MTEE Document Management System
PO	Purchase Order
PQE	Project Quality Engineering
SAP	MTEE ERP system
SPAR	Sample Part Acceptance Report
SQDE	Supplier Quality Development Engineering

5. RELATED DOCUMENTS

693-MEE	Nonconformity management, Corrective and Preventive Actions - Procedure
3811-MEE	Sample Part Acceptance Report Form
4057-MEE	Sample Part Acceptance Procedure

6. PROCEDURE FLOWS

Instructions consist of the following:

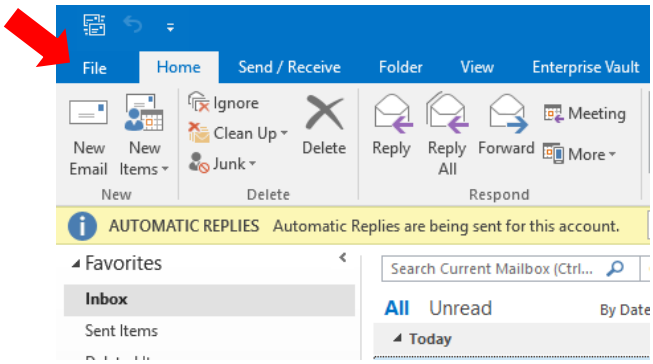
- Instructions to get acces to SPAR Mailbox
- Instructions for preparing the SPAR Form
- Process flow for SPAR

Instructions to get access to SPAR Mailbox

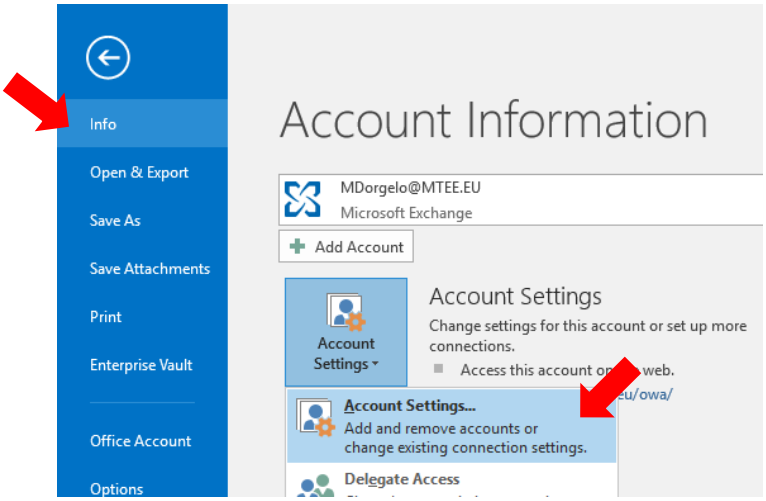
In order to fully utilize the new SPAR, access to the SPAR Mailbox is required. In order to get access to it, follow the following steps.

1. **Open Outlook**

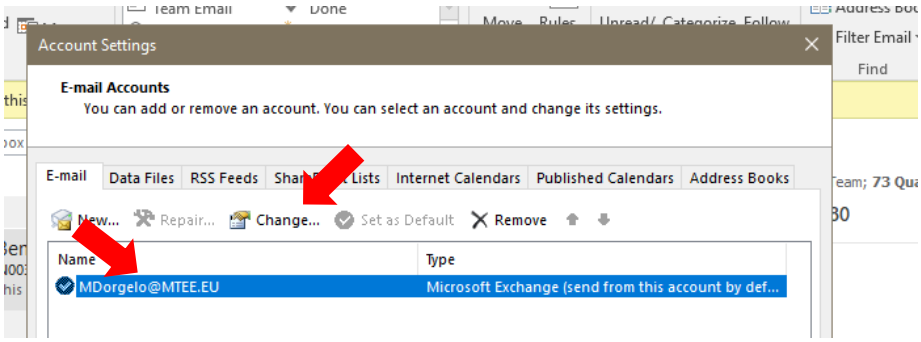
2. **In the top bar, go to “File”**



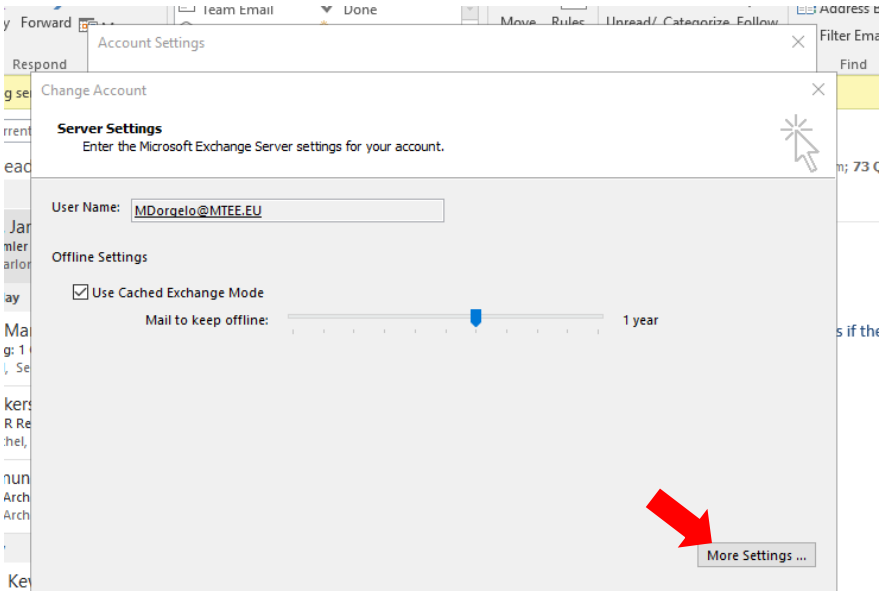
3. **On the “Info” screen, click the “Account Settings” drop down menu, then click “Account Settings”**



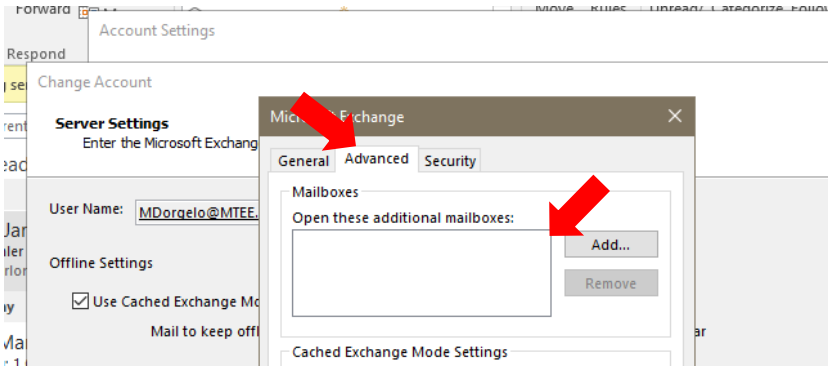
4. **In the screen that pops up, click on your e-mail address, highlighting it, then press "Change" (see next page)**



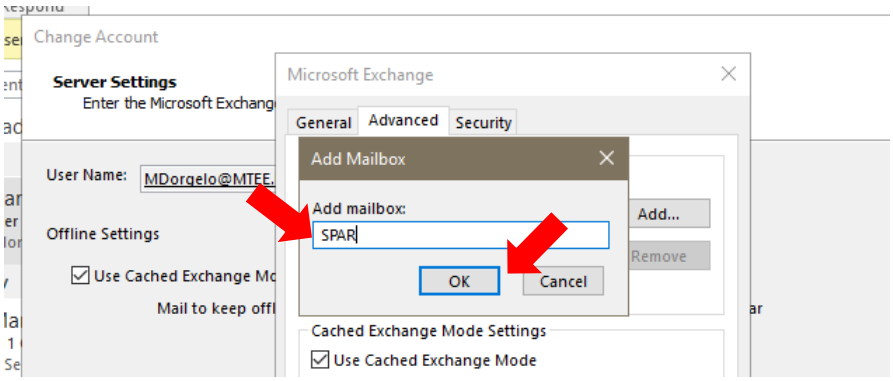
5. **In the screen that pops up, click the "More Settings …" button at the bottom right**



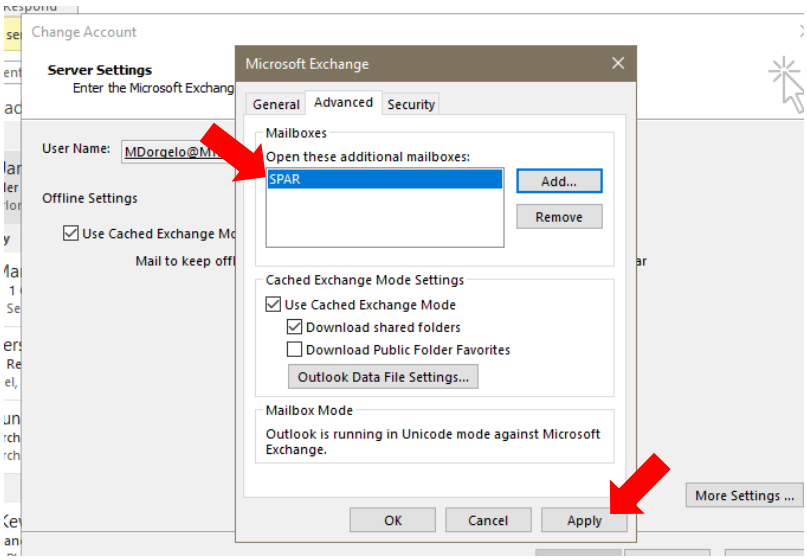
6. **In the next window, click on "Advanced" and then click "Add" under the "Mailboxes" header**



7. **In the menu that pops up, type the word “SPAR” in the textbox and click “OK”**

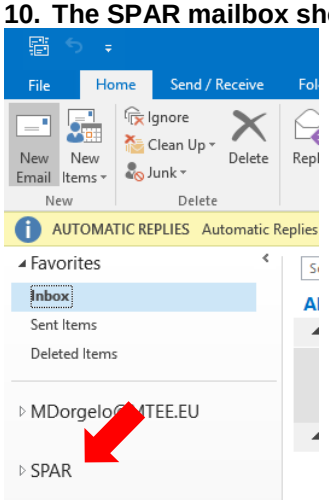


8. **SPAR should now appear in the list of mailboxes. If not, repeat steps 2-7. If SPAR is in the list, click on “Apply” at the bottom**



9. **Close all the different menus, as they are no longer needed**

10. **The SPAR mailbox should now appear in your Outlook**



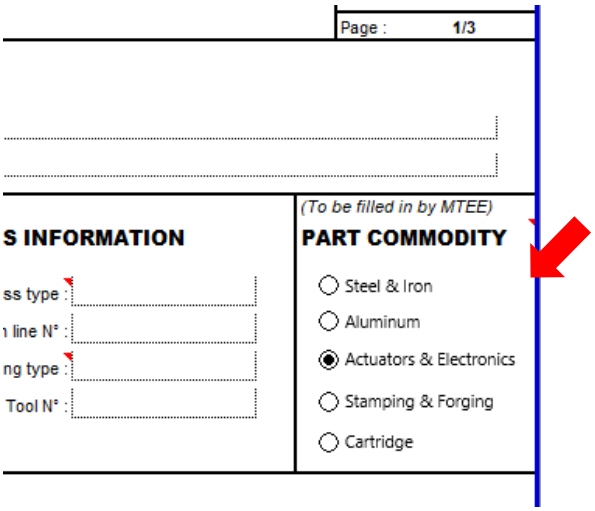
Instructions for preparing the SPAR form

In order to effectively use the SPAR form, something has to be done before it can be sent to the supplier. Follow the following instructions.

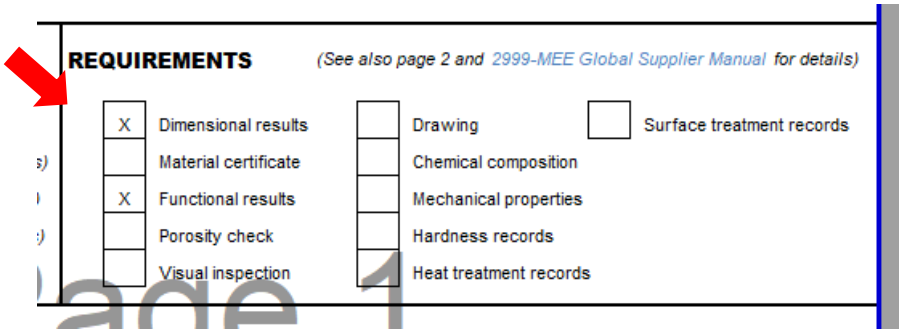
1. **Retrieve the file "3811-MTEE SPAR Form Rev 7.xslm" from Daisy and open it**

2. **If Excel prompts you to enable macros, do so, as they are required in this document**

3. **In the form, there is a section called "Part Commodity", select whichever commodity applies to the supplied part**



4. **After doing so, check if the minimum requirements have been selected automatically**



5. **If they are filled in, save the file and close it. If they are <u>not</u> filled in, close the file and open it again, making sure macros are enabled and repeat steps 3-4**

6. **The file can now be sent to the supplier**

Process flow for SPAR