# Reflective Project Report

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Lecturer: Richard Sutton

MODULE: GROUP PROJECT | MODULE CODE: ACMA5009

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## Introduction

High Precision Wales Ltd, also known as HP Wales, is a family run business. Based in Gellihirion Industrial Estate, Trefforest. Specialised in designing and manufacturing 1 Off prototypes and competent of manufacturing tools and dies.

## About Project Manager

In High Precision Wales Manmeet Singh (Project manager) is employed as CNC Programmer and Design Developer and attends the University of Wales Trinity Saint David Swansea 1 day a week to complete the bachelor's degree. In High Precision Wales he is currently working in the turning section.

# Project Introduction

## Identifying the problem

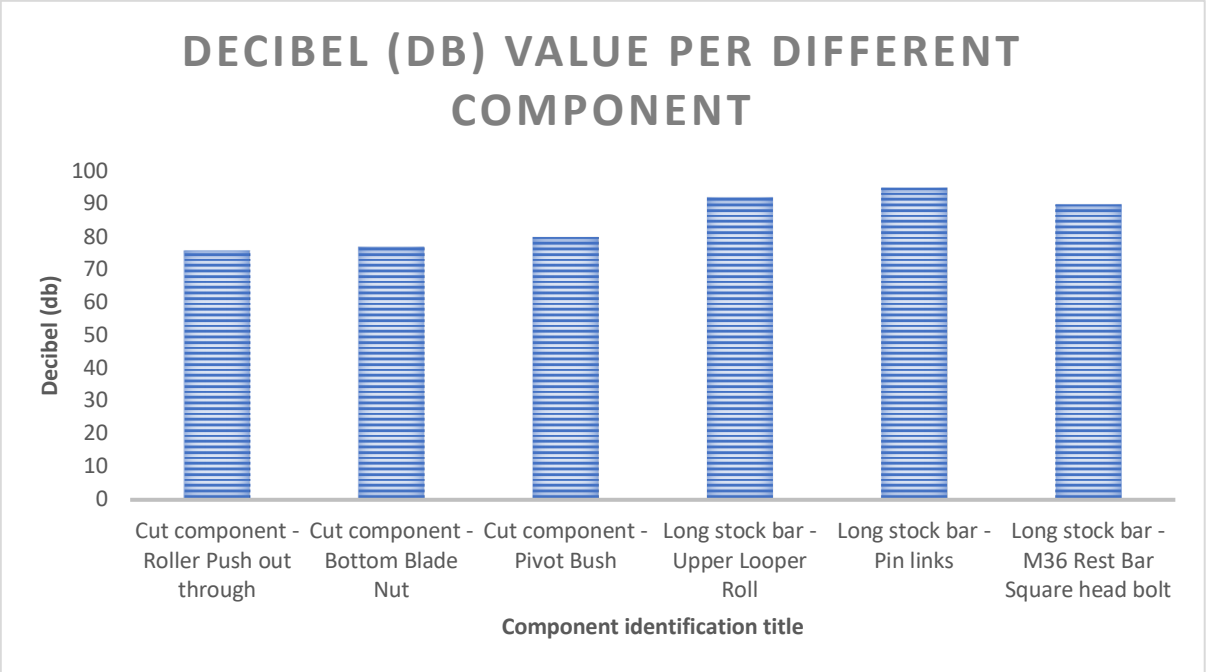
When clamping 1m long stock bars, to machine multiple components out of the bar itself, vibrations are generated as the stock bar is only clamped at one end (Lathe chuck) and the other end is loose. These vibrations carry themselves through the machine creating a chattered finish on the component, as well as inconsistent component sizes. Also, it is believed that due to the vibrations the spindle driving belt is changed every 4 months for the health and safety of the machine and operators. On 7th March 2021 spindle bearing of the machine were changed due to excessive slackness. The maintenance engineers pointed that as the machine is only 4 years old this is a very short time for the bearing to be changed. So, they agreed that the unnecessary damage to the bearing was caused due to unsafe clamping of the stock material, which causes excessive vibrations.

## Team members and responsibility

The table below shows the responsibilities of each person who has helped gain the data and identify the relevant problems in the organisation.

| Managing Director (Nicholas Paul Blake) | Supervisor (Peter Thomas) | Project Manager (Manmeet Singh) |
|---|---|---|
| Respect Health and Safety Laws | Respect Health and Safety Laws | Respect health and Safety Laws |
| Provide Funding for Project | Supervise the Project Manager | Manage project efficiently and effectively |
| Check project status | Input when needed | Collect data |
| Input when needed | Collect data from machinery when needed | Make Project plan |
| | Helped in finding problems | Find Problems |
| | | Find Solutions |
| | | Implement the solution |
| | | Select equipment needed to complete the project |
| | | Control the project |
| | | Revise project |

In a meeting it was pointed out by the managing director that the vibrations induced by the machine cause excessive noise, which enters the office and disturbs the operators and the managing director. So, a chart below shows the decibel registered when the machine was machining long bar component and a cut component.



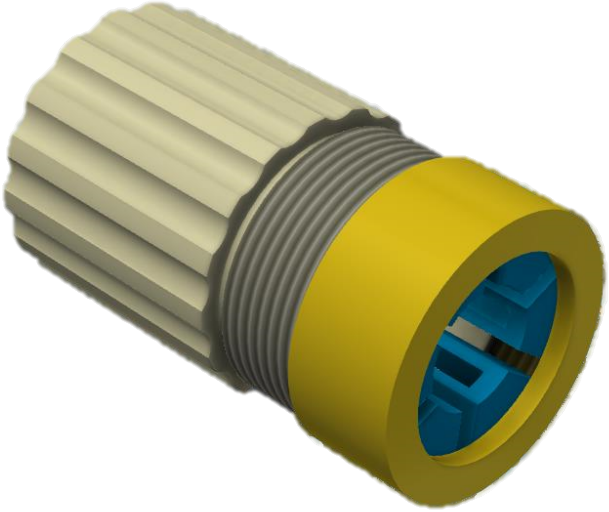

The peak registered is 95db, this is where ear protection is required, to protect hearing. According to Health & safety hearing protection is necessary for those working in areas where loud noise levels (80 decibels) exist (Health and Safety Executive, 2022).

## Requirements, expectations, and goals

A list of requirements, expectations and goals is shown below:

| Requirements | Expectations | Goals |
|---|---|---|
| Reduce or eliminate maintenance caused by the problem | Complete the project withing the timescale | Implement the solution which will reduce vibrations in the machine and components. |
| Eliminate extra operation on the components, once solution is implemented | The PDS will be followed for the design of the solution | Reduce loud noises caused by the machine in the workshop |
| Reduce maintenance interval and cost | The cost of the material will be reduced once the solution is implemented | Improve efficiency on machined parts |
| | The quality of the components should increase due to no vibrations | Reduce the excessive use of spindle belts |

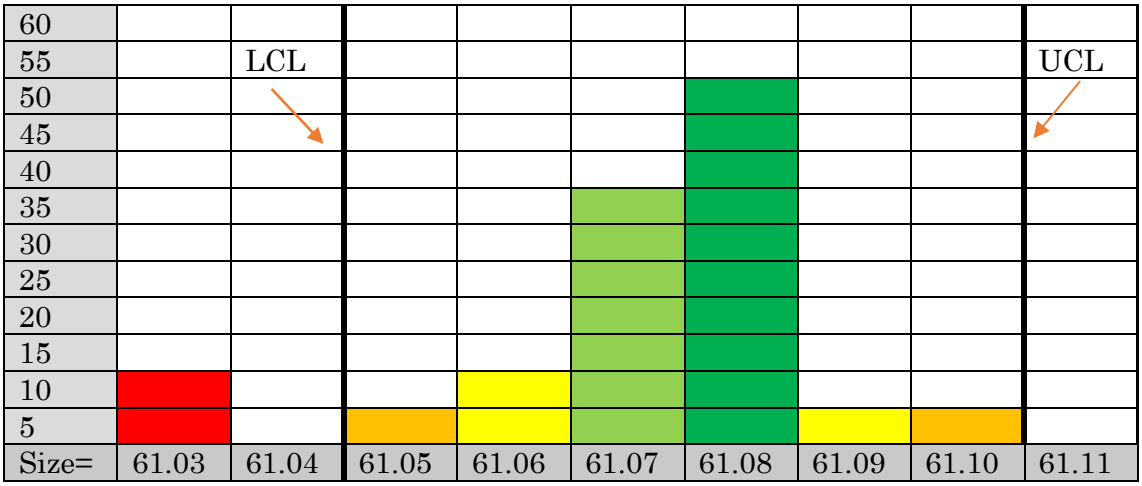
## Solution to the problem



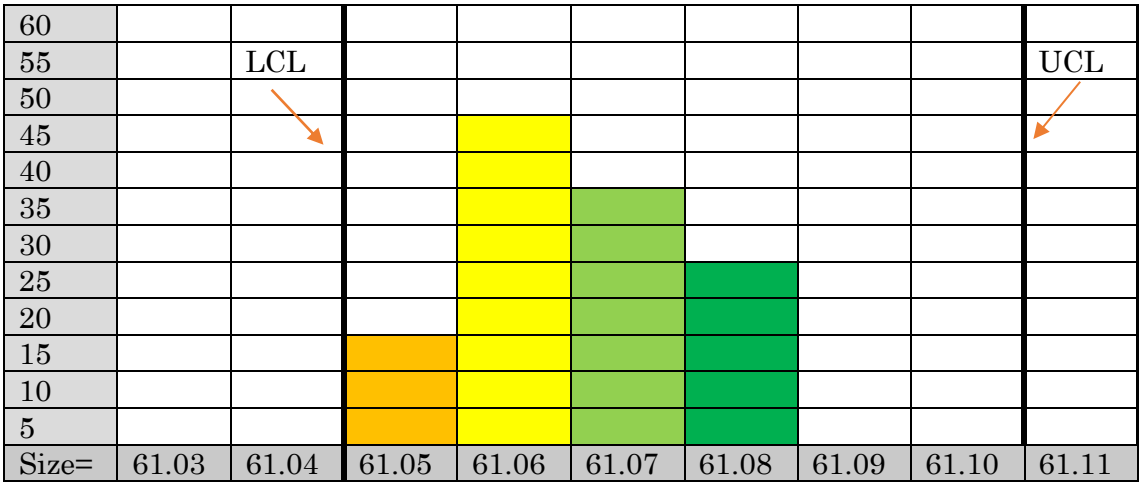
This is an adjustable sleeve which is going to fit in the nose of the spindle of the machine. The threaded Female part (nut) goes on the male threaded part and when the thread is rotated clockwise, the adjustable bar sleeve will grip on the bar very safely and efficiently. This design has been inspired from the ER32 collet chuck. The advantage of this design is that it can hold variable diameter bar, there is just needed to change the collet to hold different size of the material. This adjustable bar allows the coolant and swarf travel through the spindle bore thanks to its grooves made on the outer diameter.

## Before & after Evaluation

After the solution was implemented in the organisation some data was collected which supports the initial goal of the project and shows that it has been successful.




The first graph below shows how the production was before. The second graph shows the production with the Adaptive bar sleeve.




After evaluating these two graphs it can be clearly seen that there are no scarps in the second graph which means that the company is saving money on material, inserts and the machining cycle time is reduced from 15 minutes to 12 minutes per part.

As seen before in the report, the part sizes are very consistent, which means that the operator can judge if the tool is going to wear or not.

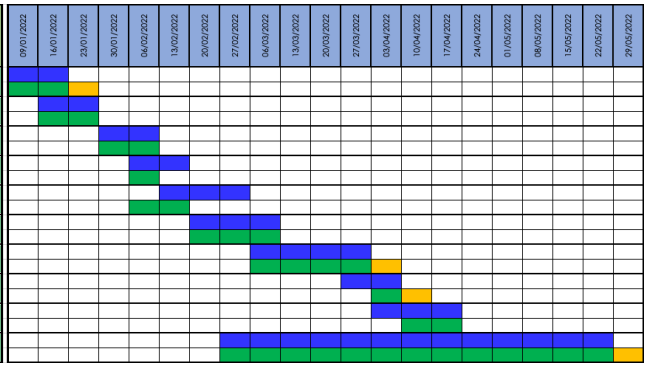
| | Before | After |
|---|---|---|
| Cycle Time | 15 mins | 12 min |
| Cp (Six Sigma) | 0.518 | 0.86 |
| Cpk (Six Sigma) | 0.414 | 0.54 |
| Scrap Amount per batch | 10 parts | 0 parts |
| Money saved | £0.0 per year | £8640.0 per year |
| Time saved | 0.0 mins | 84 hours per year |

## Time management and Gantt Chart

Gantt chart (Appendix 1) is used as a method of monitoring the project.

This chart helps in managing and scheduling projects of any sizes. The management timelines and task are laid out in a horizontal bar chart, which shows the start and end date as well as scheduling and deadlines, also including how much of a task has been completed and who owns the task.

| TASK | TASK OWNER | START DATE | DUE DATE | DURATION WEEKS | PCT OF TASK COMPLETE |
|---|---|---|---|---|---|
| Prepare Logbook | M. Singh | 09/01/2022 | 16/01/2022 | 1 | 100% |
| Do brainstorming to highlight problems in workplace | M. Singh | 16/01/2022 | 23/01/2022 | 1 | 100% |
| Create draft project charteres for the problem | M. Singh | 30/01/2022 | 06/02/2022 | 1 | 100% |
| Conduct a evaluation of the problem | M. Singh | 06/02/2022 | 13/02/2022 | 1 | 100% |
| Set a PDS (Product Design Specification) for the solution | M. Singh | 13/02/2022 | 27/02/2022 | 2 | 100% |
| Design solution on Autodesk Inventor | M. Singh | 20/02/2022 | 06/03/2022 | 2 | 100% |
| Machine the parts | M. Singh | 06/03/2022 | 27/03/2022 | 3 | 100% |
| Trial run the parts | M. Singh | 27/03/2022 | 03/04/2022 | 1 | 100% |
| Final evaluation of changes | M. Singh | 03/02/2022 | 17/02/2022 | 2 | 100% |
| Write Analytical Report | M. Singh | 27/02/2022 | 22/05/2022 | 12 | 100% |




In this chart the blue lines are the target timelines, and the green lines are where the project manager has managed to complete or worked on the task, the orange means that the deadline has been exceeded.

The above is the final copy of the Gantt chart, but from the start of the project this has changed drastically, and this is the purpose of the Gantt chart, to represent how the project will and was carried out and changed due the circumstances.

## S.M.A.R.T.E.R. Analysis

The aim of this reflective analysis is to reflect about the team performance and effectiveness as well as expectations and lessons learnt during this project. This will also reflect without being bias on knowledge gathered as well as feelings from the start to finish of the project. The advantage of this analysis is that it will help with future projects and highlight any improvements required.

For this analysis the S.M.A.R.T.E.R technique will be used, this stands for Specific, Measurable, Achievable, Relevant, Time-bound, Evaluate and Readjust (Wander lust worker, 2022). So, every step of this technique will be analysed below.

### Specific

#### Was the goal clear?

According to the team, from the very first day of the project the goal was to reduce vibrations and scrap amount in the organisations caused by the lathe CNC machine, while staying in the maintainability theme as indicated by the managing director. But there were times when the focus of the project manager would shift from the goal as the other team members would indicate other problems in the organisation which were not as important as this according to the managing director, but, thanks to the Gantt Chart and restricted timelines the project manager was able to concentrate on the right goal.

#### Why this goal?

This project changes the way the clamping equipment works, this is a very low-cost solution that can help small companies that produce small batch products, but they want to produce them quicker to lower the cost and compete with the bigger competitors, by reducing the maintenance cost. With this solution the company can run the machine 10% faster than normal, which is a big difference.

Also, the stakeholders such as the managing director were very inclined towards this project as it drastically improved their daily working life by removing unnecessary vibrations and noise which enters the office.

#### Were any obstacles encountered?

Many obstacles were encountered, but the team handled them very confidently. One of remarkable quality of the team was that whenever there were any doubts questions were asked from the relevant people to not compromise the project outcome.

As this organisation does not have separate department for maintenance, the collection of data was compromised and took extra time for it to gather but as this was allowed in the project plan the team and project manager were satisfied.

It was though that the problem solution might be affecting legislation, but after some research it was found out that the solutions would agree with the legislation easily, as the process of rectifying the problem was improving the legislation reflectance in the workplace. A good example of this is high level noise, after the project was completed the noise level decreased drastically which means that now there isn't need of ear protection when working on the machine.

## Measurable

The project was measured constantly against the Gantt chart to ensure that the tasks and milestones are completed before the deadline. As explained every task on the Gantt chart was measured against the targets to ensure that the quality of work is of high standard. The milestones were met on every occasion which ensured no delay in the completion.

## Achievable

### Was the project achievable?

From the start of the project the team knew that it is achievable, and it can be completed in the restricted timescale. The goal was challenging as it involved many variable factors such as design, health and safety, budget restrictions and change in work style, but with the advantages that would come after the completion the team was feeling confident.

### Where are all the available resources used?

Recourses such as Autodesk Inventor were used to their full capabilities to ensure that the solution is not compromised. Some resources such as suggestions from colleagues in the workplace were not used to their full extent, because of the restricted timeline for the various tasks. However, the outcome was achieved but next time this would be very helpful as it involves them in the project and gives them responsibility which then increases their confidence level drastically and they feel more engaged in their working life.

### Will or were new skills developed?

Skills like mastering Autodesk Inventor were developed by the project manager during this project but, if input was required due to incompetence the managing director would show the right path to the solution thanks to his expertise in the area.

Skills below helped the project manager complete the project in a timely manner with the expected outcome:

- **Build the plan** - The project manager was able to build the plan by using multiple planning techniques which helped in understanding the project scope, timeline, and budget.
- **Evaluation techniques** - Able to select industrial recognised evaluation techniques and use them efficiently, this ensured that the project is following the correct goal and it is heading in the right direction.
- **Risk assessment** - The project manager was able to think about the risk involved in completing certain tasks and how there is no need to hesitate to involve the health and safety manager in the workshop.
- **Managing timelines** - The project manager was able to efficiently manage the budget as well as time restrictions such as deadlines through the life of the project.
- **Document the process** - The project manager was able to identify and document the lessons learned though the project. And learned to listen to others' opinions and suggestions.

Teamwork skill was developed as the project manager was able to:

- Communicate and express ideas distinctly
- Problem solving when an issue or challenge raised. One example would be when the team was struggling to understand how to keep the spindle bore of the machine at a constant and cool temperature once the solution was applied to the machine. So, the solution to this problem was to change the design of the solution itself and eliminate another task or another complete project.
- Listening to suggestions, even though not many suggestions were taken from the colleagues in the organisation due to restricted task deadlines, many suggestions were taken from the stakeholders and other team members. This allowed the project manager to have an open-minded thinking and be a better leader and colleague in the workplace.
- Knowledge sharing skill was developed by the project manager, as lead by example ethic was very well shown. This skill was recognised and rewarded by the employer by issuing an employee of the year award to the project manager. This gesture encouraged other employees to share knowledge.
- Assembling the team, was able to identify the correct team with the help of the supervisor and stakeholders which helped in keeping the project on track and ensure success. Specialists were also reached to ensure no lack of quality is introduced in the project.
- Assigning task, was able to assign task to himself as well as others and ensure others are following their duties as well as himself without being bias.
- Leading the team, was able to lead the team in an efficient manner towards the correct goal of the project. This was done by regularly asking status updates, identifying, and clearing roadblocks, negotiating disagreement, keeping team morale high, providing, and acquiring training when required.

### Relevant

It was very important that the goal of this project was in line with the organisations goal, which is to improve the maintainability of the equipment being used. So, the project did reflect on the goal of the company and as an advantage it also improved the efficiency of the machines.

### Time-Bound

From the start of the project the deadline of the project was set, and individual tasks were researched then a deadline date was selected. It was very important that the deadline of the project and the tasks was selected realistically to allow time for written report as well as analysing and evaluating the solution. As it can be seen from the Gantt chart the time was managed very well and the task timings and deadlines were also very realistic.

## Evaluate

Evaluation of the current project was done on a weekly basis and was being noted down on the logbook. The logbook consisted of:

- Tasks achieved
- Problems encountered
- New ideas or change of project direction
- Personal achievement of project manager
- Plans for the next log
- Actions

The logbook was a very good way of keeping the project on the right path and constantly evaluating the project itself. The logbook was kept UpToDate which ensured that the history of the project is available, and this can also be used for future reference.

## Readjust

This step is all about readjusting the project if you can't achieve the goal, this doesn't mean that the goal should be changed but the way of approaching the goal should be changed.

There were occasions when the approach was changed to achieve the project goal such as eliminating the thought of machining a prototype but machine the solution straight away to meet the restricted time allowance. The second is, when the team was not able to find the solution for keeping the spindle of the machine at a constant temperature, the design of the solution was changed to incorporate this requirement.

## Conducting high level feasibility after implementation

### Technical Feasibility

This solution's main tasks were design, machine and implement which wasn't a problem for the operators in the organisation. The advantage of this problem was that it was completely sourced from company apart from the material which requires external sourcing. The team was very confident and comfortable at completing the task.

### Economic Feasibility

Before implementation this problem was costing the company approximately £1200.00 per year. But with the implementation of the solution, it costs the company only £150.00 to maintain the machine every year. Obviously, the cost of the project solution was considered which was approximately £250.00. So, for the first year the company would save approximately £950.00 and after that term it would save the company around £1,050.00 per year. Over ten year this would evaluate to approximately £10,500.00 in savings.

### Legal Feasibility

As the solution was constrained inside the spindle nose of the machine, the legislations were not affected. Also, the guarantee of the machine and the tooling were not affected by implementing this solution. And, as the customer is not affected there are no changes required to the contracts and further quality developments. This solution only affected the workplace in a positive manner.

### Operational Feasibility

When this solution was being implemented, there were no major breakdown time schedules as the solution only fits the stock bar. But, as the components needed to be machined on the machine which it is being implemented on, it required a small amount of time for the machine to process the components and not produce parts for the company's customers.

## Analytical Report

To analyse the project in a more direct way, the project is divided in four main sections which are:

- Project initialisation
- Design and Planning
- Development
- Analysis

These four sections will be analysed individually to ensure a thoroughly written report is presented.

### Project initialisation summary report

Once the project initialisation steps were complete the team was satisfied, it looked like the project is on track and the timing is within a reasonable window. So, in simple words the bullet points below show what has been achieved in the project initialisation section of the program.

- Think and find problems currently available in the workplace which can be rectified through a project.
- Find out how and who in the organisation can help the project manager with various inputs needed to highlight the main problems and suggest solutions for it as a team.
- Then there was need to make sure that the skills of the current employees would be enough to complete the project.
- With help of the team and stakeholders come up with an approximate cost required to rectify the problem.

As the project evolved the legislation was being considered but, up until this point by having an initial solution idea it is considered that the legislation will not be affected as the solutions are restricted in an internal area where it cannot harm the operator or the equipment itself.

As a project management view, until this moment right decisions were made to carry the project forward. Even the progress of the project was looking good. It should be mentioned that there were some problems within the team when there was need to highlight the problem, and it took a while to understand the maintainability theme, but after a meeting with the team and stakeholders this misunderstanding was cleared.

Overall, the team was very satisfied with their work until this moment, there was also an increase in confidence as tasks which looked foggy at the start had started to become clearer to understand and see.

## Project design and planning summary report

Once the project design and planning section was completed the team was satisfied. There were some delays in completing some of the tasks, but the section's deadline was complete in advance. As it can be seen from the Gantt chart there was four sections where there were delays which are:

- Prepare Logbook
- Machine the parts
- Trial run the parts
- Write analytical report

The reason behind the delay of the first was the uncertainty of how to format it and what important factors to include. The second and third was because all the machines in the company were all busy, which means that they could not be machined within the deadline, however they were machined and trial run the week after the deadline, this did not affect the project in a great manner as the next steps were completed within the deadline. The analytical report was slightly delayed to additional understanding required to comprehend the requirements of the assignment.

In the Draft project charter, the main problem was to find out what factors are important to the company and which ones are relevant to the project. The same problem was faced during preparing the logbook. An efficient way of representing the data was required to simplify the overall looks and ease of understanding. But after some suggestions from the supervisor in the workplace, it was competed without any further delays.

As explained before there was many problems faced during this section of the project one of the major one was to understand the design brief and then compile the Product Design Specification (PDS). The team had to think about many factors to come up with an effective PDS, some of the factors are:

- Health and Safety
- Fit tolerances
- Materials
- Ergonomics
- Ease of use
- Other factors affecting the machine operation

Obviously, it was difficult to think about all the factors at once, so the team had a strategy of focusing on each bullet point at once and complete one after other. After some time, the team was successfully able to check all the criteria above. And as a team there was a thinking that this task was completed in a very though manner and effectively.

By thinking of the progress from problem identification to design solution the team and the project manager feel that it has gone as expected. The initial plan was to identify the problem and then have a rough idea of how the solution would be looking, which is what happened. Then the team just had to make sure that all the correct steps are followed to ensure a successful project. By taking these steps

many other lessons were learned and made the process of implementing the project much easier.

From the previous section of the project the team has learned a lot which made task easier to be completed. A good example would be updating the project charter, as the team already knew most of the important factor to be included for the organisation it didn't take much time to be completed.

As a project management view, until this moment right decisions were made to carry the project forward. Even the progress of the project was looking good.

Overall, the team was very satisfied with their work until this moment.

## Project development summary report

By looking at the development section it can be said that there were many surprises in this section. The solution was not machined, and it was not trial run within the deadline due to unavailability of CNC machines in the organisation, additional week was required to complete both tasks. But there were many areas in which the team was successful achieving the target:

- The progress made in finding and developing the three solution was very good. Infect, once the initial sketches and models were made of the solution there was not really need to change them, as the team spent a lot of time and really did a good job coming up with them.
- Then evaluation of the solutions was done which included learning new evaluation methods which best applied to the project. Also, the project manager came up with few evaluation methods which really helped in considering all the criterial important to the company.
- Decided which steps are required to complete the project and how it can be improved.
- Explored the CPA and other planning methods.

But there were many tasks which were planned that were not actually completed. Such as machining the prototype. As explained before the prototype was not machined as all the machines were occupied. But the simulation was completed, and the team also predicted the time taken to produce the prototype thanks to the software's capabilities.

Another problem that was encountered during this section was the employee's attitude toward this change. As this project will impact their daily working life after the implementation some employees were hesitating on making suggestions as well as recognising the effort being put into completing this project. As suggested by (Smith, 2021) employee attitude can impact negatively and change the direction of the project and sometimes even undermine the project completely. It was noticed by the managing director that the behaviour of some employees due to this change affected the productivity of the company in a negative manner. When this was pointed out to the project manager the employees were involved more in the project and made aware of how this solution could improve their working lifestyle, this made a difference and the productivity of the company seemed to go back to normal. This problem could have been avoided if the project manager would have performed some evaluations such as gap analysis to ensure that all the employees are aware of the change.

Until now the team was happy as all the tasks were being completed effectively and efficiently, and the team had learned on how to find a way around a problem during the project.

## Critically evaluating the success of project plan and possible improvements

The project plan is a formal part of the project, this was done by the project manager. The plan was done so it could help define the main steps needed to complete the project. The Gantt chart is also showing how the project has been monitored and controlled. Thanks to the project plan Manmeet had a clearer understanding of the project scope and how to approach the project and what it will take to reach the project goals. When the project was started the progress of it, was being measured against the project plan, which allowed Manmeet to make sure that the project is kept on track of schedule. Some deviations occurred and the project manager managed to adjust the Gantt chart along the way to correct deviations. Infect now the Gantt chart can be used to see how the Project manager managed the project and how long it took him to complete each task of it.

### Implementation

The project implementation was carried very efficiently, lots of data was collected during the production. The data collected was plotted in the project logbook.

There was need to select the material which was done efficiently and there was also needed to select the machines to be used to produce the adaptive bar sleeve. The project manager had to also select some of the tools to be used to produce the solution. This is very efficient because everything was simulated on the computer, which means that there was no waste of money or time.

### Maintainability theme

The theme of the project was maintainability, which can be said it has been highly achieved. So, the problem was that when clamping 1m long stock bars on the CNC machine vibrations were generated. These vibrations would carry themselves through the machine creating a chattered finish on the component, as well as inconsistent component sizes and the spindle driving belt was being changed every 4 months for the health and safety of the machine and operators.

But now with the solution implemented the amount of spindle belts used per year reduced drastically. It is believed that with the solution implemented the belt change would be done once every 18 months as to the manufacturer's instructions.

To prove the maintenance solution the project manager clamped a long stock bar which was unsupported on one end and run the clock on the diameter of the chuck to check the concentricity. Due to the unsafe clamping the chuck was throwing by 0.02mm on radius. And then when the bar was clamped using the solution created by this project the throwing of the chuck was eliminated which then also improved the health and safety of the machine and for the operators.

## Completion

### What could have been improved?

The project could also have been improved if other company employees would have been introduced to the project and asked for their suggestions, because they could have had better ideas of solving the problem.

For the Gantt chart Microsoft Excel was used which means that extra time was invested in creating the plan, if a built to purpose software would have been used such as Microsoft Project this task would have been completed with a higher

efficiency. Also, new tools for the plan could have been used and a standard layout would mean a better understanding and professional data representation.

Communications to the managing director where only made when required, this meant possible project improvements might have been missed. Also, because of the minimal check-ins with the managing director means that he didn't have the chance to see how much effort is being put in the project and advise on any actions to be taken.

More people on the team would have been advantageous, as the tasks would have been smaller and a quicker outcome would have been achieved and better brainstorming could have been performed because of different perspectives experiences and opinions (Gaille, 2022).

The report of project progress could have been improved as most of the time it was done verbally there was no proof or future reference. If this was done electronically it would have been more professional and it would have given more time to the reader to understand the progress. A PSA software could have been implemented to present reports in a very consistent way (Kimble, 2022).

Lessons learned were discussed at the end of the four main milestones of the project but if this was repeated more times the team would have felt even more confident during the project, this is because when the questions like 'What is working?' 'What is not working?' are asked somehow the direction or the way to reach the goal is changed (Kimble, 2022), which then improves the quality of work, so a better outcome and goal satisfaction might have been achieved.

Feedback should have been asked more frequently, according to (Wormley, 2022) feedback isn't a sign of weakness infect it is a formal procedure to find out what is working for the organisation and what is not, this also includes other company employees. So, unless questions are raised no information will be received which could improve the overall project.

However, the project was carried out very efficiently and effectively according to the stakeholders, which means that all the major steps have been taken to complete the project.

If there is need to do a project in the future the project manager will consider all the suggestions made by the colleagues and evaluate them by applying appropriate criteria. A lot of personal achievements have been achieved during this project, which is the reason why there would be no hesitation if there is need to start another project in the organisation.

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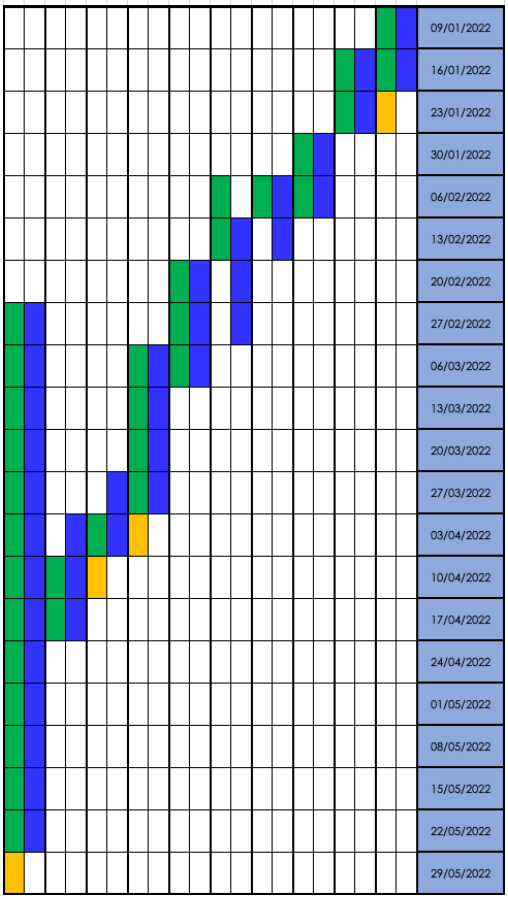
# Appendices

## Appendix 1

| TASK | TASK OWNER | START DATE | DUE DATE | DURATION WEEKS | PCT OF TASK COMPLETE |
|---|---|---|---|---|---|
| Prepare Logbook | M. Singh | 09/01/2022 | 16/01/2022 | 1 | 100% |
| Do brainstorming to highlight problems in workplace | M. Singh | 16/01/2022 | 23/01/2022 | 1 | 100% |
| Create draft project charters for the problem | M. Singh | 30/01/2022 | 06/02/2022 | 1 | 100% |
| Conduct a evaluation of the problem | M. Singh | 06/02/2022 | 13/02/2022 | 1 | 100% |
| Set a PDS (Product Design Specification) for the solution | M. Singh | 13/02/2022 | 27/02/2022 | 2 | 100% |
| Design solution on Autodesk Inventor | M. Singh | 20/02/2022 | 06/03/2022 | 2 | 100% |
| Machine the parts | M. Singh | 06/03/2022 | 27/03/2022 | 3 | 100% |
| Trial run the parts | M. Singh | 27/03/2022 | 03/04/2022 | 1 | 100% |
| Final evaluation of changes | M. Singh | 03/02/2022 | 17/02/2022 | 2 | 100% |
| Write Analytical Report | M. Singh | 27/02/2022 | 22/05/2022 | 12 | 100% |