College of Engineering
ENGINEERING WORK REPORT AND SELF-REVIEW ASSESSMENT

Student to complete:

Student	**Jackson**	**ID**	**79117073**
Employer	**RPM Tool & Die**	**Engineering Discipline**	**Mechatronics**
Assessor		**Report Number**	**1**
		Resubmission	**N**

Assessor to complete:

	ASSESSMENT CRITERIA	**ACCEPTABLE**			**DESCRIPTION**
		Y	N	NA	
1	**Presentation**				Table of Contents
					Sections / Headings / Page Numbering
					Diagrams / Figures / Referencing
					Standard of English / Grammar / Spelling / Punctuation / Formal language
					Signed declaration
					Approx. 75% technical work report / 25% self-review
2	**Technical report**				Introduction / Discussion / Conclusion
					Organisation description
					Work description
					Personal involvement
					Concise / 4000 words (+/- 10%)
3	**Self-review**				Learning outcomes
					Issues
	Competency addressed				1 Ethics
					2 Health, safety and wellbeing (mandatory)
					3 Application of engineering (mandatory)
					4 Natural environment
					5 Bicultural / Multicultural

Overall grade of report **Excellent / Merit / Achieved / Resubmit*/ Fail**

Feedback on report ______________________________

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Type of work **Practical/Professional**

Assessment of employer Did the employment, as described in the report, provide an opportunity to get good engineering experience?

Strongly disagree/ Disagree/ Neutral/ Agree/ Strongly agree

Did the student report on any issues (e.g. health and safety/harassment/discrimination)?
The Dean will contact the employer, if necessary. Please comment below.

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Assessor Signature ______________________________ **Date**______________________________

JACKSON CRAWFORD
79117073
1st PRO MECHATRONICS

Work report and self-review

Report 1

Employer:	RPM Tool & Die
Location:	Rosedale, Albany, Auckland
Work Period:	23/11/2020 to 12/02/2021
Total Hours Worked:	520
Type of Work:	Mechanical/Electrical Workshop
Word Count:	Work report: 4213 Words Self-review: 1257 Words

PART A: TECHNICAL WORK REPORT

DECLARATION
I, Jackson Crawford, certify that this report (except where indicated) is entirely my own work and I undertake that the contents of Part A: Technical Work Report shall remain confidential between me, my employer and the College of Engineering and will not be disclosed to any other party.

This is the second report I am submitting on a period of work at this organisation (N)

1. INTRODUCTION

This is a technical work report covering work experience that I, Jackson Crawford, gained over the summer of 2020-2021 at RPM Tool & Die ltd. RPM's main is designing and building injection moulds and press tools. They also have a factory automation division, which is where most of my work took place. The main project I worked on was a robot that would remove plastic parts from an injection moulding machine, perform quality control checks using a vision system, insert foam wadding into the parts, and then organize and pack the parts for shipping. I enjoyed huge breadth of experience at RPM, with my work involving manual machining using mills, lathes and grinders, and finishing/benching CNC machined parts. I also worked on electrical wiring and pneumatic plumbing. In addition to this, I used CAD models to create properly dimensioned drawings of parts for fabrication in other parts of the shop, for use by other machinists, or myself. I also worked with design and electrical engineers to better facilitate communications between the design and workshop, and assist in the design/electrical workload by creating schematics, both electrical and pneumatic. I also worked on a small project on an injection moulding machine, and learnt a great deal about its operation.

2. ORGANISATION DESCRIPTION

2.1 Overview

RPM Tool & Die is a CNC tooling workshop in Rosedale, Auckland. RPM's main focus is the design and manufacture of complex injection moulding tools, with services such as die grinding, precision CNC machining and EDM facilities to facilitate their manufacture. They also offer automation solutions from design through to integration and installation of the plant, for local and international customers.

2.2 Products and services

The services at RPM are divided into four main areas:
- Manual machining, consisting of mills, lathes, grinders, and power saws. There are also die grinding and polishing facilities for finishing injection moulds.
- CNC machining, with 3 and 5 axis mills, and CNC lathes. There is also an injection mould machine (Figure 1) on site. Though they do take injection moulding contracts, the main purpose for this machine is testing injection moulds before they are sent to the customer if the tools fit in the machine.
- EDM machining, mostly taking place in a clean room with 4 CNC wire-cutting machines, though there are several other EDM machines on site for particularly complex or detailed geometry in injection mould tools

- The design office, which provides all of the machines and machinists with parts to build.

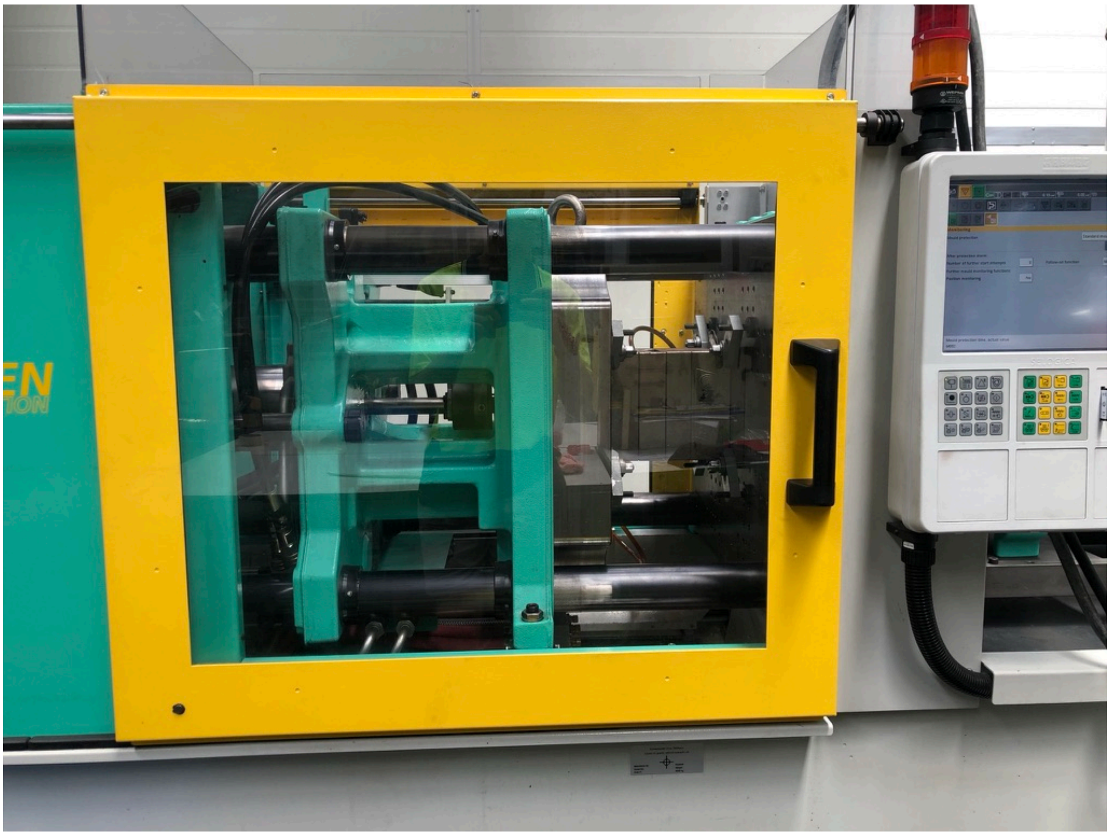

Figure 1: Injection moulding machine

2.3 Organisation structure

RPM is structured around three toolmaking cells, that each work a separate job. Typically a job will be quoted by management, designed through the design office, and the design sent through to the relevant cell. Then, between the CNC machinists and the toolmakers, parts are made and integrated until the tool is finished.
There are roughly 35 employees at RPM, and the management structure is very flat. There was not much visible hierarchy between levels of the shop, and everyone was on equal ground. The management is essentially the two founding shareholders of the shop, and everyone reports to them.

2.4 Personnel and industrial relations within the organisation

The personnel relations at RPM were healthy and positive. Collaboration and information exchange between departments was common, and I believe this was to the benefit of the company, the customer, and the employees. Interactions between different levels of the company were professional but friendly and casual. RPM fostered a number of strong local industrial connections. Not a single day went by without several incoming and outgoing items being sent and received from various industry partners in New Zealand and abroad.

2.5 Carbon footprint, sustainability, innovation

The business was responsible in how it disposed of waste. All swarf was collected from the machines and recycled, along with scrap stock where possible. Chemical waste was regularly picked up and properly disposed of. Waste is inevitable in a manufacturing shop, as mistakes are made, but RPM managed this responsibly, and as much stock as possible was put to good use. One area I felt RPM could have improved was with energy consumption. Being a large machine shop with many machines, all electrically powered, the power usage would have been high. I have worked on several solar installations in the past, and the workshop's large roof and the fact that the machines overwhelmingly run during the day made RPM an ideal candidate for a solar installation to offset or negate their energy usage, in my opinion. I suggested this during my time there, but I don't know if anything ever came of it.

2.6 Equity, diversity

The workforce at RPM was highly ethnically diverse, but there were no women on the shop floor. The company did employ several women, but they were in admin and office roles. I did hear of female toolmakers and engineers who worked at RPM in the past, including apprentices and university students on work experience, but there were none employed during my time at RPM. I don't know if this issue is with RPM, or the wider industry, but the gender distribution among the engineering students at university is more even, so hopefully the next generation of engineers will be more diverse. In my experience the only thing that determined your salary at RPM was the quality of your work.

2.7 Health and safety, employee wellbeing

There was a genuine emphasis on health and safety at RPM. I was given a pair of safety glasses on my first day, and there were earplugs readily available. I was impressed by the staff's concern with my wellbeing, particularly at their insistence I wear earplugs. Almost every machine had a poster encouraging the use of PPE, and I was surprised to find that they worked. I often remembered my PPE because of these posters. RPM had a robust system for the storage of hazardous materials on site, consisting of locked hazardous materials lockers and regular hazardous materials courses. Regular fire drills also took place during my time there. Overall, I always felt that my safety was important.

My induction at RPM involved being introduced to all the members of staff and making a note of first aiders and fire wardens. I was shown fire exits and alarms, hazardous materials lockers, spill clean-up kits, and the major hazards in the shop were explained to me, such as noise, dangerous machines, sharp parts fresh off the machines, crushing hazards from large machines, etc.

In terms of staff wellbeing initiatives, the company regularly held barbeques on Friday evenings, which was excellent for staff morale and encouraged a tight-knit culture. The break room also had a table-tennis table, and fierce competitions on lunch breaks were one of the highlights of my time at RPM. I found it to be a very effective team-building tool. It was a great way to relieve stress and stay fresh while at work, as well as building friendships between employees.

Many of the employees at RPM worked long hours, and I found this concerning from a wellbeing point of view. Though the pressure to work long hours comes from internal feelings of accountability to one's colleagues, I felt that the company could have done more to appropriately manage the workload. I feel that the strategy of throwing man-hours at large projects is detrimental to the company's performance in the long term, as burnt out staff will produce lower quality products and be at higher risk of making errors. I noticed employees who worked long hours seemed to be stressed, and took it out on colleagues around them. I think checks and measures could have been put in place to try and regulate the amount of hours an employee could work, and more robust project management may have allowed more efficient use of man-hours. In saying this, the staff at RPM were universally professional and extremely good at what they do, and detailed planning in a company of this scale is far easier said than done. I also have zero experience running a business, so this analysis can be taken with a grain of salt.

3. WORK DESCRIPTION

3.1 Orange cell

Orange cell was one of three toolmaking cells at RPM. A "cell" at RPM is a division of 3-4 toolmakers with access to a full range of tools, along with several mills. Each cell would work on its own job, and they all had different areas of expertise. Orange cell's main focus was press, and Mike was the lead toolmaker in orange cell. I'm not certain whether the lead toolmaker was an actual defined role, but with Johan mainly working in automation, Mike had the most experience. The official team that was assigned to orange cell was Mike, Johan, and Scotty, but as Johan and Scotty worked mainly in automation, Mike ran the cell by himself for the majority of my time at RPM. Scheduling of work in a cell comes from quotes by management. All employees at RPM use timekeeping software to clock onto and off of specific jobs. Over years, this data has been gathered and is now used to forecast the time that a job will take and schedule work accordingly. The designers currently designing a tool will often ask for the toolmaker's input throughout the process. Once work begins, the toolmakers will confer with the designers to clarify choices and iterate on the design if necessary. I believe this high degree of communication leverages the strengths in the design department and toolmaking cells to great effect.

3.2 Automation Construction

Automation construction was a repurposed area towards the rear of the shop, with a large amount of shelving to hold the various pneumatic and electrical components involved in the construction of RPM's robots. Apart from this, the department was mainly a large empty space, to better accommodate the robot frames, which could be several meters in length. The automation department mainly used orange cell's tools if it needed them, mostly for fabricating small parts, but it also had a mitre saw for cutting aluminium extrusions, a wire cutting and stripping machine, and a small benchtop CNC.

Johan was a qualified toolmaker, and the most senior member of the automation division. Much of the toolmaker's experience applies to automation, in that the physical aspects of modern press tools are largely similar to those of the robots, such as reed switches and cylinders. RPM also had an electrician, Denis, who was mainly in charge of providing mains power to the machines, particularly three-phase, and wiring all the various sensors and actuators into the electrical cabinets. Scotty was an automation technician who had been working with RPM essentially since high school, and was experienced both in machining and electrical work. I was directly under Scotty's instruction for my time at RPM, and my role mirrored his, filling the role of machinist or electrician depending on demand.

The workflow for automation was similar to that of the cells. This largely involved the same back and forth working on the design, confirming parts to be made between the CNC department and the machinists. There was also electrical design, though there was less room for feedback due to the nature of the electrical design of the machines. This communication mainly centred around naming conventions, the order in which wires would be numbered coming out of tools with multiple sensors, etc.

3.3 Automation Design

The automation design department was based in the Kaizen room, away from the toolmaking design department, and was made up of Simon, Rory, and Kevin. The kaizen room doubled as a storage room for small, expensive components, to stop them from getting lost on the shopfloor. Simon, a qualified toolmaker with a technology diploma in mechatronics, was the designer in charge of the mechanical design of the robots. He was also involved with the programming and designed all of the pneumatic systems. Rory is RPM's electrical engineer, and as a result the electrical design came down to him. He was also experienced in the programming of the machines. Kevin was in charge of the programming of the off-the-shelf robot components we used, e.g robot arms, and was also responsible for the PLC programming. Work for the automation department came directly through Aaron, a toolmaker and manager in the main office, who was in charge of organising the contracts that automation was working on.

4. PERSONAL INVOLVEMENT

4.1 My role

At RPM my main involvement was with the automation division, working with a team on a takeout robot for a foodstuffs company in Australia. In addition to this, I helped out throughout the shop wherever I could be of use, repairing or installing machines in particular. Before Christmas, the majority of my work was in Orange Cell, helping the toolmakers there, as the automation project had not started up at that time. The majority of this work initially involved being given dimensions of stock that I would prepare, either for CNC machining or more skilled manual machinists. As my familiarity with the projects and machines grew, particularly with the CAD software used on the shop floor, I was entrusted with more responsibilities. This started with creating drawings for CAD models for the machinists to produce, and evolved into being given part numbers, then using those to find the CAD model, create drawings, select and prepare stock, machine the given part, and then install it into the tool. I did a large amount of work on the mills and lathes (Figure 2) during this time, and my confidence on both of those machines has grown considerably, particularly when it comes to producing parts to accurate tolerances within short timeframes.

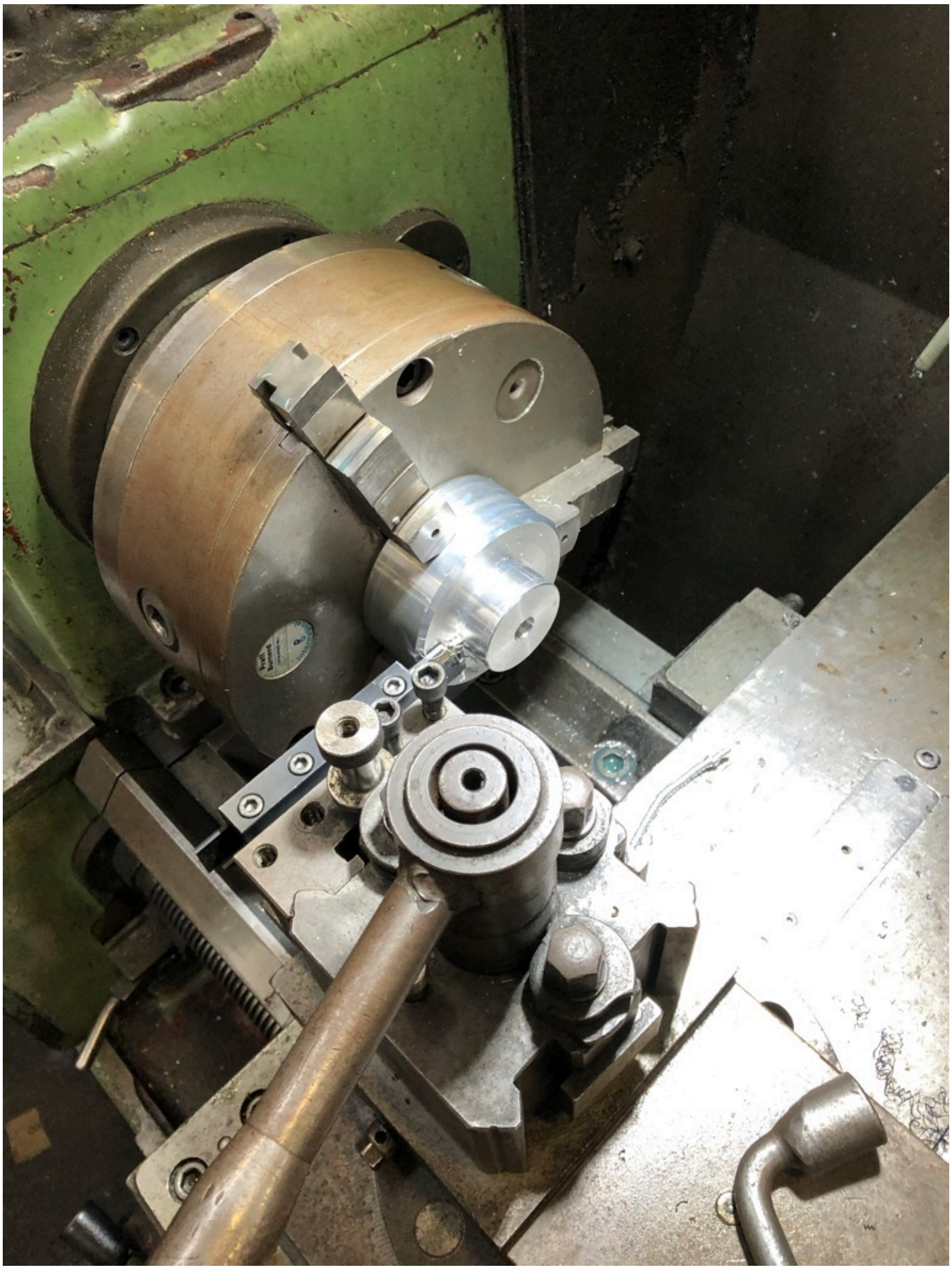

Figure 2: Turning on the lathe.

4.2 Contribution

Most of the tools produced by RPM employ pneumatic systems for part ejection and actuation of the tool. Reed switches are often used for feedback to PLC's to allow control of the tools, but they need to be positioned correctly to ensure they will work, and they need to be powered to verify correct placement. A large material contribution I made to RPM was the design and construction of a 24V tester (Figure 3) for this purpose. I began by seeking input from an electrician to ensure the device was safe, and he gave me a schematic for the required circuit breakers, and suggested the use of the 24V power supply unit and DIN rails. The tester includes a power switch on the lid, and a neutral and live wire terminated in alligator clips that allow the operator to easily connect and disconnect different sensors for testing. It is important to be able to do this safely and quickly, as the tools at RPM can include up to 12 cylinders, each requiring two reed switches to be individually calibrated. I was proud of this project, and I think it went a long way towards proving my competency at RPM.

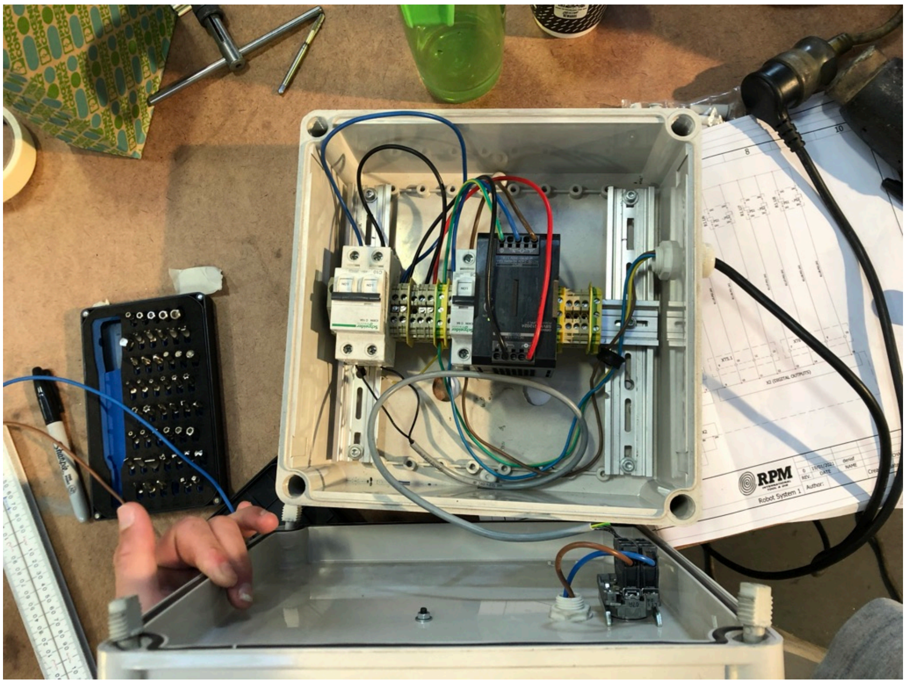

Figure 3: 24V Tester for industrial sensors

After Christmas, the frame for the robot arrived, and work on the automation project could begin. I continued to work as an amateur machinist on this automation project, using skills and knowledge I had developed before the holiday break. I also started to work on the electronic aspects of the robot. This involved consulting schematics and correctly wiring up components initially. The basic aspects of the robot were standardised, such as safety circuits from the EUROMAP standard, and schematics from older projects could be used initially, but we quickly ran out of these. The automation design team had a huge workload at this time, as the previous project had been sent over to Australia upon completion, but due to Covid-19 the team was not able to travel to Australia to get it set up for the client. This meant remote work, which was extremely slow for the type of debugging that was being done. Because of this, I stepped in to help create electrical schematics to reduce the design team's workload and ensure work kept going smoothly on the shop floor. I feel that this made a material contribution to the company, as without my contribution the work on the project would have been significantly delayed

Another area that I contributed to the company was the installation of a laser engraving machine we received. With the flexibility of my role meaning a few hours of my time would not be particularly missed, combined with prior knowledge of laser cutting machines and general computer-literacy, I was asked to install and "figure out" the machine upon its arrival. Installation mainly involved finding a place for it to live and then plugging it in, as the unit was entirely self-contained, with an included PC and preinstalled drivers. From there it was a matter of finding out what the different buttons did, as the machine had been shipped from China, and as such I couldn't read most of the documentation and labelling. It was straightforward however, and within a short time I had figured out how to operate the machine. As an engraver, it was too low-powered to cut through most materials, though cardboard cut easily. I found various pieces of stock from bins in the shop that were too small/oddly shaped to be of use and tested the performance of the laser on different materials, which was interesting, as aluminium was extremely resistant to the action of the laser, but stainless steel developed noticeable grooves on low power settings and high speeds. I thought this may have been linked to the different thermal properties of the metals, or aluminium seeming to be 'shinier', perhaps reflecting more of the energy. I also thought the weak performance engraving aluminium may have been an issue as the main purpose of the engraver was to engrave company signage on products, and the overwhelming majority of components that RPM produces that would hold such signage were made of aluminium. The engraver would still be much faster for this purpose than the CNC mills normally used for this purpose, however, and the skill required to operate it was clearly much lower, so the machine would still be useful. After this, I was able to quickly teach several other members of staff how to use the machine so that the company would not be left without anyone who could operate it after I left.

4.3 Personal responsibilities

I had a large degree of responsibility at RPM, and I believe that by proving my competency to the toolmakers and engineers there I enjoyed a great deal of autonomy and trust. I was personally responsible for the production and verification of the majority of the electrical schematics (Figure 4) used by the shopfloor team to wire up the various

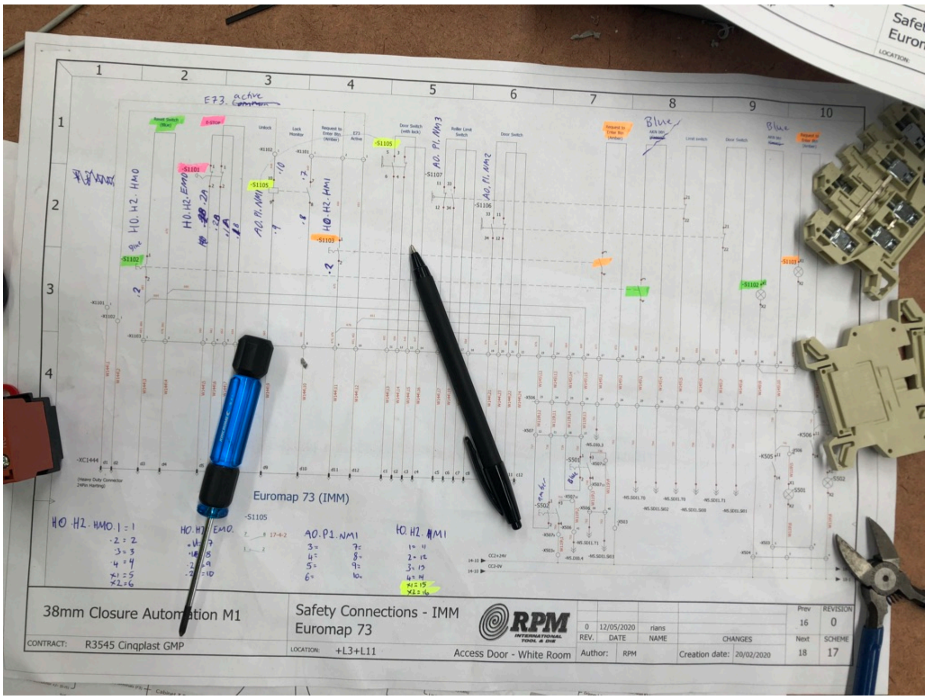

Figure 4: Electrical wiring diagram

sensors, actuators, and human-machine interfaces present on the takeout robot. This responsibility was at times stressful, but I was confident with my ability to find errors, and could always trust other members of the company to take the time to answer any questions I had about the work. I was also personally responsible for the dimensional accuracy of the parts that I made and integrated into the robot. It was important that these parts were fabricated to the correct supplied dimensions and within tolerance otherwise the robot would not work correctly.

4.4 Tasks performed

The tasks I performed at RPM were highly varied, which I enjoyed. This gave me great breadth of experience over the different areas of work in the shop, and allowed me to learn from a range of talented people. I started my work at RPM mostly on mills and lathes, using drawings I'd been given to manufacture parts to correct tolerances. This was valuable experience, as measuring parts, particularly getting square surfaces to work and measure off, is often a lot more difficult than it seems, and it's an important skill to have as an engineer. I also often cleaned and serviced mills while I was at RPM, particularly one week that I spent the majority of my time cleaning and servicing an old Hartford CNC. I believe having a healthy respect for the machines that work for you is an important part of any job, and cleaning and servicing machines, while it may seem like thankless work from the outside, can often be a rewarding way to understand the inner workings of a machine, and gain an appreciation for the complexity of the systems within. I also believe that if you look after the machine, the machine will look after you. Electrical cabinet layouts and schematics were also an important part of my work at RPM. Cabinet layouts involved a lot of hunting through manufacturer websites for part footprints, to know what size all of the components in the cabinet were going to be, as well as knowing the function of all the components and the connections between them, in order to arrange them in a way that made sense. Other factors influenced this, such as the physical and electrical separation of noise-sensitive components from large AC currents and voltages, and ensuring components that produced a large deal of heat were both in a place where they can be cooled properly and away from thermally sensitive components. Connecting pneumatic components was also a large part of my work at RPM, as the actuation for the robots there is roughly evenly split between electrical and pneumatic. This presented an interesting challenge, as our university course-work thus far has barely mentioned pneumatic actuation thus far, and I don't know what the reason for this is (if there is one). Pneumatic routing (Figure 5) was nice to work with, not having to worry about shorts or live wires at all, and the flow of air from compressor through valves to part generally being easier to visualize and mentally troubleshoot than electrical wiring. In addition to this, to check a component was receiving air, the hose simply needed to be unplugged, and the flow of air could be felt by hand.

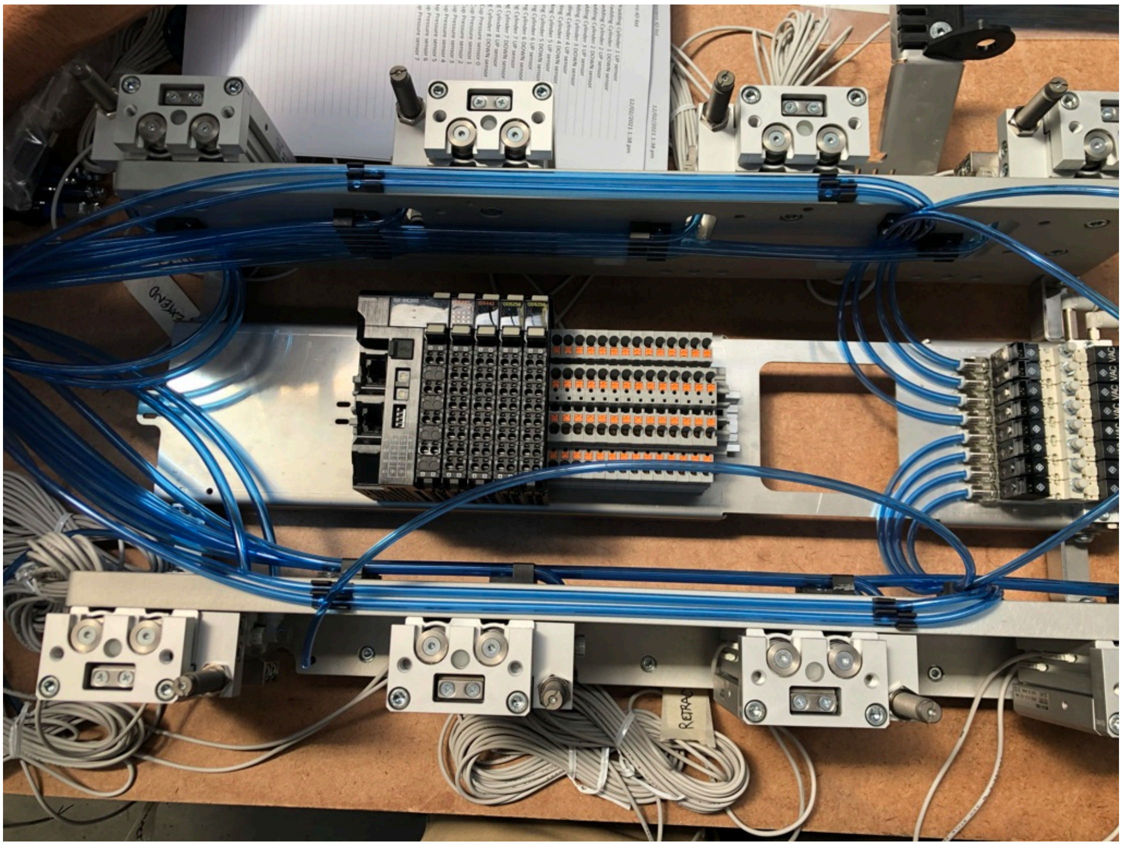

Figure 5: Pneumatic work on robot end-of-arm-tool.

5. DISCUSSION

I felt that the experience I gained at RPM was highly valuable. The machinists, toolmakers, engineers and technicians were all highly knowledgeable and willing to share that knowledge, and I benefitted from this immensely. The relevance of coursework was apparent early on, with concepts such as DFMA and the engineering process allowing me to make meaningful contributions to discussions and projects. A specific time when my university work related directly to my work at RPM was an issue we encountered with electrical noise in the limit switches on the tabletop CNC mill. Knowledge of electrical noise and filters from ENEL270 helped my diagnose the issue as electrical noise, and devise a simple low-pass filter with the correct characteristics to fix the problem. From a project I did in ENMT211, I was able to take this filter and bring it to life with a custom PCB, which I had fabricated, shipped, and then assembled and installed with soldering knowledge I gained in an ENEL270 workshop course. Knowledge of electrical circuits and circuit diagrams from these courses also served me well at RPM. Without experience in circuit design and reading circuit diagrams that I gained directly from my courses, I wouldn't have been able to assist the design department in making the electrical diagrams for the shop robots. Potentially the most valuable relation to course teaching would be from the mechanical engineering workshop course I completed last year. Without the experience in machining I had gained from this course, I would have been completely out of my depth on the tools in the shop, and I think the ability to start working effectively on the lathes and mills from day one was invaluable to my perceived competence in the shop. Various metrology concepts, particularly how to correctly take measurements, were also useful to me during my time at RPM. Though I was familiar with CAD before university, the large amount of practice we got last year also helped prepare me for using CAD in a workshop setting, for finding dimensions and orientations of parts, as well as small CNC projects on the tabletop mill.

6. CONCLUSION

I immensely enjoyed my time at RPM. Being able to use the work I have done at university practically, and have it apply so widely, was a gratifying experience. Doing the work that I'm studying to do and finding that I do enjoy it outside of university was also rewarding, confirming that I'm studying to do work that I enjoy doing. I often felt that even if work experience was not compulsory for my degree I would have loved to work at RPM, and I'm glad of the opportunity. I feel that I have gained a great deal of experience, and in particular a very wide range of experience, which is extremely valuable. I also have a much greater understanding now of why work experience is compulsory as part of an engineering degree, as there is no more effective way to teach the intricacies of working in the field. Experience with customer relations, company relations, employee relations, work ethic and etiquette, are at least as important as the practical experience on the tools and machines to the success of the engineer, in my opinion.

PART B: SELF-REVIEW

DECLARATION

I, Jackson Crawford, certify that this report (except where indicated) is entirely my own work and I undertake that the contents of Part B: Self-Review shall remain confidential between me and the College of Engineering and will not be disclosed to any other party.

1. LEARNING OUTCOMES

1.1 Tolerances

Tolerances are a relatively simple concept, and they are taught in university engineering courses. Thus, I was familiar with tolerances and how and why they're used from my university work. However, I feel I didn't really understand them until I started working with machining in a commercial environment, where tolerances are essential. Previously, when I was machining, I would view the tolerance as a target to land inside, which is correct, but I would still try to get a better tolerance, whether out of pride or to get more practice for the machines. In a commercial environment, this is not the correct approach. Tolerances are carefully specified by engineers during the design phase, and if something has a tolerance it means it will do the job it's supposed to do, as it's supposed to do it, as long as the part is within tolerance. Trying to get better tolerance than is specified is at best indulgent and proud, and at worst a gratuitous waste of time and resources. From my time at RPM I have learned to accept that a part's tolerance is specified during the design phase, and not by me (in this case), and this has allowed me to greatly increase the speed at which I machine parts.

1.2 DFMA

DFMA, or design for manufacture and assembly, was taught during ENMT211 or 221 last year. It encompasses designing products in such a way as to speed up the production and manufacture process of those products, and includes assembly, fasteners, materials, processes and geometry, among other concepts to bear in mind. Before university I had only ever designed things to be manufactured and assembled by myself, and this can simultaneously minimise and maximise the importance of DFMA principles. On the one hand, you are motivated to design in a way that's easy to assemble as you are ultimately going to have to assemble it, and on the other hand, sometimes you just want to get the job done, and without a client to disappoint or a reputation uphold, sometimes a quick sloppy job is what you end up with. DFMA is mostly common sense however, and I was surprised to what degree some of the designs I worked on did not incorporate it, and how much I noticed it. The designers at RPM were without a doubt skilled and experienced, and I think I'd be out of line saying I could have done a better job than them, but I also think some things are easy to overlook in the design stage, and I could have had some valuable input. A simple example of this is a wadding stand I worked on, that consisted of three internally tapped steel rods with some CNC'd aluminium parts arranging them into a kind of tube. For this very simple part, 5 different lengths of capscrews were used, in M4, M5, and M6. The different sizes of capscrew were entirely unnecessary as far as I can tell, as the parts were not load bearing nor were the small capscrews selected due to size constraints, as there was plenty of space. Tight tolerances between the rods and the aluminium also made aligning the rods time-consuming, and they were locked in by grub-screws anyway, so the tight tolerance was entirely unnecessary. This was just one example of several, and this experience has made me determined to strongly consider DFMA principles in my designs in future, as a small amount of time and thought in the design process could potentially save hours of frustrating, thankless work on the shop floor.

2. ISSUES

N/A

3. SELF-REVIEW AGAINST COMPETENCIES

3.1 Ethics

Ethics in the context of the automation industry are a topic of hot debate, and it is often argued that advancements in robotics and automation are unethical as they displace people from their jobs. I think there is an element of truth to this, but the jobs created to design, install, maintain and assist the automated systems cannot be ignored. This is more of an industry issue, rather than the individual employee. I believe at the employee level, ethics in a machine shop come down to the responsibility to make a product that is safe, and works. The engineering New Zealand code of conduct is one way the industry enforces this, and upholds all engineers to a standard of trust. One example of an area where the automation industry is potentially not ethically sound is John Deere. The rapid rate of technological advancement in the agricultural industry has led to hugely integrated and intelligent farming machinery. This is helpful to the farmer no doubt, until the machine breaks, and John Deere's proprietary software and hardware that they legally do not have to make available to the public means the farmer has only one place he can go to fix his tractor, and they can charge him however much they like. I think the complexity of the machinery we interact with every day means it's infeasible for everything to be user-repairable by anyone, but the option should be there for anyone sufficiently skilled or willing to learn.

3.2 Health, Safety and Wellbeing

The hazards at RPM were numerous and varied. Cranes, machines, spinning lathes, cutting instruments, high-voltage EDM machines, hot welded metal, dangerous substances, and many more. The main hazards that I dealt with on a daily basis were hazards from machines, mainly moving parts, e.g powered bench feeds or rotating cutting heads, hazards involved in the process of machining, e.g swarf, spilt coolant, and hot workpieces, and electrical hazards during wiring together machines. The main and most effective way the employer minimised harm was providing me with the knowledge of these hazards. In this way I was aware of the danger of the situations I was placing myself in and could take reasonable precautions to ensure my own safety. I was always provided with all the PPE that I needed, and it was ensured that I was coached in the operation of every machine or task I undertook, to both inform me of the hazards involved and to make sure I could work effectively. These were good practices and served me well. The safety induction was comprehensive, and presented in such a way that the knowledge actually stuck with me. The organisations wellbeing programmes, such as they were, helped me form a camaraderie with the employees there, which made my work more effective and my time more enjoyable.

3.3 Application of Engineering

An area where engineering is implemented extensively at RPM specifically is in CNC machining. Personally, I find that manual machining can be extremely draining, mentally and physically. Working to a schedule while trying to produce parts to tolerance and shape that a client has paid their hard-earned money for is incredibly stressful for me, with my relative lack of experience. CNC machining, while in no way requiring less skill, allows the hard physical work to be done by the machine, allowing the engineer to focus on the mental aspect, e.g making sure the job comes out correctly. In addition to this, it allows parts and processes that would otherwise take years of experience or even be completely possible for humans to achieve, to be machined with relative ease. Cranes and forklifts also allow a single operator to easily lift a part that a team of fifty could not budge, and do it without breaking a sweat.

3.4 Natural Environment

I consider that this competency does not apply.

3.5 Bicultural/Multi-cultural

I consider that this competency does not apply