PHOTONIC | ENTERPRISE PORTFOLIO AUS NATIONAL FINALS

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TEAM ROLES & COLLABORATION

Welcome

We are Photonic Racing, competing in the 2021 Australian National Finals. There are 3 of us in the team: Nick Hayes, Oliver Freeman and John Zhu. We strive to innovate, grown, excel and to shine brighter. Welcome to our Enterprise Portfolio.
Note: a significant portion of this document has been taken from our State Finals portfolio, and is referenced here:
Hayes, N., Zhu, J., & Freeman, O. (2020). Photonic Racing NSW State Finals Enterprise Portfolio [PDF] (pp. 1-10).

Contents

Our Previous Teams

Photonic Racing is consists of three members from three teams, Awaken (2020 National Finalist), Thrust Vector (2019 National Champion) and Paradoxum (2019 World Finalist). With the combined experience of 9 past competitions, we are now competing in the 2021 National Finals in the Professional Senior Class, and we hope to excel in all areas of the competition.

Roles & Responsibilities

We are a team of only three members but used our extensive F1 in Schools experience to our advantage when allocating roles and planning responsibilities. We are a comparatively small team, therefore our organisation of tasks is paramount to our success. We undertook a comprehensive evaluation of each of our team members skillsets and experience, which allowed us to allocate roles in which we could each flourish and excel. Before beginning work, each team member was given clearly defined responsibilities and expectations, ensuring we all knew the standard and scope of the work that was required. We then analysed and deconstructed the competition deliverables and set out micro-deliverables, goals and timeframes for each member. These were tailored to each of our roles and skillsets, enabling optimal efficiency throughout our preparation for the competition.

Nick Hayes

Team Manager & Digital Designer

As Team Manager, Nick's responsibility is to oversee the team's timeframes and ensure the quality of all our deliverables and that they meet the standards we have set. His experiences of this competition at the highest level have given him a wealth of knowledge about what is required of a successful team. As the Digital Designer, Nick invests time into researching and designing prototype cars that push the boundaries of technical innovation. Nick is also responsible for producing and maintaining the external image of our team, viewed by stakeholders and the public. Nicks roles and contributions to the team are a reflection of his skills with digital software.

John Zhu

Manufacturing & Innovations Engineer

John's role as Manufacturing Engineer encompasses the planning, organisation and innovation of each phase of the manufacturing process. His responsibilities include overseeing quality control and assembly of our car, as well as ensuring the final product represents our teams high standard.
As Innovations Engineer, John ideates and identifies unique possibilities for improvements for all areas of the project. These responsibilities as Manufacturing & Innovations innovations are tailored to his dispositions as a creative thinker and problem solver as well as his attention to detail.

Oliver Freeman

Testing & Resource Manager

Oliver's responsibilities as a testing engineer include the testing and fine-tuning of the car, incorporating his experience and extensive knowledge of aerodynamic principles and simulation software. He analyses aerodynamic and structural KPIs (Key Performance Indicators) to identify areas of improvement for future iterations. His role as Resource Manager involves effective planning and utilisation of Photonic Racing's financial, physical and informational resources, as well as ensuring anticipated expenditures can be met and accounted for.

Team Collaboration

As we are a small team, we were presented with the unique challenge of more demanding workloads than we had previously experienced, but the advantage of flexibility and agility that a small team enables. Our collaboration model involved clearly defining our individual roles, then identifying and outlining areas where collaboration between members would enhance deliverable quality, and minimise workload. Each member was familiarised with all project elements, the expectations associated with them and the collaboration we had planned to achieve that. Our frequent communication ensured that the process of updating team members on progress and organising meetings was streamlined. This model meant that each team member could lead the project areas in which they had the most experience, whilst being open to ideas, assistance, skills and experience from other team members. Our clearly defined and consistent methods of collaboration and group ideation allowed us to work symbiotically to utilise our skills to produce work that is reflective of our team as a whole.

A team interaction diagram, illustrating the responsibilities of each member and how those responsibilities are shared.

SCOPE & TIME MANAGEMENT

Project Planning

From the very beginning of our F1 in Schools project, we were well aware of the limitations that a team of 3 presented, and the importance of managing all aspects of our team, resources and project as effectively as possible. Before even beginning our project planning phase, we researched and learnt as much about project management as we could, to better understand how top companies managed projects and teams, and how we could integrate some of the key management concepts into our team, allowing us to work to our full capacity. We have introduced concepts such as Gantt Charts, Work Breakdown Flowcharts, and departmental budgeting into our project management scheme to maximise our resource and time utilisation. Our consistency in project management, whether with intra-team or external communication, scope requirements, workload breakdown, time management or budgeting, allowed each team member to work at a consistently high level, and understand exactly what the team required to achieve our goals.

Scope Management

Our project scope management was key in allowing us as a team to understand what the F1 in Schools project requires from us, the deliverables we had to produce, and how we should best achieve them. We created a project management document that each team member had access to, including our project scope management plan (see table below, a condensed version of our graph). To begin with, we decomposed our project into specific deliverables, then each deliverable into its core components. This scope decomposition allowed us to simplify the overall project into manageable tasks, to which we could then allocate time, resources and responsibility. From here, for each deliverable, we discussed our goals and expectations of quality and collated specific requirements we wanted to achieve for each, meaning whatever work we completed had to meet our criteria which, when met, meant that our deliverables were of sufficiently high quality. Our decomposition and allocation of requirements meant that we were always working within a scaffold and knew what standards we were working toward. Once the scope of each deliverable was determined, we created a Work Breakdown Flowchart for each deliverable, and Gantt Chart for our overall project, giving all deliverables a specific timeframe. Finally, we anticipated any pitfalls associated with each project deliverable, and devised contingency measures for each, whether it was allocating extra funds or time, or using existing content as a contingency. Our extensive measures are taken to plan and control our project allowed us to each work on specific tasks, and understand how they fit into our broader project scope, as well as the standards required, and mitigate any risks of scope creep, ensuring our project was completed on time, and to the highest quality.

Project Deliverable	Project Goals	Components	Responsibilities	Time Planning	Plan Change Backup
Car	Extensive testing and refinement Innovative and justified design High quality manufacturing process	Testing Refinement Final Product	Nick - CAD Oliver - Testing and refinement John - Manufacturing	Expected Time Taken: 12 weeks Time Alotted: 16 weeks	Use most recent car design and begin manufacturing if design process not completed
Engineering Portfolio	Detailed information that meets criteria Visualisation of car refinement and data	Text Data Graphic Design	Nick - Graphics Oliver - Data and Charts All - Text	Expected Time Taken: 3 weeks Time Alotted: 4 weeks	Use available graphic design and data/charts to construct portfolio
Enterprise Portfolio	Detailed information that meets criteria Key summary of project management	Text Charts Graphic Design	Nick - Graphics All - Text and communication of project management	Expected Time Taken: 3 weeks Time Alotted: 4 weeks	Use available graphic design and data/charts to construct portfolio
Trade Display (Video Format)	Aesthetically pleasing and immersive design that engages and informs	Refinement Final Design Video presentation	All - Refinement of final design John - Video render	Expected Time Taken: 3 weeks Time Alotted: 4 weeks	If not enough time to render a video, use an image render of display.
Verbal Presentation (Video Format)	Meets criteria Presented in an engaging manner Innovative and memorable	Script Presentation Video	All - Preparation and production of video	Expected Time Taken: 2 weeks Time Alotted: 3 weeks	Spend 1 day dedicated to writing and filming the video, using available data.
Engineering Interview (Video Format)	Meets criteria Presented in an engaging manner Innovative and memorable	Proof of testing and refinement Clear communication of ideas Final Video	Nick - CAD criteria Oliver - Testing and refinement criteria John. - Manufacturing criteria	Expected Time Taken: 2 weeks Time Alotted: 3 weeks	Spend 1 day dedicated to writing and filming the video, using available data.
Enterprise Interview (Video Format)	Meets criteria Presented in an engaging manner Innovative and memorable	Proof of project management Clear communication of ideas Final Video	Nick - Graphics and team identity criteria Oliver - Project Management criteria John - Fundraising and Sponsorship criteria	Expected Time Taken: 2 weeks Time Alotted: 3 weeks	Spend 1 day dedicated to writing and filming the video, using available data.
Fundraising	Well managed budget Professional communication with sponsors and dontators	Sponsorships (Proposal and communication) Donations (GoFundMe)	All - Sponsorship proposal John - Communication with sponsors and donors	Expected Time Taken: 8 weeks Time Alotted: 12 weeks	If not enough money raised, borrow from school and pay back later.

Time & Task Management

Our project scope management and decomposition allowed us to determine specific tasks to be completed and allocated to the most competent and knowledgeable team member. To contextualise these tasks within our project timeframe, we created a Gantt Chart to guide our time management, visualise workloads for each member, and allocate primary and secondary responsibilities to each member. We predicted the duration for each task, and accounted for how each task would affect, or flow on to others, and organised our schedule to most effectively structure our work, allowing each team member to be working within their field of expertise at all times. Creating this chart allowed us to easily see what work had to be completed by a specific date, who was responsible for each task, and linked to our project scope and deliverables requirements for quality and requirements of work. We split our time management processes into two categories, long-term planning, incorporating our Gantt Chart, and consisting of the broader scope of our deliverables, and short term planning, which consisted of consistent reviews of work, scope updates and alterations, and daily or weekly in-person meetings.

Short-Term Time Management

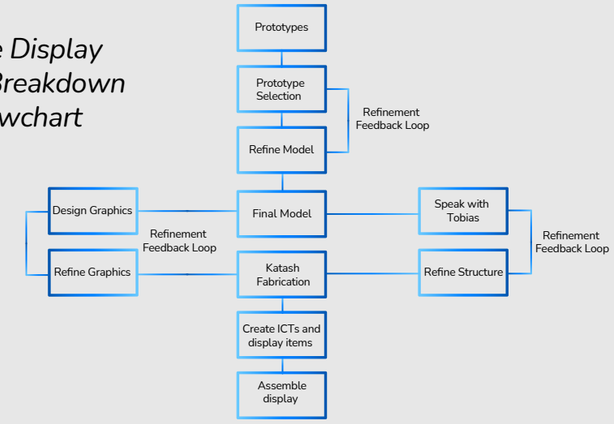
Our short-term time management consisted mainly of regular progress checks, which fed into our long-term planning and necessary adjustments of our Gantt Chart. We organised weekly meetings after school when all team members could be present, allowing us to check our progress, adjust our timeframes if necessary, as well as collaborate on tasks in person. During these meetings, we also checked and allocated work to be completed in the coming week, following our Gantt Chart. Assigning each member weekly tasks kept the organisation simple and easy to follow, enhancing our productivity. In addition to this, whenever we felt it was required, we could easily schedule group phone calls, discord chats, or in-person meetings at school to get advice, help or simply update the team on developments. Our consistent and frequent communication with regards to time management was invaluable to our completion of the project deliverables, effective collaboration between team members, and dealing with unforeseen issues. Our approach to both long-term management and short-term task allocation and flexibility meant that everyone was up-to-date and could focus on their specific tasks, as well as collaborate as a team.

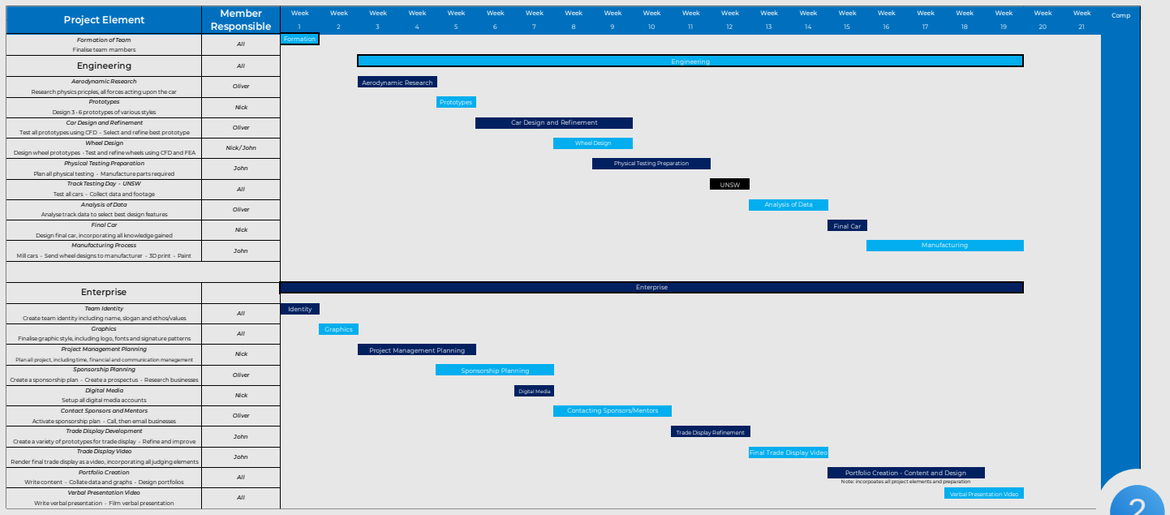
Lower Left: Our project scope planning table.
Lower Right: Our time planning Gantt Chart.

Long-Term Time Management

Our long-term time management consisted of the planning and creation of our Gantt Chart, as well as our broader goals for overall timeframes, and linking our tasks to our project and scope management plans. To create the Gantt Chart, we identified each base task, assigned a team member to primary and secondary responsibilities, placed each task into a timeframe, taking into account which tasks had to go in order, then allowed a two-week contingency at the end of our timeframe, to account for unforeseen challenges, such as our school's COVID-19 quarantine. This chart helped us to achieve effective intra-team collaboration by organising our roles and responsibilities and allocating multiple team members to given tasks based on their skills, as well as giving each member a stronger idea of how their tasks fit within the context of our broader project. The monitoring and control of our long-term time management was a critical component of making sure our time was effectively utilised and involved consistently updating the chart, as well as urgency or flexibility of our tasks and responsibilities. As well as our Gantt Chart, we also created Work Breakdown Flowcharts for each project deliverable, cars, portfolios, trade display, financing and presentations. These flowcharts allowed us to break each deliverable down into its core components and tasks, and the order in which they should be completed to flow on to one another. This visualisation of task interdependency helped us to organise our Gantt Chart and ensured each team member could collaborate on related tasks with a full understanding of how their work affects our overall deliverable. Our close attention to the planning and control of our time management meant that tasks never got out of hand or completed late, giving us enough time to ensure all work was of the utmost quality.

Trade Display Work Breakdown Flowchart





FINANCIAL & RISK MANAGEMENT

Financial Management

Effective financial management of our team is paramount to our success, as many of our requirements for project deliverables, such as parts, printing, or shirts cost require money or in-kind sponsorships. To acquire as much funding as possible, we developed 3 methods of fundraising; sponsorships, donations and fundraising events, allowing us to diversify our streams of income, and ensuring that we were never entirely dependent on a single type of income. Our 3 streams of income gave us a greater chance at raising more money.

Sponsorships

Our team's primary source of income has been sponsorships, either in monetary, in-kind, or services. Due to the ongoing COVID-19 pandemic, and the associated economic recession, we understood sponsorship opportunities would be more limited than usual, and so we focussed efforts on maintaining effective methods of sponsorship acquisition and regular contact with stakeholders. We created a prospectus outlining the competition, our team, and terms of sponsorship to give to prospective sponsors, and ensured that either a physical or digital copy was available. As we are entering a national competition, as opposed to the regional and state competitions, we have broadened our sponsorship efforts to larger, state or nationwide businesses, as they would receive the most ROI from our presence at a national competition.

Donations

To acquire as many donations as possible, we set up a GoFundMe page, a popular and well-known platform that allows people to donate money to various causes and people. We have promoted and linked this on all our platforms of social media and website, ensuring that thousands of people knew that we were accepting donations and could easily access our page. Though we were realistic about our expectations of donations and acknowledged they would likely total less than other streams of income, we have still raised a considerable amount through our GoFundMe.

Fundraising Events

Our final source of income is through community fundraising events that we planned and held. Though we planned community-wide events such as stalls, workshops, race evenings or car shows, these could not be accomplished due to the COVID-19 concerns of holding a large gathering. We did manage to organise and hold an F1-themed dress day at our school and raised over $600 from gold coin donations. This event was extremely successful in both raising money and raising awareness of F1 in Schools and the profile of our team.

Budgeting

During our early planning phase, we researched various budgeting methods and found that slightly adjusting a departmental-style budget would most effectively suit our needs and allow us to manage our funds efficiently. Our budget is split into project section, and sub-sections, visualising and organising our costs. We then predicted the expenditure of each sector, based on research and previous experience. This allowed us to accurately predict how much money we would need, and account for contingency funds for each sector. To maximise our budget we diversified our income sources. As money was coming in from various sources, we noted the date, amount and source in our budget, meaning we could easily see where our money was coming from and where we should focus fundraising efforts. For each expenditure, we tracked the cost against our predicted cost, to see if we had over-budgeted or under-budgeted. We found that for each area, we had over-budgeted, and didn't have to use our contingency funds. Once the competition shifted from a physical competition in Melbourne to a virtual competition, this freed up many funds from accommodation and travel, allowing us a large contingency fund in case of unforeseen emergencies. Our comprehensive budgeting methods of tracking predicted spend and income vs actual spend and income, as well as budgeting for changes and flexibility, meaning that we were never short on funds.

INCOME	Projected Income	Actual Income	Difference
Sponsorships	$ 5,000.00	$8,575	$ (3,575.00)
Community Fundraising	$ 200.00	$316.50	$ (116.50)
Donations	$ 50.00	325	$ (275.00)
Other			$ -
TOTAL	**$ 5,250.00**	**$ 9,216.50**	

EXPENSES	Projected Cost	Actual Cost	Difference
ENGINEERING			
Simulating Software	$ -		$ -
Rendering Software	$ -		$ -
Lathed Parts	$ 750.00	$ 180.00	$ 570.00
3D Printed Parts	$ 250.00	$ -	$ 250.00
Paint	$ 40.00	$ 20.00	$ 20.00
Primer	$ 20.00	$ 13.50	$ 6.50
Adhesives	$ 20.00	$ 16.00	$ 4.00
Physical Testing Equipment	$ 200.00	$ 320.00	$ (120.00)
Tool Kit	$ 50.00	$ -	$ 50.00
Decals	$ 30.00	$ 30.00	$ -
	$ 1,360.00	**$ 579.50**	$ 780.50
MERCHANDISE			
Phone Cases	$ 150.00	$ -	$ 150.00
Wristbands	$ 150.00	$ -	$ 150.00
Pens	$ 200.00	$ -	$ 200.00
Caps	$ 150.00	$ -	$ 150.00
Stickers	$ 50.00	$ -	$ 50.00
T-Shirts	$ -	$ -	
	$ 700.00	**$ -**	$ 700.00
TRADE DISPLAY			
Cardboard	$ 500.00	$ -	$ 500.00
ICT Displays	$ 350.00	$ 290.00	$ 60.00
Vinyl	$ 250.00	$ -	$ 250.00
Transport Fees	$ 250.00	$ -	$ 250.00
Power Cables/Blocks	$ 50.00	$ 25.00	$ 25.00
Set Up Tools	$ 50.00	$ -	$ 50.00
Other	$ 200.00	$ -	$ 200.00
	$ 1,350.00	**$ 290.00**	$ 1,060.00
TEAM UNIFORMS			
Polo Shirts - Travel and Competition	$ 500.00	$ 365.00	$ 135.00
Hoodies	$ 360.00	$ 153.00	$ 207.00
Bottoms	$ 200.00	$ -	$ 200.00
Shoes	$ 250.00	$ -	$ 250.00
	$ 1,310.00	**$ 518.00**	$ 792.00
PRINTING			
Portfolios	$ 150.00	$ 100.00	
Posters	$ 250.00	$ -	$ 250.00
	$ 400.00	**$ 100.00**	$ 300.00
TRAVEL			
Airfare	$ -	$ -	
Accommodation	$ 2,500.00	$ -	$ 2,500.00
Food	$ 1,000.00	$ -	$ 1,000.00
Entertainment	$ 700.00	$ -	$ 700.00
	$ 4,200.00	$ -	$ 4,200.00
TOTAL	**$ 9,320.00**	**$ 1,487.50**	**$ 7,832.50**

Risk Management

There are various risks associated with this competition, to both individuals and the team's success. We have created a risk-management plan to identify, manage, mitigate and track the risks associated with the competition. For each possible risk, we first identified the consequences, the likelihood and severity of each. Using our risk-severity matrix, we placed it on the scale and deemed it an acceptable or unacceptable level of risk (acceptable being 3 or below). Once these factors were identified, we devised strategies and methods of reducing the likelihood of occurrence, as well as the severity of the consequences, then re-evaluated its score on the risk-severity matrix with management processes in place. Finally, for each risk, we developed contingency plans, as well as identified the trigger for each contingency plan, or the point at which we would implement our contingency plan. We believe we have managed the risks to us and the team extremely well, and greatly reduced the chances of any circumstances reducing our ability to compete to our high standards.

Above: Our initial budget.
Right: Risk severity matrix.
Below: Risk assessment table.

Risk-Severity Matrix

	Very Unlikely	*Unlikely*	*Likely*	*Very Likely*
Minor	1	2	3	4
Moderate	2	3	4	5
Severe	3	4	5	6
Catastrophic	4	5	6	7

Risk	Consequence	Matrix Score	Risk Reduction Strategies	Contingency Plan	Contingency Plan Trigger
Illness	Health issues, possible infection of others, inability to work.	3 Moderate - Unlikely	Sanitise hands before using tools, wipe down desks after use.	Isolate until recovered, ensure online work is possible.	High temperature, not feeling well, cough/sniffle.
Injury	Possibly lasting health issues, inability to work.	3 - 4 Severe/Catastrophic - Very Unlikely	Always ensure knowledge of how to operate machinery, OnGuard safety tests	Call 000 if nessecary, if minor injury, ensure online work is possible.	Loud Screams
Team Disagreement	Unfinished work, team disharmony	3 Moderate - Unlikely	Communicate frequently, allow everybody to have input.	Take a vote, or member managing project element decides.	2 people disagreeing, inability to compromise after 2-3 days.
Lack of Time	Unfinished project elements	4 Severe - Unlikely	Plan time using a Gantt chart, allow a buffer zone for unplanned setbacks.	For each element, create a backup option easily made in 1 week.	2 weeks until competition, project element nowhere near completion.
Lack of Funds	Unable to pay for expenses, possibly in debt	3 Severe - Very Unlikely	Plan finances using a chart, always budget extra for unplanned expenses	School will loan us funds if needed, giving us time to pay it back.	Expenses come within $100 of funds
Unable to Complete Planned Work	Low standard of work, loss of points in competition	3 Severe - Very Unlikely	Always ensure team member assigned to role has proficiency in field	For each element, create a backup plan that is simple to execute	All team members unsure how to complete task to standard set

COMMUNICATION & EVALUATION

Team Communication

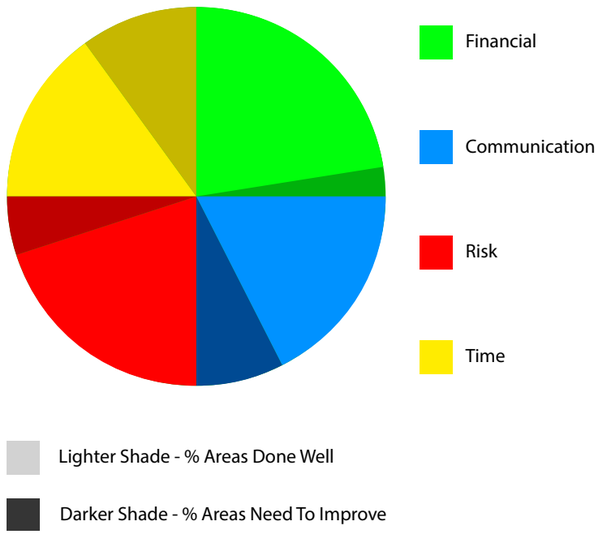
An ongoing part of our project management, consistent and effective communication across several methods or platforms is key in ensuring all team members are fully informed at all times, have access to all team documents, and those sponsors can communicate and are regularly updated about our team's progress. To maximise our team's internal communication, and resulting collaborations, we have created a detailed communication plan, outlining each type of communication, the respective platforms that should be used, and the goals of what we want that communication to achieve. Key to our internal communication was frequency and consistency, ensuring that all team members met either in-person or via Discord at least once per day, allowing constant team unity and understanding of current project goals. Weekly team meetings were scheduled every Wednesday after school, allowing us 2 hours together in the workshop to touch base, complete work as a team, and use any necessary equipment. Another element of our communication is file-sharing, and for this, we have used Google Drive, a free, online file storage system, that allowed us to organise and access any file at all times. Communication with stakeholders and mentors was also key to our success in fundraising and mentoring, so we incorporated these types of communication into our plan. To contact sponsors and mentors, we created our email account and domain, contact@photonicracing.com, from where we could send files, newsletters, and keep in regular contact with our stakeholders. We also scheduled zoom calls where necessary, which allowed us to engage in face-to-face conversations, which we found a far more efficient method of communication. Our multiple methods of intra-team and external communication gave us structured but flexible options for communication and allowed us to work cohesively as a strong team.

Communication	Method	Frequency	Goal	Benefits of Chosen Platform	Recipients
Team Discussions	In Person	Daily	Ensure all team members are fully aware of ideas, work required and project timeframes. Allowed for efficient collaboration on work.	Quick Easy to Organise Efficient	Team Members Teachers
Team Messaging	Discord	Daily	Used when team members are not together, allowing communication at all times. Quick and easy to use.	Always available Efficient Able to share photos/files	Team Members
Team Meetings	In Person	Weekly Every Wednesday	Scheduled team meetings for 2 hours every Wednesday. Allows efficient work and collaboration and access to school machinery and technology.	In-depth work possible All members present to collaborate Access to machinery	Team Members Teachers
Image / File Sharing	Google Drive	Always Available Files Uploaded as Soon as Complete	Cloud-based, so all team members can access. Allows sharing of large files and project elements, even when not in person	Cloud-based Organised Large file sizes available	Team Members
CAD Sharing	Onshape	Always Available Consistently Updated	Cloud-based, so all team members can access and view car design. Comments allow idea generation and conversation.	Ease of access Constantly updated Cloud-based	Team Members
CFD / FEA Analysis Sharing	Simscale	Always Available Contains all Engineering Data	Cloud-based, so all team members can access and view car airflow and part strength. Allows everyone quick and easy access to nessecary data.	Cloud-based Private All data easily available	Team Members Jousef Murad (Mentor)
Sponsorship Proposals	Gmail	Initial Sponsorship Proposal - One Time Monthly Updates	Initial phone call to propose sponsorship. Follow up email containging prospectus, and email used for all further correspondence.	Professional Easy to manage File transfers possible	Team Members Sponsors
Mentoring	Gmail / Skype	As Often as Required Usually Weekly	Initial phone call to propose mentorship. Further communication with flexible dates and methods. Gmail used for file sharing.	Flexible Face-to-face communication possible All members can access	Team Members Mentors

A table detailing our communication plan, covering all internal and external communication, for different types of information.

Management Evaluation

Throughout the process of planning and adhering to our competition preparation, we have evaluated, learnt from and refined our methods of scope, financial, communication, risk and time management. Our ongoing self-evaluations have allowed us to learn and improve in all areas of project management, improving our success as a team and in this competition. We have completed our final reflections and evaluations as a team on our management processes, what we did well, areas we can improve in, and we hope to learn and reflect on this to improve in all areas of management in future.



Financial Management Evaluation

Our financial management, budgeting plan, and sponsorship/stakeholder acquisition plan was created very early on in our project, which assisted us greatly in securing sponsors, stakeholders and funding. We utilised a departmental style budget, which worked well for us, was easy to update regularly and track, and helped result in our budget surplus.

Improvement Actions
- Spend more time and effort obtaining and contacting stakeholders
- Run more fundraising events where possible

Team Communication Evaluation

We believe we took advantage of our small team size, and communicated very well, resulting in great collaboration, easy issue resolution, and a smooth-running project. Though we feel that communication is a team strength, sometimes our communication with other stakeholders, especially external ones, was less effective than we would have liked.

Improvement Actions
- Communicate more frequently with sponsors and mentors, to reduce delays.
- Hold team meetings even more frequently when required to assist task completion.

Risk Management Evaluation

Our risk management plan was created early in the project, which helped us throughout the project. The only issue that arose that dramatically impacted our schedule was a COVID 19 outbreak at our school. All team members were tested, and proved negative, but access to machinery and materials was impacted for more than 2 weeks. A full shut down of senior school premises had not been anticipated in our risk management plan, but we worked around the situation by completing as many other tasks as possible.

Improvement Actions
- Create a more detailed plan and contingency plans.
- Anticipate effects of COVID-19.

Time Management Evaluation

We planned and monitored our time well, and adapted to changes in plans quickly and effectively. The Photonic Gantt chart proved very helpful, providing both a visual reference as well as detailed task and scheduling plans. Most tasks did take longer than expected due to balancing schoolwork with F1 in Schools project tasks.

Improvement Actions
- Begin work earlier, to avoid buildup of tasks toward deadline.
- Plan for school assessment schedules.

SKILLS DEVELOPMENT

Linking Skills With Careers

F1 in Schools has introduced us to a wide range of industry and life skills. The skills that we have learned and the experienced we have had through this competition have given us valuable insight into a range of potential careers.

Through the management of our team, we have been introduced to project management, time management, financial planning, budgeting, and communication. In branding our team we have learnt about graphic design, digital media strategies, website development and programming, organizing events, community outreach, teaching and mentoring, and display construction. Throughout the engineering process, we have learned about the design process, CAD software, CAM software, CFD and FEA, various aerodynamic and physical concepts, CNC routing, 3D printing and painting.

These skills and areas of knowledge that are promoted within F1 in Schools correlate closely with careers in the Australian Defence Force (ADF), or their industry partners.

The ADF offers a very wide range of career opportunities, spanning management, communication, public relations, engineering, and manufacturing areas, all of which correlate directly to skills that we have learnt during our participation in F1 in Schools.

The skills that we have learnt throughout this competition, both in our competition experiences and the skill development we have undertaken during mentoring relate to a variety of careers offered within the Defense Force and related defence industries.

Far Left: An aeronautical engineer maintaining a helicopter. This is just one example of the many careers that exist in the defence force.
Australian Defense Force. Military Helicopter [Image]. Retrieved 15 April 2021, from https://www.defencejobs.gov.au/jobs/army/aeronautical-engineer.

Project Management

The management of our team has introduced us to so many skills that are relevant in almost every career, such as collaboration and interaction, project work, time management and budgeting. These skills are used extensively in careers with the ADF, such as Accountant, Human Resources Officer, Logistics Officer, and Communication Systems Officer, areas where experience in planning, logistical thinking and effective communication are required.

Aerodynamic Design

During the design and analysis phases of our engineering process, we have learnt about aerodynamic principles that affect the performance of our car, and how to utilise them within our design. Concepts such as the Venturi effect, Bernoulli's Principle, and layers of air are all used in higher-order aerodynamic engineering. This knowledge of aerodynamics and design thinking is applicable in careers with the ADF, such as Aeronautical Engineer, Marine Engineer, Aerospace Engineer, or Airfield Engineer.

Manufacturing Processes

Much of the experience we have gained through the manufacturing of our cars, such as the use of machinery, G-code, sanding, priming, painting, finishing and quality control applies to any manufacturing industry, including the ADF. The experience and skills we have gained are valuable in careers such as Electronics Technician, Aircraft Fabricator, Aircraft Painter, Equipment Maintenance, or Motor Mechanic.

Communication

The communication between team members and the wider community was key to our team outreach and effective intra-team communication. We have learned how to communicate with others, concisely and effectively, using a variety of methods. These skills are critical in careers with the ADF, such as Communication Systems Officer, Learning and Development Manager, Logistics Manager, or Psychologist.

Branding

Throughout the development of our branding and team identity, we have gained experience in the creation and marketing of a brand. We have also learnt about graphic design, video production, website development, just to name a few. These can be implemented in careers such as Public Relations, Public Affairs Officer, or Liaison Officer.

Linking Skills With Careers

Nick - Flight Test Engineer

I would love to become a flight test engineer with the Department of Defence, analysing the mechanical state of various aircraft to determine flight safety. This also involves repairs and analysis to ensure all planes and helicopters are safe to fly. I have visited the RAAF base, and seen new Lockheed Martin aircraft, sparking my interest in this field. F1 in Schools has helped me with my critical thinking and analysis skills, creative thinking and innovation skills, and general engineering skills.

Oliver - Geospatial Intelligence Analyst

I have long been interested in maps and navigation but had never previously conceived a career in this field. Becoming a geospatial intelligence analyst for the Australian Army sounds like an amazing job, photographing, surveying, mapping, and making models of various terrains and areas to provide geospatial intelligence to the Army. This field needs precision measurements, and careful collection of data, things that F1 in schools has helped me greatly with.

John - Aeronautical Engineer

Before F1 in schools, I had no idea about my future career paths, but I now have a great interest in designing and aerodynamics and would love to become an aerodynamic or aerospace engineer with the Australian Defence Force. The main work involved in the maintenance of the Navy's fleet of helicopters, but there is the potential to work on various other projects. F1 in schools has opened my eyes to a multitude of career paths that I hadn't previously considered.

STAKEHOLDER PLAN

Overview

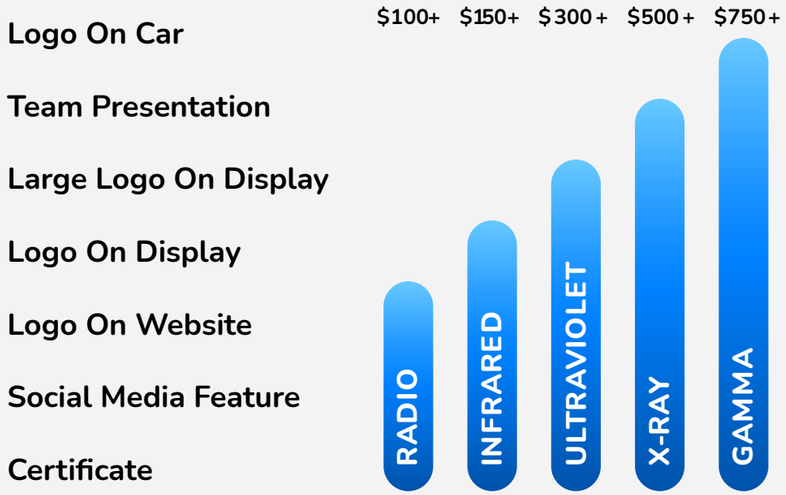
To control our approach to acquiring sponsors, stakeholders and mentors, we created a financial plan, as part of our larger project management plan, detailing our budgeting methods, streams of income, prospectuses for sponsors and mentors, our methods of finding and contacting potential stakeholders, and our contingency plans that link to our risk management plan. Creating this plan allowed us to be confident in our methods of gaining sponsorship and stakeholders and meant that each team member was confident in communication or collaboration with our stakeholders.

Sponsorship

As sponsorships were our primary source of income, we focussed much of our financial plan on the acquisition of sponsorships, as well as stakeholder ROIs (Return On Investments) and methods of ensuring consistent communication with all stakeholders. In previous competitions, we have contacted companies that matched the region of our level of competition, so for the Western Sydney Regionals competition we focussed on contacting local companies, as they would be more invested in the ROI we were able to offer, and for the NSW competition, we expanded to larger, state-wide companies. We continued this approach for the Nationals competition and began to contact larger Australian and even global companies, as well as more local businesses. This approach has worked well, earning us sponsorships from high-profile companies such as Ford. To give to each potential sponsor, we created a sponsorship prospectus, which gave details of what F1 in Schools is, who Photonic Racing is, our background, as well as details of the ROI that we could offer them. We had two methods of contacting businesses, either in person or via phone or email. We printed high-quality copies of our prospectus, then organised a day where we could all go to businesses in the Greater Sydney Area, talk with them about F1 in Schools, and give them a prospectus. The second method we used more frequently with businesses outside our area, we could call or email them, ensuring they got our prospectus, then follow up with consistent communication if they were interested in sponsorship. Once sponsorship was agreed to, we kept stakeholders consistently updated with regular emails or newsletters regarding our progress, to ensure that they were consistently engaged with our team and the project and could see how they were assisting our team. This detailed planning ensured that all team members could step into this role effectively if needed and meant that our methods of contacting sponsors were effective and well-received.

ROI Plan

We have created a Return on Investment (ROI) plan for each of our sponsors, which was explained and shown in our prospectus. This plan ensures that each of our stakeholders has an incentive to assist our team and that we could offer something in return for sponsorship or mentorship, increasing the chances of a business sponsoring us. We have created 5 different levels, or tiers of our ROI plan, that equate to various amounts of sponsorship, and to incentivise larger sponsorships. We have named them after different wavelengths of light, linking into our team name, Photonic. The various tiers provided differing levels of exposure both within and outside the actual competition, and thus advertising effectiveness. Our ROI benefits include logo placement on project deliverables such as the cars, portfolios, trade display or presentations, with larger stakeholders being afforded a more prominent presence on each of these. We also offered certificates of appreciation and a presentation/track demonstration to companies if they wanted to arrange one, allowing them a greater insight into what this competition is about, and what we do to compete. To ensure companies received ROIs that were adequate to their needs, we also offered tailored ROI plans if they wished. Our ROI plan has been extremely beneficial to both our team and our stakeholders in offering them exposure on various platforms and other benefits.



Mentorship Prospectus

In addition to our sponsorship prospectuses, we have created a mentorship prospectus to give to prospective mentors and in-kind sponsors, which is similar to our base sponsorship prospectus, but is tailored specifically to the individual or company group, and further explains our potential partnership with them. This allowed us to provide mentors or in-kind sponsors with detailed information and plans specific to their field or industry, meaning that they had a greater understanding of our potential partnership, and what it would entail. For our mentors, we allowed a flexible and extensive ROI plan, as we wanted to express gratitude for their time and to promote them as widely as possible. Our specifically tailored mentorship prospectuses allowed us to reach out to specific individuals or companies with relevant information, increasing the likelihood of a partnership with them.

Contacting Sponsors

To contact our chosen sponsors, we have created a plan to ensure that we engage the businesses as much as possible, and so every team member has a professional approach when contacting potential sponsors.

1. Call the sponsor and introduce our team and the competition. Ask for the contact of someone who can manage sponsorships.
2. If we get the contact of a different person, call them, introduce ourselves and the competition, and inquire about sponsorship.
3. Send a follow up email further detailing the competition, and reasons forsponsorship. This will also contain our prospectus.
4. If sponsorship is agreed to, ask the sponsor about the amount they will donate, and any specific ROIs they would like.
5. Agree on terms of sponsorship.
6. Email a sponsorship invoice, containing details of sponsorship level, ROIs, bank details, and business details.
7. Once funds are received, email a sponsorship receipt containing confirmation of deposit.
8. Follow up with agreed-upon ROI activities, including monthly progress emails to ensure that sponsors are engaged.

If at any point sponsorship is declined, we would send an email thanking them for their time and consideration of our proposal.

Far Right: Our national final sponsors & mentors.
Upper Right: A graphical representation of our ROI options, and their associated donation range.

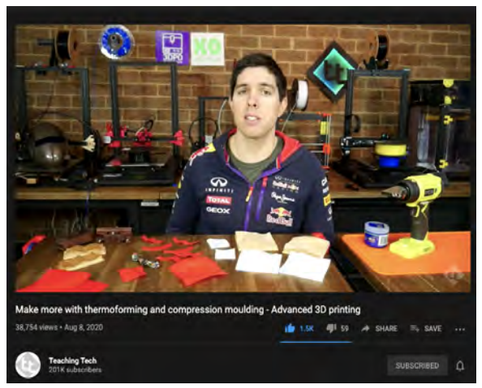
MARKETING

Overview

Our team's marketing strategy has been deliberate and constructed to achieve our primary goals of increasing the profile of our team within and outside the F1 in Schools community, secure funding and mentorship, engage team stakeholders, as well as to create a strong, recognizable brand with a large online presence. To achieve this, we have utilised as many social media platforms as possible and built a large audience for our content, designed and created our website to where we can direct traffic and present information about our team and the competition, as well as broader community initiatives such as our F1 in Schools Co-Curricular program we are running at our school. Our approach has been carefully designed to target as many different demographics as possible and to maximise our outreach to various communities as well as potential stakeholders. All team pages and sites have consistent and instantly recognizable Photonic Racing branding, such as our colours, logo(s), and fonts, to promote a cohesive team brand. We believe our marketing approach, both physically and digitally has been extremely successful in achieving our objectives.

Teaching Tech Collaboration

One of the cornerstones of our marketing strategy is our collaboration with the YouTube channel Teaching Tech, run by Michael Laws, an engineer and design expert based in the Blue Mountains. His channel currently has over 250,000 subscribers, nearly all of whom would be interested and engaged in his engineering-related content. Being able to promote our team, and engage with this specific demographic is extremely beneficial to our efforts in building an audience interested in our team and content. Our team is featured in one of his videos, titled Make More with Thermoforming and Compression Moulding, in which we speak about our experiences in F1 in Schools, the design requirements of our car, and test and explore the benefits of thermoforming plastic parts in the manufacture of our car. This video provided an interesting and relevant insight into our team and related it to topics that the viewers of this video find engaging. Through this video, we have been able to reach out to over 50,000 potential new audience members and link our social media sites and websites for easy access. This opportunity has been invaluable to our team and our brand, as it has allowed us to promote both our team and the F1 in Schools competition to a far wider audience than before and increase engagement and support of our team in the wider community.



A clip of Teaching Tech's video featuring our team.

Laws, M. (2020). Make more with thermoforming and compression moulding - Advanced 3D printing [Video]. Retrieved 15 April 2021, from https://www.youtube.com/watch?v=ywLc-qOu_0ZI.

Digital Media Strategy

Website - photonicracing.com

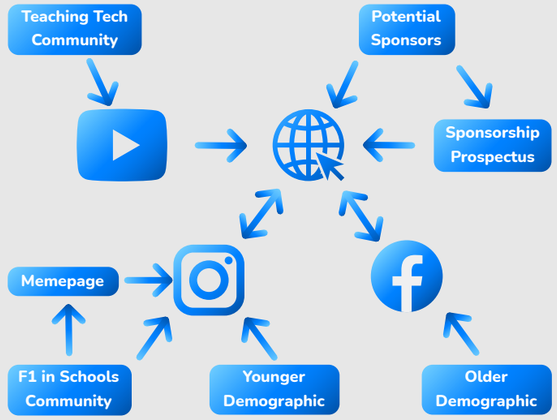
In our digital presence network (see above), all social media sites are linked to and feed into our website. We feel that an effective team website is the best way to present detailed information about our team to a wide audience in an easily digestible and understandable manner. To most effectively utilise the website format, we have written and coded our website from scratch, and hosted for free on GitHub, allowing us to add key features that would otherwise be unavailable when using a website tool, such as linked information boxes, parallax scrolling, and custom icons. We have complete control over our website, free of cost, and have designed it to be as user-friendly as possible, whilst remaining an important source of information on our team. As we have designed it with sponsorship acquisition in mind, any potential sponsors or stakeholders can easily access our sponsorship prospectuses and contact details, streamlining the process and increasing the likelihood of sponsorship offers. Our custom website has been a huge success and is critical to our digital presence.

Instagram - @photonicracing

As part of our social media strategy, we have used Instagram, an online image and video-sharing platform, mainly populated by a younger demographic. We have utilised our Instagram page to target this younger demographic and build as large an audience as possible, from which we can link and redirect to our website and other social media pages. We have posted on this account regularly, with frequent updates, images of us working, and expressions of gratitude to our stakeholders (part of our ROI plan). To maintain a strong brand image, even when viewing individual images, we designed and used a matching border for each post, in our blue branding wave pattern, that when viewed as a whole, lined up to create a large network of waves encompassing our posts. Our frequent posts and stories allowed us a high level of user engagement and growth, as we currently have over 600 followers, helping feed into our digital presence network and strengthening our online audience.

Facebook - @photonicracing

Similar to our Instagram account, we used Facebook, which is an online image-sharing and messaging platform. Facebook is by far the most popular social media site for adults and an older demographic, and similar to our Instagram account, our Facebook page was designed to target this older demographic. We have maintained our strong branding image through the use of similar borders to those described above, as well as featuring our logo on our homepage. A key distinction to make between these two sites was the more likely presence of companies and potential stakeholders, so our content on this site was more geared toward promoting our team and directing potential stakeholders to our website and prospectus. We also regularly posted progress updates and expressions of gratitude to our sponsors. Our Facebook page has been another key element of our digital presence and has helped to grow our brand in a range of communities.



Left: A diagram illustrating our social media strategy.

Below: A screenshot of our 'memepage.'

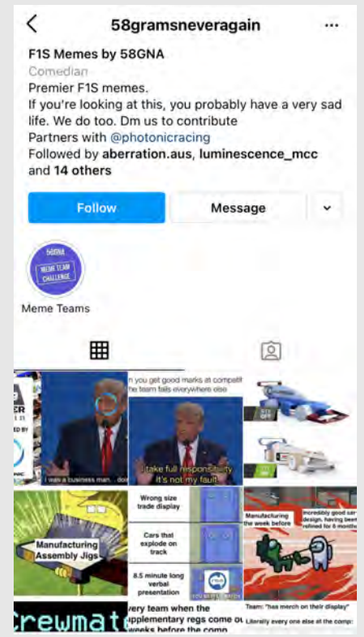
Community Involvement

Co-Curricular Program

To raise the profile of not just our team, but F1 in Schools as a whole within our school community, we have designed, organised and run an F1 in Schools co-curricular program for any students wishing to compete. This allows anyone in our school, in any year to compete, as previously F1 in Schools was limited to the Design and Technology classes. We hold mentoring sessions once a week, after school on Wednesdays for all teams competing, to teach them the skills required, and mentor them as they do their work. This program is already showing its success, with two Development Class teams qualifying for the 2021 National Finals, the most ever in a single season.

Secondary Instagram 'Memepage'

In addition to our primary digital media platforms, we have developed an innovative and creative method of reaching out to as many people involved in the F1S global community as possible. We run a page on Instagram where we post satirical content on a variety of topics relating to F1S, often referred to as a 'meme page'. It is called 58GramsNeverAgain, and we regularly post humorous and relatable memes, specific to F1S Doing this allows us to specifically target the F1S community, in a unique, innovative, memorable way. From this page, which has a much larger audience than any of our primary media platforms, we can market our team, and redirect followers to our primary media platforms, to a much broader and more engaged audience than our primary social media platforms. Some of our content has attracted audiences outside of F1 in Schools, such as other REA programs and people from the wider STEM community.



TEAM BRANDING

Primary Branding

Team Name

Our team name is Photonic Racing, referring to the photon, a particle of light that is the fastest known thing in existence. Our core aspiration is to create a car that races as fast as possible, as well as to speed past all other teams in the competition, and we believe that this name most accurately reflects these values and exemplifies our team. This name is a product of extensive brainstorming, refining, and various concepts and iterations such as Vanguard, Omni, Midas Racing or EmbRace.

PHOTONIC

Logo

As the logo is our key branding element, and the most widely utilised of all branding elements, we have put extreme care and thought into the design of our logo, its connotations and meaning, and its use on our branding and project elements. Our logo is simple, but effective and meaningful, as well as easily used in nearly all branding applications. Our core icon is a stylised photon ring, strengthening the connection to our branding, with 3 sections, representative of our 3 team members uniting to form one team, as well as our team's history of our 3 original teams, Thrust Vector, Paradoxum and Awaken. is easy on the eye, doesn't overwhelm other branding elements visually and can be used either with our signature gradient on each section or as a greyscale icon, increasing its versatility. The icon can be used as a standalone logo, or in conjunction with our team name in a slightly modified K2D font (see above). Our ability to use two logos further increases our branding versatility whilst maintaining a consistent branding image. Our final logo is a culmination of an extensive and nuanced design process, spanning over 20 various logo iterations and concepts, each utilising different shapes, colours and fonts.

PHOTONIC

PHOTONIC
SHINE BRIGHTER

Three of our previous logo designs. The upper logo was used for the NSW State Finals, and the lower left logo was used for the Western Sydney Regionals.

Additional Branding

Colours

For our colour palette, we decided to use a blue-on-white scheme, as this is a subtle, clean, yet extremely good-looking and effective scheme, in keeping with our understated branding style. We have 3 different blues that form to create a gradient, either of which can be used in branding applications. The choice of using blue also pays homage to our previous teams, Thrust Vector and Paradoxum, who also used predominantly blue branding, as well as our home, the Blue Mountains, whereas the incorporation of a gradient pays homage to Awaken Racing's iconic gradient branding scheme.

RGB	HEX	Colour	Gradient
70, 178, 255	#46b2ff		
0, 130, 255	#0082ff		
0, 83, 172	#0053ac		

Fonts & Typography

Our team fonts have been selected for effective readability, good scaling, and consistency in branding. For our logo, we chose K2D font, as we feel it is aesthetically pleasing and reflects our branding, as well as working with our logo nicely. Our page and content headings are Nunito, a modern, rounded and clean font that is distinct from our body text, yet not overwhelming. Our body font is Helvetica, a classic typeface that we feel is perfect for our blocks of text, as it is easy to read at all sizes, and creates a professional-looking document.

PAGE TITLE

Subheading 1

Subheading 2

Subheading 3

Body Text

Captions

Wave Pattern

To complement our branding style, and to add depth to any of our branding applications, we have created a primary branding element, our signature wave pattern. It is a free-flowing wave structure, tying in with our brand style, that is created of simple blocks of each of our 3 colours, and can be used in borders, features, or as a space filler. Photons are particles of light but behave as a wave, and this behaviour served as inspiration for the creation of waves as our branding element. To diversify our ways to fill space or create an accent, we created a rounded line pattern, which are inspired by light's particle based behaviour. Each of these can be used, to suit the application.

Branding Refinement

Since the NSW State competition, we have decided to update our branding to better reflect our team, as we felt our overall branding style was too bold, over-the-top, and stylistically overused within the F1 in Schools competition. As a result, we have subtly changed several branding elements to create a more effective and aesthetically pleasing brand. We have simplified our colour scheme to more consistent colours, updated our wave and band patterns into more fluid, rounded forms, filleted the edges of our logo to create a more free-flowing and rounded shape, and altered our team fonts. To reveal our new brand, we created a minute-long branding reveal video, which unveiled and showcased our new team branding. We posted this on all social media platforms, and gathered much interest and engagement with this video, successfully boosting our online presence and brand. As a result of our alterations, we feel that our branding is now more contemporary, more subtly effective, and creates a far more unique team brand than what we have previously used.

Virtual Merchandise

To spread awareness and raise the profile of our team in both the local and F1 in Schools communities, we wanted to create Photonic Racing branded merchandise which we could sell or give away. Unfortunately, due to COVID-19, the manufacturing of many types of merchandise was difficult, and we had concerns over handing out physical items. However, we still felt that merchandising was an extremely effective method of spreading our team brand throughout the local community, and our previous teams have had great success in using the merchandise. We decided to create and release a wide variety of custom phone and laptop wallpapers on all our social media pages, which people could download and use extremely easy. We have found this even more successful than physical merchandise, as we can send this 'Virchandise' to all our audience, not just those we can meet in person. Additionally, people are constantly surrounded by their screens, and placing our branding on those screens allows us to gain high amounts of brand recognition and awareness, over a wide audience.

TRADE DISPLAY

Uniform Design

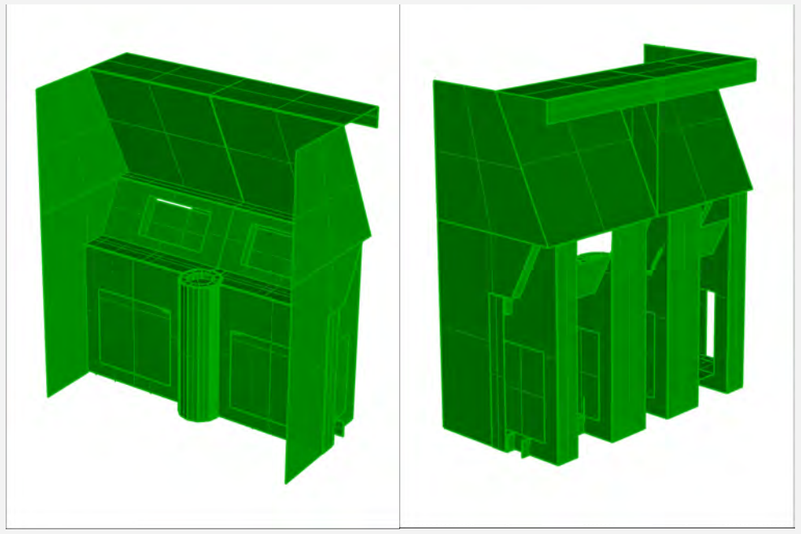
Though we, unfortunately, did not produce a physical uniform (though are looking to in future, as a memento for our team), we have designed both primary team shirts and supporters shirts, displaying our branding, names, and sponsors. The design features our signature wave pattern as a sash, splitting the plain white of the chest from our gradient on the bottom of the shirts. This pattern runs around the shirt, creating a continuous pattern, visible and recognisable from any angle. Layered onto the gradient, each shirt has a large-scale icon wrapping around the front and back. Each team member's icon is in one of our 3 colours, strengthening the connection between our logo, the 3 team colours, and our 3 team members. On the chest is a simple and clean design, with our logo on the right of the chest and each team member's name and role on the left. On the rear of the shirt, our generous sponsors are displayed on the white background, as part of our ROI plan, as well as the F1 in Schools corporate partner logos. On each shoulder is our team logo, ensuring when the shirts are worn, we are easily distinguishable as Photonic Racing from any angle. Finally, as a homage to our history and background, the logos of our 3 previous teams are featured at the top of the shirts. The secondary uniform utilises the same design, using inverted colour placement, to maintain consistency yet be able to easily distinguish team members from supporters. These shirts are designed to be worn with plain black pants and shoes, articles of clothing owned by all team members, to maintain consistency across all uniform elements.

Our primary (upper) and secondary (lower) uniform designs.

Trade Display

Structure

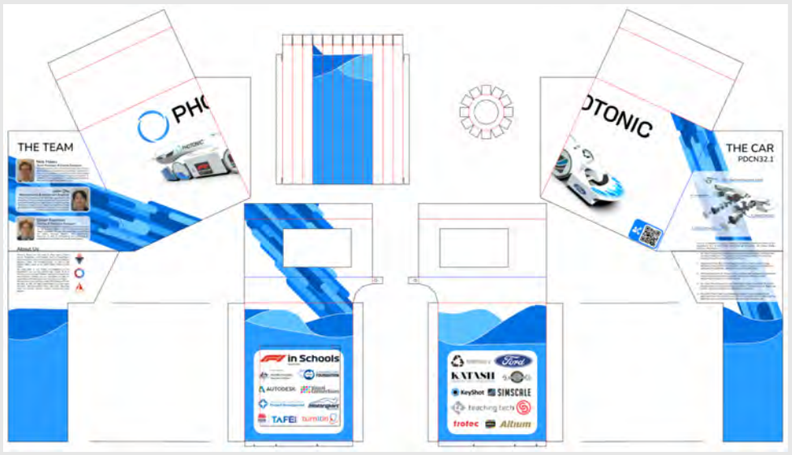
We have given extensive thought and refinement to the construction and physical structure of our trade display. Early in the design process, we decided on key goals we wanted our trade display structure to achieve; we wanted it to be lightweight, easily assembled in under half an hour, strong enough to hold our display items, and 100% reusable or recyclable. To achieve these goals, we have partnered with Tobias Horrocks from Fold Theory, a leading cardboard display design company, and Katash printing, a cardboard fabrication company. We have worked with Tobias extensively in the structural design of our trade display, discussing ideas and refining concepts regularly until we decided on our final design. This design utilises large, folded panels of cardboard, which can be packed flat for transport or storage, then quickly unfolded, slotted into place and assembled. Our choice to use cardboard means that our display is extremely strong and fully recyclable. This design also features recesses in which we can place our monitors and display items, as well as a hinged door on the front panel which opens into a storage area underneath the pit. Our ability to display and store items on our trade display is extremely successful and will be very useful at a physical event. Once Tobias had mentored us through the design process, we then designed our trade display graphics on the required panels, to be aesthetically pleasing, informative, and reflective of the Photonic Racing branding style. After any required alterations, after discussing our design with Katash, the panels could be fabricated and printed at Katash. Our design is printed directly onto the cardboard, achieving a smooth sheen with no gaps or cracks in the overall design, as well as eliminating the need for posters or coreflute boards. Once our design was printed, it was ready to assemble and can be done by our team in under 15 minutes, less than half our original target. Our trade display has been carefully planned and considered to meet our goals of transportability, lightweight design, strong, and fully environmentally friendly.



The CAD model of our display structure.

Design

We have designed our trade display to be as interactive, informative and memorable as possible, through our structural design, information design, use of ICTs and technology. We have made our car the key visual feature of the display, highlighted as the salient image, in the centre of our booth, and we have incorporated a turntable in the centre of our table to showcase the physical model to visitors. We have also been innovative in the design of our display, as we chose to mimic a real F1 pit wall, using 2 large touchscreen monitors to create an interactive element. These monitors can be used by viewers, and show videos, documents and project elements that we have created, to allow them an interactive and memorable insight into our team and our competition preparation. Our table is at standing height, allowing easy access to our display items, such as our large-scale car, display parts, and booklets. Our design also incorporates a flap door at the front bottom panel, which gives us easy access to storage and cables underneath the display. We considered using integrated holograms in our final design, which light up at the touch of a button, using parabolic mirrors embedded in the table, to show different parts of our car, though this idea was rejected due to its difficulty in creation. We have displayed our information as cleanly and as clearly as possible, so viewers can see our journey easily. On the left of the display, we have information about our team and our team members, and so the left monitor displays documents related to our enterprise work. Similarly, the right of the display shows an annotated diagram of our car, allowing viewers to visually explore and learn about our engineering processes, and the right monitor shows documents related to our engineering work. In the centre and front panels, we have displayed a large-scale car, and our generous sponsors as the salient images, maximising their ROI as well as recognition of our car. This information design is simple yet extremely effective in creating a clean and easily understandable trade display. Overall, we believe that our trade display is well branded, extremely engaging, utilises innovative concepts, is uniquely memorable, and reflects our team to a high standard.



The fabrication graphics for our display.

INDUSTRY COLLABORATION

To assist us in our learning and our competition preparation, we have sought out mentors and stakeholders in a wide variety of fields related to our experiences in F1 in Schools. Our mentoring processes have allowed us to learn about a wide array of topics, enhance and improve our skills, and gain experience in these various fields. We've learnt skills we would never have even considered before this competition and have been able to use them to our advantage in enhancing our quality of work in this competition. Our mentoring process has been extremely valuable to us, in both our personal skill development, as well as furthering our team's chances of success.

Tobias Horrocks - Fold Theory

To create an amazing trade display at a professional quality, out of cardboard, to meet our recyclability goals, we contacted Tobias Horrocks from Fold Theory, a leading Australian cardboard design company. We emailed and zoom called regularly with him and talked through the requirements for our display. Once we had designed our final prototype, he taught us how he takes CAD designs and turns them into his final cardboard structural models, using RHINO software. Throughout our correspondence and zoom meetings with Tobias, we have learnt not just about his work as a cardboard fabrication designer, but about the broader design processes he goes through, as well as design concepts such as structural integrity, refinement, and how to work with constraints.

An example of Tobias's work.
Taylor, B., & Horrocks, T. (2016). Cardboard Metropolis [Image]. Retrieved 15 April 2021, from https://foldtheory.com/portfolio/cardboard-metropolis/.

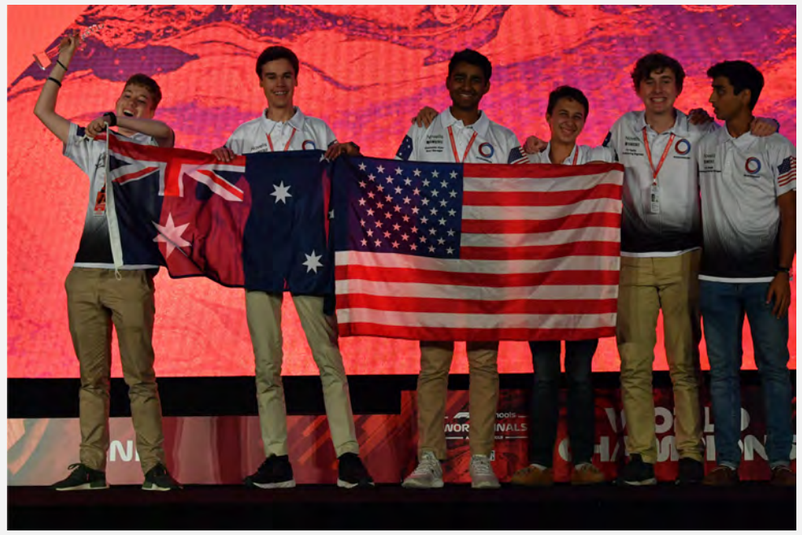
Emily Zirkle - Keyshot

We have also been sponsored with software from KeyShot, an industry leader in real-time rendering. They have provided us with KeyShot 9 (see centre right), their premier rendering software package. We have been mentored by Emily Zirkle, head of KeyShot's Education Program. She has taught us how to use KeyShot 10 and has given us advice on meshes, colours, decals, lighting, environments, as well as showing us how to use animations, and how to minimise render times, enhancing our efficiency. She has been a great mentor to us, and we now are so much more skilled and knowledgeable in renders and rendering software.

Our final car design in Keyshot 10.

Paradoxum

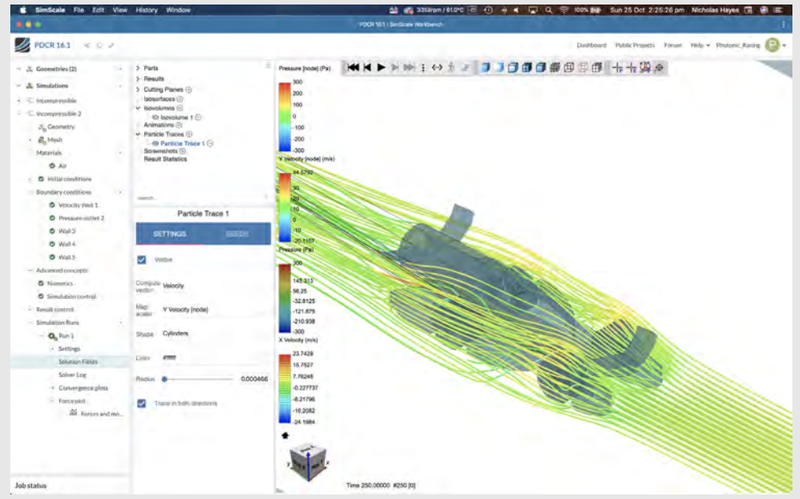
We also received mentorship from Zach Burgess, and Matt Foster, from the 2019 World Finals team Paradoxum. Zach's role was as Marketing Manager, and Matt was the Graphic Designer. Both of them, in addition to our Team Manager/Digital Designer Nick, have extensive experience as competitors in F1 in Schools World Finals and have great insight into what we should do to maximise our success. They have mentored us in the branding of our team, in elements such as logo, colours, typography, digital media and community outreach. This was our main focus given that they won the Digital Media Award at the 2019 World Finals (see below). We have been in frequent communication with them, at most of our weekly meetings, and they have been extremely helpful to us.



Paradoxum receiving their Digital Media Award at the 2019 World Finals.

Jousef Murad - SimScale

We have been given access to Simscale's industry-standard CFD and FEA software (see below), and have used it extensively in the analysis and refinement of our car design. Jousef Murad, Student Ambassador for Simscale, who is based in Munich, Germany, has been mentoring and helping us, frequently communicating via email. He has taught us how to best utilise Simscale's features, and how to set up simulations to gain data that was relevant to our needs.



A particle trace visualisation using SimScale CFD.

Michael Laws - Teaching Tech

We have been mentored by Michael Laws, from Teaching Tech, a CAD, CAM, CNC router, 3D printing and graphic design Youtube channel. He has a wealth of experience in design, manufacturing, technologies and branding, all skills that are hugely important for our team in this competition. He also has previous experience with F1 in Schools, has been a teacher, and taken students through the competition for over 7 years. This experience has been invaluable to us, as he knows how we can improve our engineering and manufacturing processes. He has introduced us to several concepts in a variety of areas, such as building a filament shredder to recycle old prints, using silicone mould casting to create perfect parts.

A clip of Teaching Tech's video featuring our team.

Laws, M. (2020). Make more with thermoforming and compression moulding - Advanced 3D printing [Video]. Retrieved 15 April 2021, from https://www.youtube.com/watch?v=ywLc-qOu_0ZI.