



Managing the Formula Student Odyssey

An outline to manage functionality and workings of a formula student team during covid

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Abstract : The following report outlines the working and functioning of a formula student team in India, “VeerRacerss Electric”, the official formula student team of Veer Surendra Sai University of Technology (VSSUT), Burla, formerly known as UCE, Burla. This report outlines the adaptation of the team to function during the closures of the college owing to COVID-19 and the team's further planning to look out for its transition from being a core combustion-based team to an EV team. The research is based on the duration when the team is just in the nascent stages of its transition and is working its way to validate the designs while aiming for the first offline formula student competition, “Formula Imperial ‘23,” to be held at the legendary Buddh International Circuit, Noida. The paper apart from the general functioning of the team, focuses on the team's communication and structural methodology alongside outlining the risks and their impact with regard to the changes during the aforesaid period.

INTRODUCTION

1.1. Formula Student India :

Designing and developing a formula style mini race car might probably be the world's best competition to test the engineering acumen of students. And this has really gained much prominence in India with events like Formula Bharat that would provide an avenue for churning out engineering prowess, innovation, and teamwork. Of course, it is not purely on speed; it depends upon such factors as engineering design, financial planning, and project management. The competition involves much of the students' teams represented from various universities of the whole nation. He analyses static and dynamic events based on his technical knowledge and the ability of performing a car and business acumen of people in a team. Not a racing competition, but a learning environment fully integrated in the curriculum that offers the engineering student real-life challenges of automotive engineering and the world of motorsports.

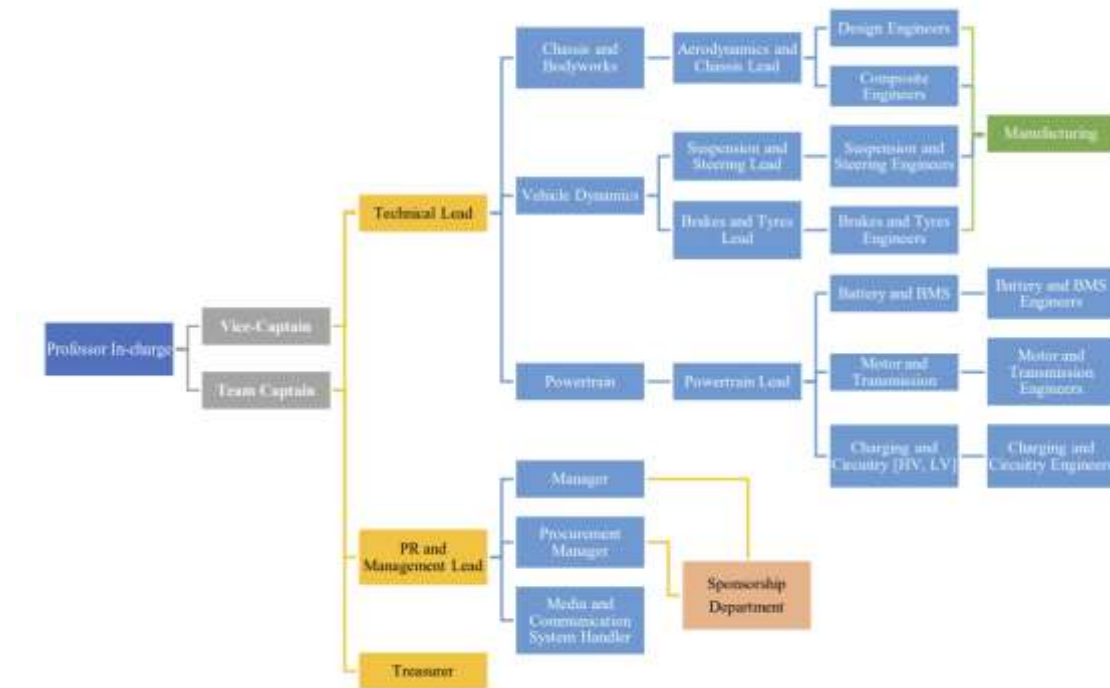
1.2. Managing a Formula Student Team in India:

Since it throws challenges against the engineering students into designing and producing a small Formula-style race car, hence it is one of the most identified competitions around the world. The world spotlights have fallen on India about something as mass scale as Formula Bharat for churning out engineering prowess and innovation as much as team spirit. It is not a race competition merely because its parameters include engineering design, financial planning, and project management. The competition is that which involves multiple teams of students chosen from various universities all over the entire nation. It measures the static and the dynamic events on the technical knowledge of an individual and the performing ability of the car along with the business acumen of people in a team. It is a race, but it is much more than that-being part of a formula student team; that's rather a pompous thought: an integrated learning environment equipping the engineering student with real-life challenges of automotive engineering and the world of motorsport.

A Formula Student team in India is a very intricate coordination of the different areas of technical design, manufacture, financial planning, and logistics. Students members may come from a very broad spectrum of engineering disciplines that pool their skills and forces over a period of more than one year to build a performance car. When all these diversified members work on individual work related to powertrain, suspension or aerodynamics, they kept themselves in close co-ordination with each other to integrate the whole vehicle. For instance, sponsorship and fund, which are pretty expensive, particularly when one is building a racing car. Additionally, there are logistics connected directly and indirectly with the transport of a vehicle to the place of competition and accommodation of team members, competitions rules. All these combined with good leadership and teamwork eventually make a route to success in automobile systems - not only for the team but for the car itself on the racing track.

TEAM STRUCTURE

The roles are distributed in the team based solely on merit resulting from a written test and a PI. Junior freshmen are inducted into the team as junior engineers who work their way up based on their performance and dedication toward the achievement of the team's goals. They are allotted jobs to be done by the department leads who try to divide based on the evaluated levels of expertise needed and available. Each person has to report to the department lead who in turn report back to the technical lead or to the manager. This aids in the easy division of work and roles to be played for effective functioning and, at the same time, allows the leads and the captain, as a whole, to have their scrutiny over the team working in adherence to the preset deadlines and is always in the pre-decided path.



(flow chart outlining the team structure for the team of 2022)

2.1. Decision-making tools :

2.1.1. For decisions regarding vehicle manufacturing and development:

Any decision was only taken after it was discussed with the team members and the departments concerned in a meeting and was resolved. Prior to this the concern, it has to be discussed with the department members which helps in the refining of the idea and the decision and by this, it removes the possibility of wastage of time for absurdities in the process. Following this, if the decision tends to involve more than one department then the other concerned department(s) were put up in a meeting before involving senior members of the team. This makes the team, work in an environment where every member has a say on any decision to be taken at the same time the experience and knowledge of the senior members are also harnessed and put into work. With the present ongoing pandemic situation, now these communications have shifted to the online modes in the form of online video conferencing platforms or over conference calls.

2.1.2. For decisions regarding budget and monetary spendings:

These decisions demand involvement of the college authorities along with the team's management. Hence these decisions are undertaken after a discussions with the dean of student affairs and the professor in-charge alongside the team captain and management.

2.2. Conflict management :

Team conflict can be a source of excellence, quality and creativity. However, occasions can arise where conflict in teams becomes interpersonally destructive and leads to lowered effectiveness. Basically conflict arises broadly due to 8 major reasons:

1. Perceived breach of faith and trust
2. Unresolved disagreements
3. Miscommunication
4. Personality clashes
5. Differences in acquired values
6. Underlying stress and tension
7. Ego problems
8. A combination of these

For solving the issues arising in the team we follow the 3-step conflict management cycle, a model developed by McDaniel et al.:

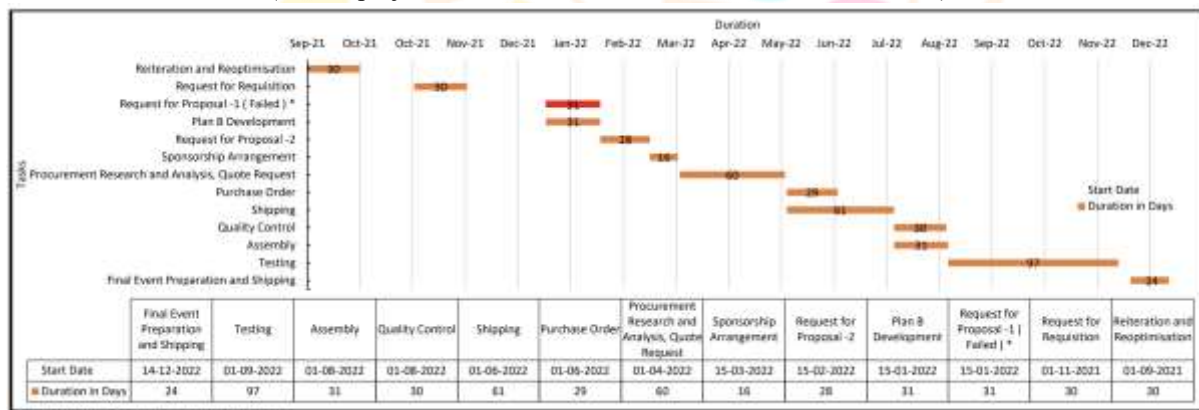
- **Concern:** The first step teaches the responsibility of both parties participating in a dispute to understand the other person's concerns. This requires the understanding of the emotions, needs, and reasons behind the stated position of the opposition.
- **Vision:** The second step illustrates the importance of both parties envisioning one another's view of a win-win solution for the team. Recognizing the perspective of the team as whole is a critical element when arriving at a fully accepted solution. This becomes a meeting point between the two arguing parties.
- **Action:** The third step is a commitment by both disputing sides to take the appropriate actions to ensure the particular conflict will not reoccur. Both parties state these actions, along with a prescribed method for mediating the problem, should it re-occur.

The interpersonal conflicts are resolved by a meeting with the senior members where the parties involved are made to realize each of their concerns and needs and arrive at a win-win situation for the team. These kinds of meets are quite informal and mostly are redressed during the chill out nights and fun sessions so as to keep things go along the jibe of amiable environment as much as possible. Yet if the conflict has a proximity to a greater bad happening then its straightway makes way for an immediate meet in the team break.

PROJECT TIMELINE

With the reference taken being of the duration for when Covid-19 being quite widespread in the country and colleges were taking the hit for the coursework taking a back seat, given the offline and the need for a “co-working” nature of the formula student team, things weren't quite a cakewalk either. There were major hits to the project timeline, leading to further delays in the transitioning of the team into an EV team.

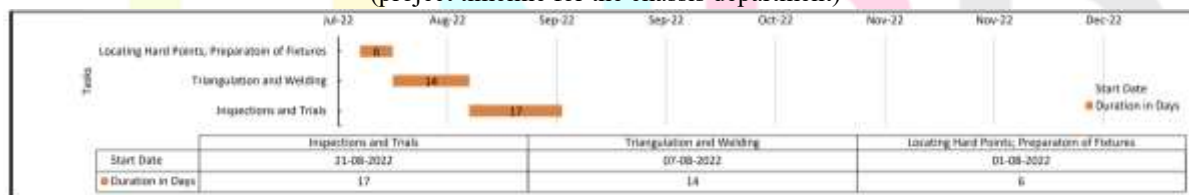
(overall project timeline for the first EV of the team – Zeus 1.0)



3.1. Department-wise manufacturing timeline:

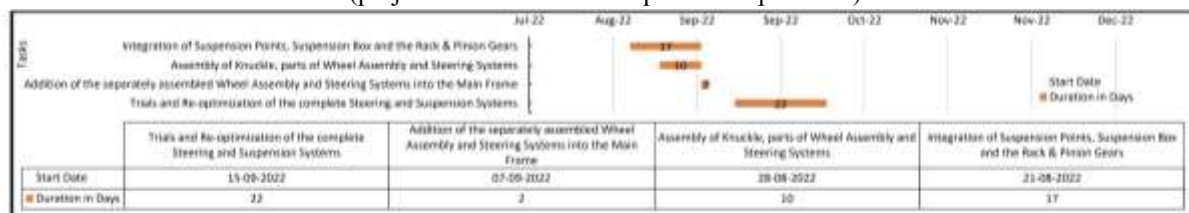
3.1.1. Chassis:

(project timeline for the chassis department)



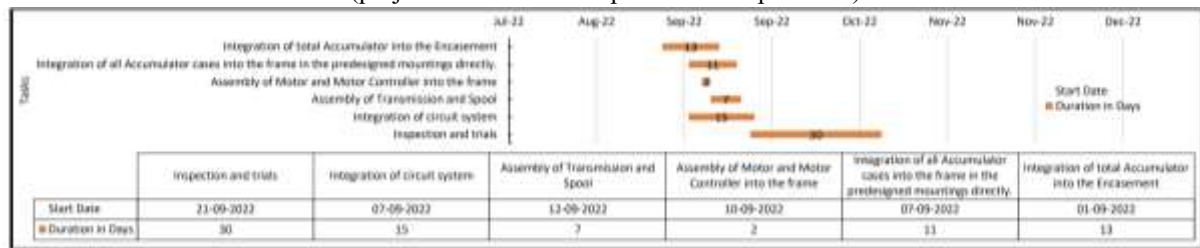
3.1.2. Suspension:

(project timeline for the suspension department)



3.1.3. Powertrain:

(project timeline for the powertrain department)



3.1.4. Brakes:

(project timeline for the brakes department)



3.2. Tool used for Project Management Timeline: Microsoft Excel

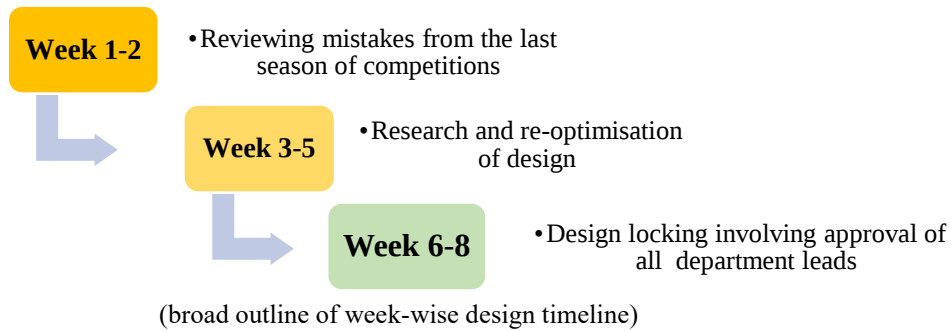
We initially put up the total schedule of the timeline and the deadlines in an excel sheet and we update it weekly based on the deadlines set and the proximity of its completion. With the involvement of risks and constraints in the timeline, whenever we fail, to catch up with the set deadlines then the deadlines following are reset and managed accordingly to keep up with the timeline after a discussion with the team members and the leads in a team meet as soon as possible.

RISK ANALYSIS AND MITIGATION

(risk and cause analysis and mitigations allocated)

Sr no.	Risk	Cause	Impact	Mitigation
1.	Internal Conflict regarding technical designs and materials selection.	Different perspective of team members; miscommunication	Delay in product procurement and overall vehicle construction; degradation of team bonding.	The captain, technical head and team manager conduct a proper selection of material and design by voting; Management of conflict by using team management strategies.
2.	College Closure due to pandemic	Increment of covid cases; closure of college due to government	Delay in proposal request to college; unavailability of college resources due to closure of college; delay in production	Framing of Plan B in which a new timeline was planned which has been mentioned above. Allocation of buffer time to tackle these kinds of situations.
3.	Delay in Shipping or bad quality product received	Bad weather conditions; Technical error in logistics; improper vendor selection	Delay in product procurement; more time wasted in shipping; additional costs may incur	Allocation of buffer time in our timeline for shipping; Proper reviewing of vendor; performing product quality check before installation on our vehicle
4.	Delays in timeline due to College Examinations	Changes in exam schedule by the college	Affects the pre-planned timeline	Going easy on academics for a week or two (as per requirement) and providing extra time to the team workshop post exams

DESIGN TIMELINE



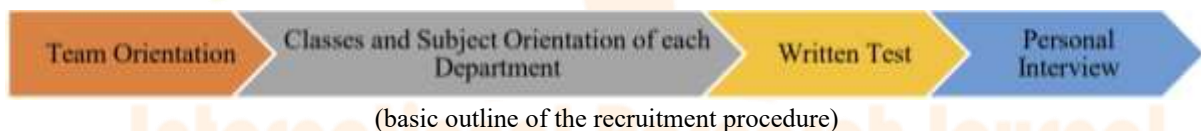
The design timeline is the timeline specifying 'Technical Research' phase of all the departments. It was carried out in the months of September 2021 (or 4 weeks in total), providing us ample time to conduct relevant research on desired components for our vehicle. However, as shown further on FSEV CC '21 completion, the faults and rectifications suggested by the judges are looked upon, and designs are reoptimized accordingly. Further after validating changes in the FSEV CC '22 we will proceed with the final battery pack integration and powertrain assembly. By this, we aspire to get our first EV vehicle to be highly optimized and in the best possible ways to meet all our goals and objectives. However, the vehicle undergoes continuous evaluations and rectifications throughout the manufacturing phase allowing us to be open to ideas and innovations all the way throughout while at the same time minimizing the scope for possible errors and lapses.

HUMAN RESOURCE

6.1. Recruitment:

The team seeking to create a new car every academic year will require a steady supply of trained manpower, as well as a plethora of enthusiasm and commitment for autos. For this reason, recruiting begins early in each academic year, allowing freshmen to join the team from the start of their college careers, while also allowing students in their second year to join if they did not do so during their freshman year. Consequently, the team is easily accessible via organized yet flexible channels.

The process of recruitment occurs in terms of 4 major stages:



The recruitment process begins with posters across the college advertising the initial meeting and posters posted on the team's social media accounts. Following a team orientation based on our accomplishments, completed projects, or giving freshmen a basic understanding of what we do and who we work for. The first classes are held to impart the basic ideas and concepts related to each department, allowing people with no prior knowledge but plenty of interest to join the team, allowing students to recognize their own acumen and choose their preferred department among the available departments. The students are then short-listed based on their results and invited to the personal interview process, where the technical leaders and other senior members of the team assess their grasp of their ability and enthusiasm to participate in overall vehicle research and development. They are assigned to respectable departments based on their scores and areas of interest.

The procedure may appear to be overly lengthy and rigid. Still, it allows us to locate the finest individual for the position and assemble the most effective and devoted team possible. After completing the recruiting procedure, these freshman year students are recruited as "Junior Engineers" in the respected departments.

This process also improves the retention rate of our team members. Selecting the dedicated individuals enables us to retain more members in the team throughout the year.

During the pandemic the recruitment process was held online starting with online introductory classes followed by departmental classes on online meeting platform Google Meet. Following the classes, a test written test was taken online in which the students wrote and uploaded their answers on the same day of the test. Finally, a Personal Interview was taken on the online meeting platform Google Meet through which the final judgement was taken.

6.2. Retention:

You must keep a group of individuals together once you have gathered them. This is one of the most difficult leadership roles. There will be a lot of turnovers no matter what you do. The task is difficult. Many people are unable to maintain the effort owing to academic or other obligations. Some individuals despise it or refuse to put forth the effort. Others leave because they don't feel welcome. Rather of being overwhelmed with actual hands-on tasks, new recruits are instructed to undertake menial jobs such as cleaning workspaces and sorting components. When new members are given the opportunity to participate in these tasks, they will feel more involved in the project, and a sense of team spirit will emerge among new and returning members. When we start planning and producing things, new members will get more enthusiastic about the work itself. We feel that one approach to keeping employees is to set reasonable expectations up front, according to the team's ideals. They must understand that a great level of personal dedication is required of them. It is typical to work roughly 10 hours every week. They should also be aware that poor work will not be tolerated. Another way to keep people is to make them feel comfortable. We engage in a variety of team-building events, such as fortnightly movie evenings, picnics, board game nights, and many more, in order to create a welcoming atmosphere in the workshop. We don't merely dismantle old automobiles. Rather, we encourage freshly recruited members to open up and recognize their many roles. We can repurpose outdated automobiles as recruiting, retention, and motivating tools in this way.

Because this is a voluntary organization, all members need to feel that their ideas are being heard, even if the final choice is to do something different. As a result, we strive to ensure that newcomers are given the opportunity to speak up and feel heard. Setting up team meetings regularly and encouraging each member to share their views helps in increasing the individual's confidence and also strengthening of the team bonding. Work recognition is given to each individual during weekly meetings in which their ideas are represented in-front of the whole team, in this way the individual feels rewarded. Furthermore, sponsored webinars and seminars are held on a regular basis to provide members with the necessary expertise, as well as industry interactions, which provide members of the team an academic advantage over their peers.

(year-wise data of retention & attrition rates)

Year	Inducted member	Active members	Retention rates	Attrition rates
2020-2023	25	18	72%	28%
2021-2023	30	23	76%	24%
2022-2023	28	25	89.28%	10.72%

6.3. Change of management:

With the end of each academic year comes a day filled with conflicting emotions: nostalgia for some, ecstasy for others. With the senior members of the team who are final year graduates, it is time for the team's management to shift hands. The process begins long before the last team bids farewell to the departing senior members. The department leaders are chosen exclusively on the basis of performance, achievements, loyalty; jobs such as Captain, Vice-Captain, Treasurer, and Team Manager are chosen by the outgoing members from among the interested individuals also considering the past performances, personal achievements, acts of taking up initiatives, team player capabilities. With every department upon further developments happening with time, the members are gauged according to their performances and are promoted to the senior engineers in each segment and further up with due time to leads.

6.4. Alumni connections:

Alumni have an important role on the team, serving as unsung and unheard members who assist and lead the team with their own skills and previous experience. Even after graduation, many graduates are put in prominent job profiles with well-known businesses, assist with sponsorships, and are available to answer technical and non-technical questions and difficulties whenever and wherever they are needed. The alumnus was also consulted for significant team choices, such as the recent shift of the team from CV type to EV type. Furthermore, we hold frequent alumni gatherings to allow members to benefit from the older members' knowledge and competence.

FINANCIAL MANAGEMENT

7.1. Budget allocation:

Being a student run body and solely being dependant on the fundings received by college and prize money apart from the sponsorships, managing a stringent budget is quite a need given the ever changing dynamics and cost overruns involved. At the same time, keeping up with the clearances maintained, a larger clearances maintained shall lead to multiple budget reallocations in multiple stages up ahead in the future of the project .

Owing to all such constraints, a detailed budget plan was made up involving each of the departments submitting their budget to the meeting chaired by the captain and with reiterating needs and requirements and optimizing the budgetary requirements and on approval from the professor in-charge, the allocations are locked for the project year.

Following broadly, here follows the key observations done during the making of “Zeus 1.0” : the first EV of the team :

- A proper revenue budget was planned considering all sorts of needs of the project.

- Proper quality of the manufacturing materials and or products were considered at reasonable prices.
- Potential sponsors were also approached and offered deals.
- Each component has been allotted with reasonable prices and proper buffer amounts.
- Proper timeline for the completion of the project was made, although at first, we failed to perform accordingly yet we managed to replan it and act further.
- Early proposals of budget were provided to the college administration for proper procurement of the required components.

7.2. Budget Forecast :

Budget forecasting plays quite an important role given the sheer amount of uncertainties to be gauged and predicted in a calculative guess earlier so as to keep focus on the optimal expenditure of the team's budget while at the same time keeping up with the need for essential provisional of buffer and reserve amount into consideration.

For the same, we laid out a systematic outlay of terms and conditions for the way of functioning to be followed:

1. Request for requisition were received from technical teams.
2. Potential vendors were approached and selected
3. Quotations were received from vendor
4. Sponsorships were offered to vendor
5. An adequate tolerance were added to quoted price depending onto the degree of variability possible
6. Logistics and fixed prices were added u
7. Master budget was planned

Quality with its literal meaning being referring to the ability of a product or service to meet or rather putting forth as such "exceed" consumer expectations. Customers' requirements determine the quality scope. It is almost always listed first, presumably because poor quality often results in bad business. The quality of a product depends almost entirely on the quality of the supplied materials. One cannot produce a high-quality product from low-quality components. Suppliers and manufacturers must be willing to work together to reduce and eliminate errors and defects and achieve higher quality end products.

7.3 Service-Cost-Quality

Delivering a quality product requires, at a minimum

- Selection of high-quality components.
- Well-established and well-documented manufacturing processes.
- Experienced and responsible Workforce.
- Controls that meet impartial standards and customer requirements.

Poor quality results in business loss and productivity are reduced. The biggest cost in most business organizations is the manufacturing cost. Production has a direct responsibility when it comes to controlling and reducing manufacturing cost.

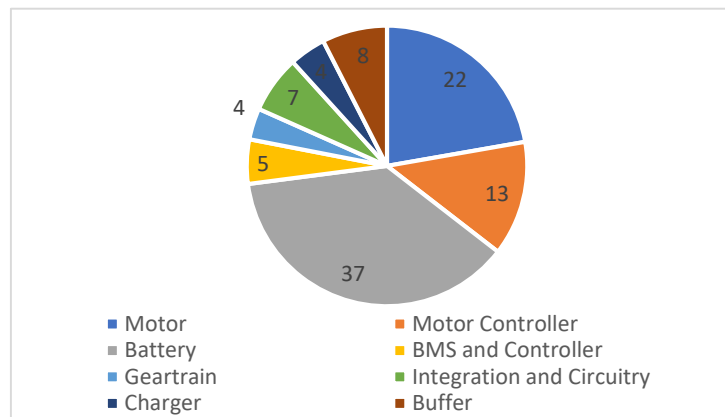
There are four basic types of manufacturing costs:

- Raw materials
- Direct labour
- Variable overhead
- Fixed overhead.

The primary important aspect of logistics is indeed providing the supplies to the consumer. Logistics customer service can be separated into three elements (before, during, and after delivery of the product), i.e., Pre-transaction elements, Transaction elements, and post-transaction elements, respectively. These are interconnected as one depends on the other, quality and service both depend on cost. We try to get superlative quality at nominal cost with moral logistics.

(table demarcating the actual budget allocation of the team for the year 2022)

COMPONENT	PRICE
Motor	3,70,000
Motor Controller	2,20,000
Battery	6,23,000
BMS and Controller	85,000
Geartrain	60,000
Integration and Circuitry	1,1,0,000
Charger	70,000
Buffer	1,25,000
Grand total	16,63,000



(graphical demarcation of the actual budget allocation of the team for the year 2022)

The reason for the budget disparity is because, as a new team to the Electric Car category, our starting expenditures are quite high, worsened by the fact that our major focus is on purchasing a high-quality powertrain to power our vehicle. Because of the personnel provided by university students, significant cost savings have been achieved. With the exception of a few tiny tools and equipment, we have made no big investments in our resources. The students are extremely motivated to devote a significant amount of time and effort to the vehicle's construction while learning new skills. The total buffer/tolerance is 10% of the net amount, which would be used during any future uncertainties. There is also an amount put aside as Working Capital for day-to-day expenses of the team.

7.4. Protocols for budgeting:

We used the Bottom-Up technique of budget estimating since we are a young team focused on attaining a short-term cost-benefit balance. Each component, such as people and resources, was identified, and their costs were calculated. The technical team devised cost-effective components down to the smallest detail, assisting in the hunt for possible vendors who could provide the greatest services at the most cost-effective costs. Because the budget was being produced for the entire year, all elements impacting the total budget estimate were considered by taking a realistic approach. These decisions are taken in the Budget review meeting organized every month in the presence of the team captain, vice-captain, management lead, department lead and all the members of the team. Appropriate funds were allocated to each department and a buffer amount of 10% was considered.

7.5. Protocols for expenses:

The expenses are managed by the Treasurer who is accountable for all the expense details. The expenses are approved by the captain and then allowed with full transparency. Because our team did not function like a traditional revenue-generating corporation, it was obvious that each cost was meticulously documented. The budgeting guidelines permitted the best tight-to-budget framework, resulting in only effective use of capital on hand and a lack of thoughtless expenditure. A working capital budget of 0.5 percent of the entire budget, or Rs. 10,000, was set aside for day-to-day needs such as First Aid.

7.6. Risk analysis and mitigation:

(table : risk and cause analysis and mitigations allocated)

Sr no.	Risk	Cause	Impact	Mitigation
1.	Allotted budget is less than required.	Short of funds; Less number of sponsors; Procurement of more expensive component(s) due to change in design	Unable to procure other components; disruption in overall budget	Approaching more sponsors and increasing reach; seeking financial support from Alumni.
2.	Price increased by vendor without a proper notice.	Surge in demand of the product; unavailability of product readily in market; monopolistic vendor	Unable to procure other components; disruption in overall budget; delay in procurement of other components	Entering into a contract before final order placement

3.	Market inflation.	Sudden changes in the economy and geopolitics due to factors such as War, changes in laws etc.	Rise in the cost of materials; Inability of the manufacturer to supply the components; possible increments in shipping charges	Putting Plan B into action
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COMMUNICATION

Communication is crucial for team development and obtaining the maximum performance from team members. Each of the team member must be clearly understanding what his team does more importantly what his teammates are doing. He or she must be very clear about his or her team's tasks and responsibilities. It is the team leader's responsibility to allocate responsibilities based on the team members' interests and specialties rather than simply putting tasks on them.

Members utilize social networking sites such as WhatsApp, Instagram, LinkedIn, and others in addition to traditional e-mails. Members also use features groups, which allow a large number of individuals to engage, discuss, and make decisions at the same time and on a single platform. During the peak duration of the pandemic, few of the discussion sessions had been shifted to online conferencing platforms while most of the discussions were taken in the physical mode at the college workshop. In online mode every member was allowed to freely elaborate their ideas by putting them together on a blank page (Microsoft word, Google docs, etc.) and then sharing their screen using 'Screen Share' feature which is available on digital meeting platforms. In physical mode, every member shared their ideas during the regular team meetings. With the timely conduction of fun nights, the members of the team feel more open about their thoughts.

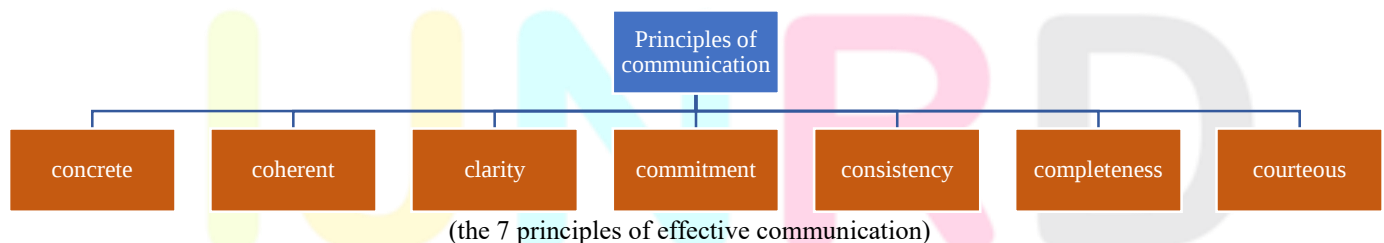
This makes it easy for all team members to identify their areas of interest and opinions on any given problem, which in turn allows them to interact with like-minded individuals, resulting in more productive hours for the team. They will feel much more driven and vital to the team as a result of this.

It is usually preferable to address topics in an open forum where individuals are free to share their minds. As a result, our Team Leaders urge fellow members to participate in our Workshop's discussion sessions.

We have dedicated team meetings as follows:

- Weekly Meetings: The weekly progress of the team is discussed. It is organized in weekends based on availability.
- Monthly Meetings: Financial Expenditure and overall Expenditure and maintaining adherence to timeline is discussed. This was usually scheduled on weekends.

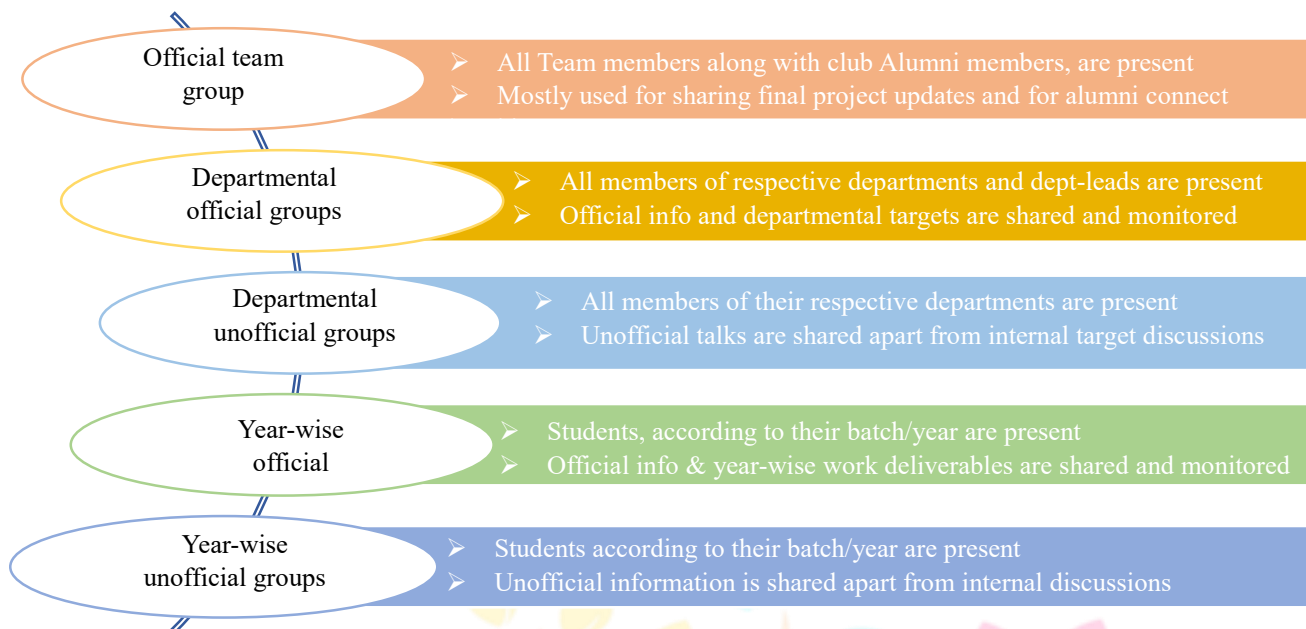
Effective communication decreases the likelihood of team members having divergent viewpoints. Communication strengthens team member relationships, making them feel more energized and driven. To make sure that all the team members communicate in their most effective manner possible, we have inculcated the basic 7 principles of communication in orientation period:



7.1. Protocols of Communication:

Juniors submit their thoughts and findings to Second years during their daily or weekly meetings, and the second-year students intimate the same to their seniors. Generally, horizontal and diagonal level of communication takes place, yet this doesn't mean to be stringent in practice; there can be changes pertaining to the need of the hour when the chain of hierarchy can be broken easily. We emphasize transparency of information and also increase team bonding by implementing an ideal flow of communication within ourselves.

We have also a regular line of communication through WhatsApp with the team members. There are several groups in which the members are distributed. The groups are as follows:



(whatsapp group functioning in the team being primary work-flow channels for both formal and informal communication)

MEDIA AND MARKETING

A Formula Student team is expected to tackle hurdles like sponsorship, marketing, and publicity. We have a group of students under Public Relations, Marketing and Media Department, dedicatedly working to inform the mass about the team's mission in a credible manner. We have assigned one team member as SPOC (Single Point of Contact) to avoid any kind of miscommunication whatsoever. Media wing directly deals with people responsible for covering our Team in mass and social media in a positive sense. The goal of media wing is to provide maximum positive coverage in social media without paying for it through advertisement.

We are actively present on various social media platforms such as YouTube, Facebook, Instagram, LinkedIn, etc. And we interact with our audience frequently by hosting different fun competitions like quiz, polls, etc. online. We proudly exhibit our prototype vehicle in various events, functions, etc. where we can spread awareness about our team, vehicle, and racing in general.

The department first spots and lists potential sponsors from different domains. Then those companies are reached through proper channel. Having a person of reference within the organization (Potential sponsor) is a win- win situation, both for the sponsoring organization and for the team as well.

We spot potential sponsoring organization/ individual who:

- Actively indulge in sponsoring sports teams.
- Spend handsome amount on CSR related activities.
- Are present in our neighbouring districts.
- Can offer us upfront discounts on their services and products.