

# Student Guidance for the 2023 Design Event at FS UK

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## Universal approach to scoring

In order to facilitate the planning and organisation of the event, and to reinforce that Concept entries are intended to be progressed to a running FS entry within 12 months, we will have a single Design Score Sheet (see end) that will be used for both Classes. All advice below applies equally to both classes.

**A reminder** that the Design event assumes that your design is built, or will be built, in accordance with the Rules such that it will be eligible to start one of the dynamics events. Therefore, it must be designed to meet the Technical and Safety Requirements and all the Technical Inspection Requirements set out in the Rules.

The Score Sheet is split into categories covering the core areas of the design process, A to E. I have repeated the categories below from the Score Sheet to which I have added some information that indicates what may be expected to be discussed within each area. As can be seen, and partly by intent, some physical car areas will fall across multiple categories.

Each Design Judge Group will consist of a Lead Judge and then an individual Judge for each category area A through to E (two Judges for Category C, an IC and an EV person).

**Note** that an evidently unfinished/non running car will be assigned a ZERO score but the team will be judged and receive their Score Sheet for feedback.

## The Aim of FS UK

The UK event objectives are outlined at the beginning of the Rules: "*Formula Student UK (FS) is an educational challenge organised by the Institution of Mechanical Engineers (IMechE) for the purpose of educating and preparing students of engineering and other disciplines for their future careers.*"

In summary the event is more than just the car: it's not simply a technology competition. Student understanding is the key.

All of the static events are, by definition, interrelated. It's the same vehicle design and entrant. Cost and profit are design choices: their absolute values are driven by early engineering decisions.

## Where you will be Judged

All entrant teams in both classes will be assigned a scheduled judging timeslot for each of the Static events. If you are not on time, you will receive correspondingly less judging time and it is likely that your score will suffer. If you do not attend at all within the scheduled timeslot, you forfeit the Design event, i.e., you will score ZERO. **Please ensure you know where you are supposed to be and when. It is good manners to let us know if you are running late as otherwise we may go home!**

**FS and Concept Class:** you will bring your vehicle (parts for Concept) and student team members to your assigned numbered "bay" within the Pavilion. **Space is quite limited and we strongly advise you against bringing marketing style boards/displays.** Better to bring parts etc. and

have the required engineering back up information in folders or on screen. The Organisers have no responsibility to provide any Internet connectivity nor power supplies: you have been warned.

Design and Cost judging will be timetabled back-to-back to minimise vehicle movements wherever possible. Rather than move the car at the end of the first hour the Design and Cost Judges will swap bays. *Please appreciate this won't be 100% possible for every entry but we will do our best.*

Example: your team is scheduled as below.

09-00 to 10-00 Design in Bay 1 by Design Group 1

10-15 to 11-15 Cost in Bay 1 by Cost Group 1

The car will remain in Bay 1 from 09-00 to 11-15 and between 10-00 and 10-15 the D1 Design Group will swap physical locations with the C1 Cost Group.

**Getting the car into the Pavilion and in place will take a few minutes: ensure you are queued outside the entrance early and follow directions of the marshalls.**

[How you should run the Design Session/how scoring and feedback will work](#)

We try our best to provide a Judge, one per Category, that can discuss each area with your similarly skilled team members at the event to go through anything you feel relevant to that area. We advise Judges, insofar as it is practicable, to allow students to lead the Design Judging session so you get to bring up anything you feel relevant across multiple areas if needed.

We appreciate that this isn't perfect; for example, where do we consider "aerodynamics" as arguably this is something that impacts on every Category. It's part of the overall vehicle concept, it has obvious implications for powertrain, structures, brakes and suspension. It clearly requires to be organised and planned for its manufacture, tested and it carries a cost and reliability risk.

It is to your advantage to practise "leading" the judging session. It's interactive and two-way so don't have lots of long pre-prepared marketing type presentations. I always feel that a printed image is far better than a laptop screen and so a folder of relevant graphs or images, clearly indexed so you can easily find what is needed works well. By all means have a short introduction (5 mins maximum) but after that the discussion between Category Judge and corresponding student expert(s) should be two-way. Parts, especially tested and failed parts, are great "props".

You are assigned a one hour judging slot. You will get approximately 45 mins "one to one" time with Judges and the remaining time is generally for the Judges to discuss and record their opinions on the Score Sheet. Shortly after the weekend you will each receive your Score Sheet complete with raw scores (\*) and Judges' feedback. If the Lead Judge has time, they will often discuss your design in that last 15 mins but they cannot provide an indication of your score as they will only see about 10% of the total entry!

\* As there are 9 Design Groups, a team of Head Judges will spend a long time reviewing every Score Sheet to normalise scoring across the 9 Groups so the "raw" score on your sheet may not match exactly that given to you in the final Results. As with student exams, results are banded into grades.

**At the 45-minute mark Judges will ask you to leave the Pavilion so they can discuss and write up their thoughts and observations.**

[Maximum number of Students per Category/Judge](#)

To maximise knowledge transfer and to minimise cross talk, we limit the number of students within each Category/Judge to **two (2) maximum**. There are 5 Score Sheet categories so that's up to 10 students in the judging session. You can tag students in and out as required.

We will be monitoring this: it's necessary to avoid overcrowding and to keep background noise down. It is in your interest to keep to this.

[Score Sheet Category Advice \(based on Score Sheet headings\)](#)

We have set out below some brief guidance as to which part of your car design may be best placed under each of the categories. This is clearly **not** an exhaustive or detailed list but we hope it serves to assist you. Maximum possible score is 150 points.

You really only need to remember this: **we want to know why and how you decided things: we don't want a list of what you did.**

## **“Design Report Score” (maximum 10 points)**

*Before the event, Head Judges read and review every Design Report and provide you a written summary of their observations and a points score.*

## **“A” Overall Vehicle Concept (maximum 30 points)**

(Major choices, e.g., powertrain and mass. Cost & weight schedules, benchmark data. Design integration, sales appeal)

*This is **the** key driver for all subsequent design decisions and all principal package choices must be included. For example, type of powertrain and energy source, performance versus cost balance, target customer versus cost/performance and reliability. Outline of why and how the major sub systems are coherent and consistent with target performance and customer.*

*Example: aero package as regards pros and cons should be detailed here. Details on the dynamic effects and mass etc. belong in Category B, as does the supporting structure and effect of front wing on IA test. The drag and mass and hopeful downforce will influence the power needed: detail this in Category C. Wings will need making or procuring and this should be detailed in Category D. The cost of the package belongs mainly in Category E.*

## **“B” Structural Design inc. Suspension & Brakes (maximum 30 points)**

(Specifications, use of design tools & analysis. Load cases and load path appreciation. Safety considerations)

*This Category should include the main structure (chassis) but also supporting structures such as wing mounts. It includes all the suspension and steering systems, i.e., tyres, geometry considerations, structural analysis and testing. All decisions start with the tyres. Include the entire brake system in here as well, including cockpit ergonomics and controls. Judges may sit in your car to evaluate the driver experience.*

## **“C” Powertrain concept & choice, simulation, design, & analysis (maximum 35 points)**

(Possible choices explained, Predictive simulation, actual tests, margins of safety and errors explained.) Fail safe modes considered. Costs. Market appeal. Appropriate component sizing for batteries (where used) and machine (kW, kWh, C-rates) with supporting validation

*This category should include details of the entire powertrain (engine and driveline) including keeping it fed, oiled, watered and quiet! Differential can be here or in Category B.*

*For IC engines this means debating the actual choice of engine used (your IC versus EV debate should be in Category A), choice of fuel, forced induction or not, gearing, oil surge mitigation, differential, drive shafts and exhaust and restrictor.*

*For an EV this means debating the actual motor choice, gearing, control systems and safety considerations, battery pack methodology and pack size evidence. Note 60kW power limit for 4WD.*

## **“D” Overall Timing, Manufacturing, Procurement Plan plus Team Organisation Plan (maximum 20 points)**

(Plan to design, procure and build and test full car for next year)

(Team organisational structure, resource management, risk analysis and data sharing)

*Fairly self-explanatory, this is your chance to showcase your project management skills; we need more than just a Gantt chart! For FS teams this is how you did it, for Concept teams include anything here that you feel adds conviction that your design will be made and tested on time and within budget next year. Contingency is a wonderful thing.*

## **“E” Design for Manufacture & Profit, Customer Respect and Innovation. Lessons learnt from Prototype Parts (maximum 25 points)**

(Manufacturing understanding, Added value & innovation. Customer base considered)

(Lessons learnt from screen to actual item process) (Quality of manufacture and assembly, fit and finish and considerations to mitigate likely failure points, e.g., harness security, fluid pipe location etc.)

*Cost, or more importantly value/profit sit across every real-world design choice. Highlight in this category how you considered not just performance but how to move from screen drawing/model to real parts. It's quite easy to model something that cannot easily be made. Even if you haven't managed to make or buy those parts yet you will hopefully have thought ahead and understood that not everything can (or should) be 3D printed! Show us that you have consistently considered your target customer, e.g., car is easy to set up/adjust. Be very careful that innovation is not just a risky gimmick. We judge reliability by looking at your car's quality and for the usual suspected potential failure points. If we have time, we will hopefully discuss with you why we are not confident of your reliability and how to improve it.*

**"DEDUCTIONS" for Lack of Knowledge (up to 50 points lost)**

*We see a lot of "copy and paste" in both the written Design Report and the car itself. This is usually because a new intake of keen students "inherits" a car, sometimes running, often broken. The first instinct is to finish it or fix it. This is generally fatal as you learn so much more by starting from scratch, i.e., with the Rules, evaluating your resources, undertaking market research/benchmarking and then deciding what is realistically achievable for you and to meet your target customer's requirements.*

*The best thing to do is to cover up last years car and ignore it at least for a few months.*

**So in this area we may penalise those of you that show an inherent lack of knowledge of your design, especially relating to fundamental engineering practices.**

Score Sheet Categories (all Classes)

Max Points	Assessed Area
10	<b>Design Report Score</b> (quality of pre-submitted report)
30	<b>"A" Overall Vehicle Concept</b> (Major choices, e.g. powertrain and mass. Cost & weight schedules, benchmark data. Design integration, sales appeal)
30	<b>"B" Structural Design inc Suspension &amp; Brakes</b> (Specifications, use of design tools & analysis. Load cases and load path appreciation. Safety considerations)
35	<b>"C" Powertrain concept &amp; choice, simulation, design, &amp; analysis</b> (Possible choices explained, Predictive simulation, actual tests, margins of safety and errors explained.) Fail safe modes considered. Costs. Market appeal. Appropriate component sizing for batteries (where used) and machine (kW, kWh, C-rates) with supporting validation
20	<b>"D" Overall Timing, Manufacturing, Procurement Plan plus Team Organisation Plan</b> (Plan to design, procure and build and test full car for next year) (Team organisational structure, resource management, risk analysis and data sharing)
25	<b>"E" Design for Manufacture &amp; Profit, Customer Respect and Innovation. Lessons learnt from Prototype Parts. Build Quality, Preparation and Indicators of Reliability</b> (Manufacturing understanding, Added value & innovation. Customer base considered) (Lessons learnt from screen to actual item process) (Quality of manufacture and assembly, fit and finish and considerations to mitigate likely failure points, e.g. harness security, fluid pipe location etc.)
150	<b>DEDUCTIONS (up to -50 max)</b> <b>ONLY use for lack of knowledge</b>
	<b>Total (before moderation)</b>