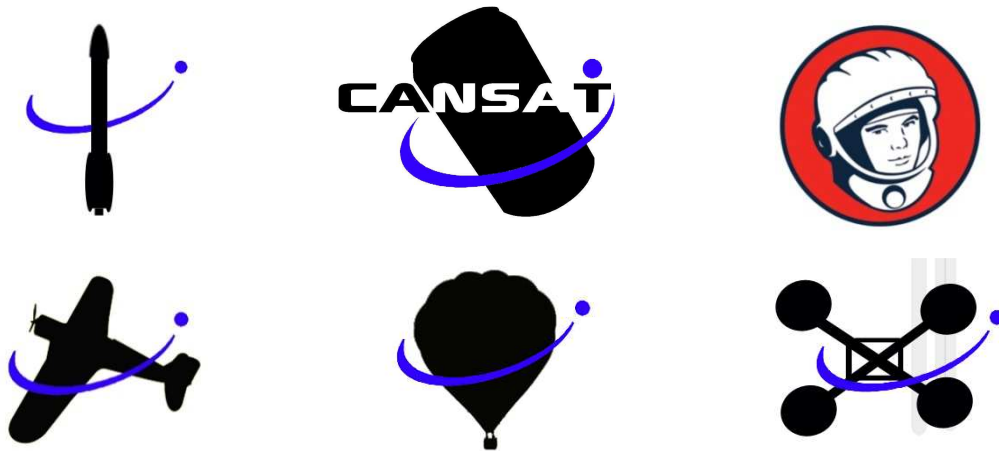




# All You CAN Fly 2010

## Competition's guide



8<sup>th</sup> to 11<sup>th</sup> of April of 2010



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## Acronyms List

CDR	Critical Design Review
COIAE	Colegio Oficial de Ingenieros Aeronáuticos de España
COITAE	Colegio Oficial de Ingenieros Técnicos Aeronáuticos de España
CONOPS	Concept of Operations
INTA	Instituto Nacional de Técnica Aeroespacial
LCO	Launch Control Officer
LEEM	Laboratorio para Experimentación en Espacio y Microgravedad
MSDS	Material Safety Data Sheet
NAR	National Association of Rocketry
PDR	Preliminary Design Review
RSO	Range Security Officer
TRA	Tripoli Rocketry Association
UPM	Universidad Politécnica de Madrid



## 1. Introduction to “All You CAN Fly”

All You CAN Fly as its name indicates, it's a meet-point between amateurs and experts, students and professionals, of different categories of non conventional flying devices, inside a scientific-technological frame in which the Aerospace sector deserves a special mention. In All You CAN Fly 2010 - from **the 8<sup>th</sup> to the 11<sup>th</sup> of April**- there will be international level exhibitions and competitions of:

1. CanSat (2nd International CanSat Competition LEEM-UPM)
2. Rockets (Rocket Master)
3. UAV - Probes
  1. *Airplanes*
  2. *Balloons*
  3. *X-copters*

This platform wants to offer to the students a first touch down with a real project and all of its typical phases (mission design, design reviews, certification, launch campaign, result analysis, etc). The main objective is to motivate the students giving them a “reduced” view of their technical and professional future.

LEEM considers that the fact that the students tackle the realization of a project with the quality degree required in space, it's a personal and professional challenge in which are acquired vital skills for the professional and personal future of the students, comprising what solutions are feasible and which ones are not, learning how to work in a team, and obtaining a whole view of all the factors that make project a success.

To the companies and organizations of the sector, All You CAN Fly is one of the most active and attractive events to look for appropriated profiles between its participants.

Also, small and medium sized companies are invited to launch their CanSat, inside the Professional category of the competition so they can show the performance of their products in a real mission.

The inscription of participants is open until the 28<sup>th</sup> of February of 2010, 23:55 via the webpage of the Organization: [www.fly.leem.es](http://www.fly.leem.es)

All the teams will have a Preliminary Design Review (PDR) with technicians from the LEEM to make sure that all the requirements of the competition are met. The documentation to participate in that review has to be sent before the Sunday 28<sup>th</sup> of February of 2010, 23:55. This competition is open to:

All the students of high school or university of any country

All the professional engineers, scientists, etc, of any sector

All the companies of the scientific-technological sectors that want to show and test their products.



## **2. General Information**

### **2.1 Team composition**

They will be considered separately:

1. **Student teams** if at least one of four components of the team are students
2. **Professional teams** the contrary

It is considered a student the person that had ended their studies with a maximum of one year before the competition date. The persons that don't meet that requirement will be considered professionals regardless of their laboral situation.

The teams will have to be composed of at minimum of two people and a maximum of eight; a team member can only belong to one team. Every team must fill the inscription form indicating it's team leader's name, that at all effects will be the only contact between the organisation and the team; also the team must send a picture of the team and indicate a name for the team. Badges with the logo of the team will be welcome and they will be stuck to the rocket that will launch the team's CanSat.

The team must indicate during it's inscription if it realises their project under the supervision of a teacher or an expert. The tutor will be welcome in the competition's acts and during the launch day.

### **2.2 Competition Rules**

All the participant teams must send before the Sunday 28th of February of 2010 the required documentation for the Preliminary Design Revision (PDR).

All the participant teams must send before the Sunday 28th of March of 2010 the required documentation for the Critical Design Review, and prepare a small presentation of the project (Briefing) with a length of 15 minutes at most, that will be presented before the launch campaign.

All the participant teams must make a presentation after the launch campaign (Debriefing).

The minimum contents of the PDR and CDR documentation will be specified in the corresponding document in the Web of the Competition.

All the documentation (PDR, CDR, presentations) must have be written and exposed in English. No other language will be accepted under any circumstances.

#### **2.2.1 PDR and CDR**

##### **2.2.1.1 PDR**

The main goal of the Preliminary Design Revision (PDR) is to be sure that all the teams had understood the requirements of the competition and that their designs adjust to them. The documentation will be revised by technicians of the LEEM that will send back possible issues for their correction.



The language used to write the PDR must be English. The deadline to deliver the PDR is the Sunday 28<sup>th</sup> of February at 23:55 CET of the 2010.

### **2.2.1.2 CDR**

The goal of the Critical Design Review (CDR) is reflect all the data, processes, schematics, tests, simulations, budget, etc. of interest about the project and the team.

The documentation of the CDR will be delivered to the jury so they can proceed to evaluate the originality and the quality of the designs, and the amount of budget and external collaboration received. The designs will freeze in the CDR and any later change will have to be communicated before the reception of the CanSat the prior day of the launches. The CDR must be written in English. The deadline to deliver the CDR is the Sunday 28<sup>th</sup> of March at 23:55 CET of 2010.

### **2.2.2 Presentation of the Project (Briefing)**

In the briefing of the competition, that will take place in the morning of the day before the launches, every team must have to make a brief presentation of it's device (15 minutes at most) in witch the objectives of their mission will be showed. This briefing has the only mission to present the team to the other participants. The language used must be English.

### **2.2.3 Presentation of the results (Debriefing)**

The day after the launch day, it will take place the Debriefing of the competition, in which every team will show the data obtained and the analysis of the mission (with 15 minutes at most). The languages used must be English.

At least the content of that presentation must be the following:

1. Description of the goals of the mission.
2. CONOPS (Concept of operations).
3. Description of the final design.
4. Graphics of the raw data obtained during the flight.
5. Analyzed data and results.
6. Failure/Success analysis.
7. Comparison with the initial concept.
8. Conclusions.

### **2.2.4 Economic Budget**

Every team must show in the CDR a detailed relation about the necessary expenses for the construction of its device. I case of the CanSat, the budget it's limited to 500€. Other expenses like the following station, ground facilities or auxiliary services won't be limited, but they must be included in the budget.



Also it must be delivered a report of the hours used by the team in the implementation of the project, indicating at least the hours of design, fabrication and tests performed by the team members and by the external help they had received (consultancy, mechanized, etc.).

This report must be reliable and will be used by the jury to evaluate the personal effort of the participants.

## 2.2.5 Communications

The frequencies used for communications must be related inside the ORDEN ITC/3391/2007 of the 15 of November, for which is approved the CUADRO NACIONAL DE ATRIBUCIÓN DE FRECUENCIAS (CNAF) (National Attribution Frequencies Frame).

Source of information: <http://www.mityc.es/telecomunicaciones/Espectro/Paginas/CNAF.aspx>

For this reason, the communication devices of non regulated use must use the bands assigned to ISM communications (Industrial, Scientific and Medical). The bands ISM defined by the UIT-R for the Region 1 (were Spain is located) are displayed in the Table 1.

The use of these frequencies bands is open to everybody without the need of a license, respecting the regulations that limit the levels of power transmitted. This fact forces that this kind of communications have a certain degree of tolerance to errors and that use protection mechanisms against interferences, like techniques of widening spectrum.

<i>Frequency Range [Hz]</i>	<i>Central Frequency [Hz]</i>
6 765 – 6 795 kHz	6 780 kHz
13 553 – 13 567 kHz	13 560 kHz
26 957 – 27 283 kHz	27 120 kHz
40,66 – 40,70 MHz	40,68 MHz
433,05 – 434,79 MHz	433,92 MHz
2 400 – 2 500 MHz	2 450 MHz
5 725 – 5 875 MHz	5 800 MHz
24 – 24,25 GHz	24,125 GHz
61 – 61,5 GHz	61,25 GHz
12ç2 – 123 GHz	122,5 GHz
244 – 246 GHz	245 GHz

**Table 1. ICM Bands defined for the UIT-R for the Region 1 (Spain)**

To the teams that want to use the bands assigned to radio ham, the organisation will demand them the Certificate of Operator of Radioelectric Radio Ham Stations according to the legislation in use, and the station's indicative. According to the ORDEN ITC/1791/2006, of the 5th of June, for witch is approved the *Reglamento de Uso del Dominio Público Radioeléctrico por Aficionados* (Regulations of the Use of the Radioelectric Public Domain by Amateurs), the frequency bands and technical characteristics of the application are displayed in the tables: Table 2, Table 3, Table 4 and Table 5.



<b><i>Bandas de Frecuencias in kHz</i></b>	<b><i>Max emission power</i></b>		<b><i>Max wideband (-6dB)</i></b>
	<b><i>carrier</i></b>	<b><i>peack</i></b>	
135,7 – 137,8	<i>1 w p.r.a</i>		0.3 kHz
1.830 – 1.850	50 w	200 w	3 kHz
3 500 – 3 800	250 w	1000 w	3 kHz
7 000 – 7 100			
7 100 – 7 200			
10 100 – 10 150			
14 000 – 14 250			
14 250 – 14 350			
18 068 – 18 168			
21 000 – 21 450			
24 890 – 24 990			
28 000 – 29 700			

Table 2

<b><i>Frequency Bands in MHz</i></b>	<b><i>Max emission power</i></b>		<b><i>Max wideband (-6dB)</i></b>
	<b><i>carrier</i></b>	<b><i>peack</i></b>	
50 – 51	100 w	--	12 kHz
144 – 146	150 w	600 w	25 kHz
430 – 440	50 w	200 w	25 kHz

Table 3

<b><i>Frequency Bands in MHz</i></b>	<b><i>Max emission power</i></b>	
	<b><i>carrier</i></b>	<b><i>p.i.r.e.</i></b>
1 240 – 1 300	10 w	30 dBw
2 300 – 2 450	10 w	30 dBw
5 650 – 5 850	10 w	30 dBw

Table 4.

<b><i>Frequency bands in GHz</i></b>	<b><i>Max emission power (p.i.r.e)</i></b>
10,00 – 10,50	30 dBw
24,00 – 24,05	
24,05 – 24,25	
47,00 – 47,20	
76,00 – 77,50	
77,50 – 78,00	
78,00 – 81,00	

Table5.

In the moment to carry out the register of the team in the competition, the team must inform about the frequency that wants to operate, this way the organization will be able to distribute the participant teams in different groups. A unique frequency will be assigned to each team to communicate with its CanSat. During the reception of the CanSats, it will be checked with each team that it only operates with a specific frequency. If a team causes interferences with other participants, it must shut off its equipment while it's not its turn of operation and launch.

The use of walkie-talkies will be allowed for the communication between the team members, never for data transfer. This communications will have to be suspended from the evacuation of the security perimeter until the landing of the rocket and the CanSat, during this interval will be used by the security and control personal of the launch area.



### **3. Field Operations**

#### **3.1 Preparation**

It will be provided a workbench and a power socket for team in the hangar in the fly field for the setup of the devices, available since the first hour of the day. Half an hour before the start of the respective group of launches, the teams could take their place in the flight line to set their following station and the ground equipment. The flight line is located directly in the edge of the restricted area, allowing the direct view of the launch and the flight operations.

#### **3.2 Information available in the field**

##### **3.2.1 Meteorology**

The organization will install a meteorological station near the launch ramps with the purpose of make public the following data to the participants:

1. Temperature.
2. Relative humidity.
3. Relative Pressure (hPa).
4. Wind direction and speed.
5. Tendency of variation of the relative pressure.

##### **3.2.2 Flight measurements**

Before the beginning of the participants launches, the Organization will launch a CanSat that will measure the real conditions of the flight and the atmosphere in the previous instants to the start of the competition. With this data, the participant teams could adjust the parameters that they consider necessary to optimize the actuations of their devices. The organization will publish graphics of the following data, represented against barometric height:

1. External temperature.
2. Acceleration in the 3 axis.
3. Vibration level.
4. GPS deviation from the theoretic trajectory (qualitative information about the wind strength in height).

#### **3.3 Schedule of the launches**

There will be four launch zones clearly differentiated:

##### **3.3.1 White Zone**

The White Zone is the scenario for the Planetary Probe of CanSat and for Balloons, either in the category Open Class of CanSat or for the balloons competing as UAV-B (Balloons). In the case



of the scenario of the planet *Ayllón* the organization will create an enclosure, were the CanSats could land and explore the area. There will be recreated the conditions of a possible planet to explore.

The security time for the launches will depend upon the volume of the Balloon that would be launched and they will be announced in the web of the Competition as the Organization knows the details of the projects of the participants.

### **3.3.2 Blue zone**

The Blue Zone is the zone for the UAV-A&B (Airplanes & X-copters). This zone will have available two sub zones, a longitudinal one for the manoeuvres of the Airplanes and a square one for the manoeuvres of the X-copters.

### **3.3.3 Red Zone**

Three launch pads will be disposed in parallel in the longitudinal axis of the runway of the airfield for the CanSat and the rockets, with the exception of the ‘Open Class’ and ‘Planetary Probe’ of CanSat and the ‘Experimental Rockets’. Every team will be assigned in advance to a group of launches.

Fifteen minutes before the group of launches, the rockets will be available for the integration with the CanSat in the cargo bay. The teams in the rocket Category could access to the launch pads to realize the rocket integration.

Five minutes before each group of launches, the tree CanSat must be ready for the launch, with the rocket in the launch pad and with their electronics on. The security perimeter near the launch pads will be evacuated, and only the security and launch control personal will have access to it.

The launches will be made sequentially, giving a security margin of two minutes between the rocket’s recovery and the CanSat of one team and the launch of the next one. This way is anticipated a delay of less than 30 minutes between the connexion of the teams and the launch of the last CanSat of the group.

The beginning of each group of launches will be split half an hour of the anterior, this way the ground teams can be ready in the line of flight and the rockets could be reconditioned.

### **3.3.4 Black Zone**

The Black Zone is composed by a single launch pad. This launch pad will be used exclusively for the Experimental rockets. It will be more isolated form the other zones. In this launch pad every launch will be performed in a coordinated way along with the Organization and the Team Leader or with other team member.

A rocket will be launched every 30 minutes, and each group assigned to perform the next launch must be ready 30 minutes before each launch.

## ***3.4. Delays and unforeseen circumstances***

### **3.4.1. In the case of the CanSat**



If for any reason beyond the participant's team control (meteorology, field logistics, launch operations, etc) the waiting in the launch pad were more than 30 minutes, the team will be allowed to replace the batteries of their CanSat so it can be launched in the next group..

If the delay is caused by the team, the Organization can close the corresponding group. The team will have the opportunity to effectuate their flight in the last group of launches of the day.

### **3.4.2. General Case**

In case of a non success flight for any reasonable motive presented before the Organization, the opportunity to repeat the launch in the last group of launches of the day is contemplated, one for each team, and being that decision in the hands of the jury.

If the meteorology forbids effectuating the launches in the day designated to do so, a demonstration of the CanSat actuation will be performed in an enclosure, and a static exposition of the rest of the devices. The decision of the jury in all the categories will be limited to the evaluation of the documentation presented in the CR.

### **3.5. Security Field Rules**

The security rules that are exposed next are proposed by the Organization and will complement the ones indicated by the owner of the launch field:

1. It is completely forbidden the consumption of alcohol and/or illegal drugs during the launches.
2. Mobile phones or radios are forbidden in the restricted area.
3. It is forbidden to smoke near the marquee were the fuels are stored and near the restricted area.
4. It is forbidden to try to catch rockets by hand during they descent phase.
5. All the spectators and participants must be outside the restricted area unless the RSO expressly allows them access to it.
6. When a launch is announced, all activity must stop and everybody must pay attention to the launch pad. You must be alert, standing on foot and ready to move if it will be necessary.
7. Rockets mustn't be touched or grabbed unless the LCO gives it's authorization to do so; there could be unexploded pyrotechnic charges inside of them.
8. In the event of finding any piece of rocket or CanSat in the field the RSO will be notified immediately about it. Any lost object will be send to the table of the RSO.
9. The kids must understand the security rules and be under constant supervision during all the competition.
10. It is forbidden the access of pets in the launch area.
11. The violation of these or other security rules will mean the automatic expulsion of the Competition.

## **4. Insurance**

During the day of the launches all the participants will be covered by a Civil Responsibility Insurance that will cover the possible damage to third parties caused by the rockets. All the participants and assistants must sign a document before that day committing to know and respect the security rules of the field.



The Organization will not be held responsible for the damage caused to the CanSat, UAV or rockets not belonging to the organization during all the competition, or the ones that could be the result of a launch, ejection or recovery failure.

## 5. Awards

The award ceremony will take place in the debriefing of the Competition, the day after of the launches and after the delivery of the jury. Trophies will be given to the winners and to the second and third classified of each category. All the participants will receive a certificate of participation.

## 6. Information about the event

In the first day of the competition (Thursday 8th of April) will begin with the registration of the participant teams. Following that, in the briefing will be explained with detail all the aspects of the Competition, the rocket that will launch the CanSats will be presented and every team will perform a brief exposition of their mission.

During the afternoon, the devices will pass a test to verify that they comply with the indicated requirements. In parallel with that, posters of the different teams will be putted in place and a static exposition of the CanSat will take place. There will be available a workshop for the teams that need to make repairs to their devices.

During the second day (Friday 9th of April) will take place the launches in the airfield provided to this effect.

During the third day (Saturday 10th of April) it will take place the debriefing of the Competition where each team will show their results and conclusions and the awards ceremony will take place.

During the fourth and last day (Sunday 11th of April) there will be organized different round tables so the participants, the organization and the guests can exchange opinions and suggestions. This will be an informal meeting.

This program will be updated in the web of the Competition ([www.fly.leem.es](http://www.fly.leem.es)) until it is submitted the definitive one, a month before the Competition takes place.

### 6.1. Preliminary Program

The preliminary Program could not be the definitive one of the Competition. Any modification of it will be displayed through the web [www.fly.leem.es](http://www.fly.leem.es).

Here it is de detailed preliminary program for the competition:

#### Day 1: 08th of April

##### 8:30 Reception and register of the participants (UPM)

- Delivery of the *Badge*, book of *Abstracts* and the UPM welcome kit
- Display of posters and loading of presentations

##### 9:00 Briefing of the Competition

- Welcome by the representative of the UPM



- Welcome by the Organization LEEM
  - Presentation of the association
  - Description of the Competition
  - Presentation of the rocket RK-20 of the LEEM
  - Future Perspectives
  - Thanks
- Presentation of the Teams (15 minutes/team at most)

**12:55 Group picture 1**

**13:00 Welcome Cocktail**

**15:00 Revisions of the devices**

**15:00 Static exposition of CanSats, rockets and UAVs**

- Possible demonstration
- Workshop for last minute repairs
- Guided visit through the installations of the University

**19:00 Closing of day one and free time**

### **Day 2: 09th of April**

**7:15 Pick up of the participants in the Base of the Competition**

**7:30 Pick up of the participants in the concerted Hotel**

**9:15 Arrival to the Launch field**

- Distribution to the teams in workbenches (Hangar)
- Announcement of the program through megaphony – animation and music

**10:30 Reception of VIPs and press (Hangar)**

**10:30 Start of the Launches**

- Tandas de 3 cohetes, 10 min por cohete. 30 min entre dos tandas.
- Lanzamiento de micro-cohetes realizados por alumnos de secundaria.

**18:55 End of the Launches; Group Picture 2**

**19:00 Participants bus leaves the launch field**

**20:45 Arrival to the concerted hotel**

**21:00 Arrival of the participants to the Base of the Competition**

### **Day 3: 10th of April**

**9:30 Debriefing of the Competition**

- Introduction in charge of the Organization
- Presentation of results (15 minutes/team at most)

**12:45 Coffee break. Reunion of the Jury**

**13:00 Ceremony of Awards (UPM representative)**

**13:15 Conclusions of the Competition (Organization)**

- “Towards a Global Competition” – Comments of the participants

**13:30 Closing. Transport leaves for the farewell lunch.**

**14:00 Farewell lunch**

**Free afternoon**

**22:30 International night’s party – Yuri’s Night**

### **Day 4: 11th of April**



### **10:30 Round table**

- Between participants, organization and guests.

### **13:30 Closing of All You CAN Fly 2010**

## **6.2. Logistics of the Competition**

Every team must take care of their accommodation and transport to and from the base of the Competition. The organization will make a reserve in a concerted housing for the teams that requested it.

In the day of the launches, a bus will pick up the participants in the base of the Competition and in the concerted accommodation to bring them to the launch field and will bring them back once the day end. Indications about how to arrive to the launch field will be provided to the teams that don't want to use that service.

In the Briefing and launch days there will be workbenches and power sockets in a covered installation for the teams that need to repair their device. The Organization won't provide any components or tools to the teams. During the launches, the teams will be provided by a table under a marquee to install and operate their monitor station and other ground equipment, with direct view to the launch pads and the flight field. During this day, the Organization will provide food to the participants.

## **6.3. Last hour**

Any modification of the place or date of the event will be announced in the web [All You CAN Fly](http://www.fly.leem.es), and using the social nets of [Twitter allyoucanfly webpage](https://twitter.com/allyoucanfly) or the [CanSat facebook page](https://www.facebook.com/cansat)

## **6.4. Suggestions**

Every suggestion will be welcome. To address them to the organization, you can use any of the methods specified in the Contact section.

## **6.5. Contact**

For more information you can contact the Organization using [cansat@leem.es](mailto:cansat@leem.es) or using the forum or the social nets.

### **6.5.1. Web pages**

- All You CAN Fly: [www.fly.leem.es](http://www.fly.leem.es)
- International CanSat Competition LEEM-UPM [www.cansat.leem.es](http://www.cansat.leem.es)

### **6.5.2. Social groups**

- *Official Facebook webpage:*  
<http://www.facebook.com/pages/CanSat/320398390281?ref=mf>
- *Event Facebook group:*  
<http://www.facebook.com/event.php?eid=56148310839&ref=mf>



- *Twitter webpage:*  
<http://twitter.com/allyoucanfly>

## 6.6. Sponsors and contributors

### 6.6.1. Sponsors



**POLITÉCNICA**

Universidad Politécnica de Madrid



Instituto Nacional de  
Técnica Aeroespacial



Colegio Oficial de Ingenieros  
Técnicos Aeronáuticos de España



Escuela Universitaria de Ingeniería  
Técnica de Telecomunicación



Escuela Universitaria de  
Informática



Escuela Politécnica Superior de Castelldefels



Asociación de Latas de Bebida



Presidencia de la Ciudad de Madrid de la Comunidad de Ciudades Ariane





## 6.6.2. Contributors



## 7. Appendix I: System of evaluation of the projects

While the evaluation of the technical complexity of the devices will be left in the hands of the members of the jury, from the Organization is especially valuable the Exchange of opinions and personal experiences between the students and professionals of the industry and the following points will be evaluated positively or negatively:

### Positive evaluations

- Global educative experience and learned lessons (to explain during the results display)
- Previous computer simulations (*Fluent, Fortan, Catia...*).
- Parachute design with it's own simulations.
- Development of inboard electronics (not based in integral commercial solutions like *Arduino*)
- Use of improvement systems of GPS: SBAS o GBAS. It will be particularly valued the use of EGNOS.
- Use of manually manufactured systems (example: antennas).
- Originality of the technique solutions that contribute to the realization of the Project..
- Getting the economic support of a company, university, institution
- Having accomplished that the effort is used as an academic project in the University of Origin (end of career project, practices...)
- Good presentation of the PDR and the CDR

### Negative evaluations

- The use of commercial solutions like: *CanSat Kit, Kit Aeromodellismo radio-control, Arduino*, etc.