67th International Astronautical Congress (IAC), Guadalajara, Mexico, 26-30 September 2016.

IAC-16-E.1.IP.18

THE DEATH STAR CHALLENGE: AN AMBITIOUS AND MOTIVATING ENGINEERING PROJECT TO PROMOTE ASTRONAUTICS AND TRANSFORM SOCIETY'S VISION ABOUT SPACE RESEARCH

Antoni Perez-Poch[1*], Fermín Sánchez Carracedo[2], David López[1], Marc Alier[3]

[1] *Institute of Education Sciences, Universitat Politècnica de Catalunya (UPC). Ed. Vèrtex, P.Eusebi Güell 6, E08034, Barcelona, Spain.*
[2] *Department of Computer Architecture, Universitat Politècnica de Catalunya (UPC).*
[3] *Department of Services and Information Systems Engineering, Universitat Politècnica de Catalunya (UPC).*
* Corresponding Author: antoni.perez-poch@upc.edu

Abstract

The race to put a person on the Moon motivated and captivated the imagination of USA society and the community worldwide. This led to an unprecedented investment in science, technology and the space program, which eventually resulted in a successful Moon landing in 1969. Current estimations state that, for every dollar invested in space technology, there is a return of more than five dollars for the country's GDP. However, public opinion worldwide does not perceive this investment as a benefit for the society. The moonshot was a challenge, an idea, a dream that aligned a whole society towards progress. To change society's vision about space, our proposal is to promote an outrageously ambitious, exciting and motivating Engineering project. While this project may be extremely difficult to implement, it can be envisioned, brainstormed, analyzed, and even brought to the attention of policy makers.
It would involve the design of the greatest Engineering work in space, even greater than the International Space Station (ISS). This endeavor would also help to raise awareness in our society about the Earth's sustainability. To that end, the project would drive a circular economy requiring the development of technologies that in the mid-term would reverse climate change. We believe that involving students from different backgrounds in this project would be vital to attract the interest of future generations in Aeronautics and Space research. In order to do this, we propose a number of outreach activities at all different teaching levels. We also propose the organization of an international contest for different ages, in which student groups would submit innovative proposals for different technologies that would be developed throughout the project. Furthermore, in order to raise awareness in our society, the project should generate a debate.
The project would consist of the design and construction of a Space Station similar to that of the Star Wars "Death Star", but without its weaponry and making the most of the publicity around and the revived interest in the Star Wars movies. Its construction would be feasible within a reasonable period of time, and the design would involve international, intercultural and multidisciplinary student teams. This paper outlines the principles that underpin the viability of this project. It also proposes a communication plan for universities as well as an outreach plan for the public at large. Finally, it defines a strategy for developing sustainable projects and assessing the students' learning outcomes.

Keywords: space education, STEM, outreach, sustainability, space station, death star.

Acronyms/Abbreviations

Challenge Based Instruction (CBI).
Centre National d'Études Scientifiques (CNES).
European Space Agency (ESA).
Gross Domestic Product (GDP).
International Space Station (ISS).
Project Based Learning (PBL).
Public Relations (PR).
Software Technology Action Reflection Legacy Cycle (STAR).
Science, Technology, Engineering and Mathematics (STEM).
United States of America (USA).
Union of Soviet Socialist Republics (USSR).

1. Introduction and rationale

Our world needs engineers to design and build technologies and artifacts that improve the quality of life of its inhabitants. These engineers should be able to create clean energy sources that allow us to reverse climate change, as well as being capable of designing the technology needed to feed the entire world population and definitively eliminate hunger from the earth. Furthermore, they would enable us to achieve the seventeen sustainable development goals [1] in the short term. However, the vocation for such a task is largely absent in today's youth. Young people think that engineering is a difficult subject and prefer to study other higher education courses because they believe them to be easier, a choice that often leads to unemployment or to jobs involving something very different from what they have studied. It may be that space engineering could help to alleviate this serious problem.

Forty-seven years after man first stepped on the moon, space applications and activities remain largely unknown to the general public. Space technologies and services are in the worst case simply ignored, and in the best case still regarded as simply a tool for specialized science and research [2]. Except for a small group of space professionals, teachers and students around the world are poorly informed about space systems, and so are unable to grasp the importance of aerospace and space studies for the human progress.

The current vision of space endeavors is that of a non-sustainable and expensive undertaking that gives rise to very few direct applications for improving the quality of life of the earth's inhabitants. A concerted outreach effort is needed to overcome this situation. Our goal is to change this perception held by the public at large in order to bring science, space engineering and research closer to everyday life as well as raising awareness of its day-to-day importance.

Our proposal to engage students in science and space engineering is to encourage them to participate in a Moonshot or an even bigger project. So why not build a Death Star? The question arises of why choose such a huge project as a motivation rather than others that may be less ambitious. The main reason is its direct outreach impact. Everyone has heard about the Death Star because of the huge commercial success of the Star Wars® movies. This in itself means that little effort would be required to explain and publicize the final objective. It also constitutes a controversial project from the outset; an endeavour of such magnitude would undoubtedly have its supporters and its detractors, and would therefore give rise to a broad cross-section of opinion from many people all over the world.

Sustainability is another important asset in our vision. Teaching sustainability in Engineering studies is a current trend, and building a sustainable space station of such a size is already a current matter of discussion. Would a Death Star be sustainable [3, 4]. This is precisely the purpose of this article: to raise interest in and stimulate discussion about the suitability of a space project. Our aim is not to actually construct the Death Star, but to develop all possible technologies involved in building it, and most importantly, to analyze how these developments may lead in the short- or long-term to the improvement of the everyday life of citizens on Earth.

With a view to the involvement of student groups worldwide, we have designed a plan for building a Death Star which will also benefit different aspects of life on Earth. The next step will be to find companies and sponsors to invest in this research and commercialize the spin-offs that may lead to improvements in day-to-day life on Earth. Stakeholders would then include [5] not only public space agencies like ESA or NASA, but also private hi-tech companies that may build products in line with the objectives of this project.

2. Opportunity: Creating a global space education community

To change society's vision about space, a new approach is needed in education. First, we need to arouse the sense of vocation among the young vis-à-vis STEM studies (Science, Technology, Engineering and Mathematics).

One of the problems with STEM studies is that young people only see the hard part: it is necessary to study many hard subjects in order to master the discipline. Neither are they familiar with the reality of the daily work of scientists and engineers. As Theodore von Karman (1918-1963) said, "A scientist discovers that which exists. An engineer creates that which never was". The key words that young people must bear in mind when speaking about science and engineering are "creativity", "discovery", "design", "solving real problems", and "help humankind", rather than "difficulty", "too abstract" and "boring".

There is a need for a humanistic vision in STEM studies. When the young, especially young women, say that they want to study to help humankind, most of them are thinking about health sciences, because they can hardly imagine how a mathematician or an engineer might help humanity. Even nowadays, when global warming has become a huge problem of which the young are aware, few of them wish to become scientists in order to address this problem.

What are the challenges capable of capturing the imagination of kids, young people and senior scientists? Which of these challenges could become the dream of a generation while also involving policy makers and investors?

2.1 A contest to achieve our goal

Space research has been one of the agents of change in this regard: the launching of Sputnik in 1957 [6] and the widespread perception that the United States was behind the Soviet Union in technical capability was one of the reasons for the 1950's emphasis on increasing mathematical and scientific foundations in engineering curricula. In addition, the race to put a person on the Moon led to an unprecedented investment in science and engineering. By the end of the 1960's, the dream of most children was to become an astronaut, and they were the modern heroes.
We believe that involving students from different backgrounds in a collective project is fundamental for making the new generations interested in STEM ideas, and therefore in Aeronautics and Space research. To this end, we propose a number of outreach activities at all different teaching levels, ranging from secondary school to Bachelor Degrees, Masters and PhD theses. We also propose the organization of an international contest for different ages, to which student groups would submit innovative proposals for different technologies to be developed for the project.

In order to raise awareness in our society, the project should generate a debate. It must also be attractive to both young and old generations as well as drawing attention from the media. No such project will be a success unless it is easy to understand, fashionable and creates a sense of community. Nowadays, it is hard to find a project as attractive for the public as the Moon project once was. Hence, we propose the design and construction of a Sustainable Space Station similar to that of the Star Wars "Death Star", but without its weaponry (some kind of Live Star) and taking advantage of the publicity coming from the revived interest in the Star Wars movies. The construction of such a station would be feasible in a reasonable period of time, and the design would involve international, intercultural and multidisciplinary student teams. The design would address the most scientific challenges in manned space exploration and colonization of other planets, eventually guaranteeing the survival of mankind.

However, it is necessary to bear in mind that the final objective is not the creation of a real Death Star Space Station, but rather the organization of a contest in which new ideas would be discussed. The main idea is to create an environment in which everyone can participate, from primary education student to young postdocs. The most important factor is to create a sense of community for participation in a project where the current problems facing our planet are presented and discussed. This would provide the opportunity to make the new generations conscious of current and future problems and how science and engineering can solve them.

From the pedagogical point of view, the aim is to introduce students into a familiar community where creativity and active discussion are paramount. A challenge-guided contest in which real problems are discussed is the best way to involve the new generations in STEM topics and change young people's perception of space research.

The creation of a global space education community would therefore require a concerted effort from space education stakeholders in order to engage teachers, learners and citizens in shaping a vision in which the mutual benefits of preserving planet Earth are made manifest, as well as conveying to a broad cross-section of people how space exploration can help global societies to overcome 21st Century challenges both on Earth and in space [7].

Different educational and outreach activities have so far been proposed and conducted. Space scientists have a wide range of possibilities for conducting their experiments in hypogravity conditions, from drop towers to sounding rockets [8] as well as satellites and the International Space Station (ISS). All these facilities provide flight opportunities for their diverse research interests. In addition to these well-known opportunities, parabolic flights have for some time been carried out as an alternative way of performing short-time duration experiments and technical demonstrations. Aircraft parabolic flights provide up to 23 seconds of reduced gravity and are used for conducting short investigations in Physical and Life Sciences, both for senior researchers and for international students' experimentation and motivation. The French Company Novespace, a spin-off from CNES, has been conducting a large amount of parabolic flights for many years [9]. Among these events, seven ESA Student campaigns [11] and joint partial-g parabolic flight campaigns [10] have taken place, in the latter case providing partial gravity similar to that present on the surface of the Moon and Mars. In 2014, the highly successful Airbus A300 ZERO-G was withdrawn from service, and a new Airbus A310 ZERO-G entered into operation in early 2015; new parabolic flight campaigns are currently being conducted with this aircraft [12]. Finally, in recent years small single-engine aerobatic aircraft have also been used out of Barcelona for conducting motivational parabolic flight campaigns as part of the "Barcelona ZeroG Challenge" international contest [13].

Indeed, the International Space Station (ISS) is a unique space platform used for research in such fields as life, physical sciences, and space medicine The ISS is also used as a testbed for several technologies and applications, including robotic operations, as well as several bodies' maneuvers in orbit. Perhaps most interestingly of all, it provides a platform for educational and outreach events for new generations. Among these educational activities, we may mention the following: "Butterflies, Spiders and Plants in Space", from Nasa, which has shown the efficiency of ISS for conducting experiments aimed at students; the "AuroraMAX" by the Canadian Space Agency, the first monitoring project of aurora borealis from Earth, and ISS Modular didactic materials developed by the European Space Agency, including ISS educational kits issued in 12 languages with videos. Finally, we may also mention the SUCCESS student contest [14]. SUCCESS stands for Space Station Utilisation Contest, which was a competition for University students all disciplines and belonging to ESA member states. All these initiatives have been successful over the years, although as regards overall awareness of the importance of space research and activity, they have had a limited impact on the general public.

What we propose herein is an even bigger and more ambitious project; that of building the most complex, popular and compelling space station imaginable; a motivational endeavor such as the design and construction of a realistic Death Star (Figure 1). Such huge undertaking would provide the opportunity for developing new sustainable technologies and scientific research projects, all of which would constitute an advance in knowledge as well as a parallel practical application on Earth to enable the quality of life to be improved for all humankind.

Figure 1. Designing and building a sustainable Death Star may foster people's imagination.
[Image: http://misterkenneth.deviantart.com/]

2.2 The roadmap for designing a challenge: a story to tell.

In 1919, Raymond Orteig offered a prize of 25,000 USD for the first allied aviator(s) to fly non-stop from New York to Paris. This challenge was made in a letter to the president of the Aero Club of America "*Gentlemen: As a stimulus to the courageous aviators, I desire to offer, through the auspices and regulations of the Aero Club of America, a prize of $25,000 for the first aviator of any Allied Country crossing the Atlantic in one flight, from Paris to New York or New York to Paris, all other details in your care.*"

This prize prompted several groups of aviators and engineers to invest time, effort, optimism and money towards a common goal, even putting their lives at risk. At least 6 teams competed with different technical and organizational approaches. In 1926, the team led by René Fonch invested 100,000 USD in building the S35 aircraft and setting up the flight to win the Orteig Prize. Unfortunately, the plane was overloaded and crashed at takeoff, and two of the four crew members were killed in the accident. Nevertheless, it became clear that the prestige of the prize had provided enough incentive to invest four times more than the prize itself.
The following year, 1927, with backing from the bankers of Saint Louis, Charles Lindberg won the price. He won by using a different strategy from his competitors: just one engine in the aircraft instead of 3 (therefore lighter and able to carry more fuel); he flew alone (avoiding friction with teammates, an issue that delayed at least one of the competing teams), and took the decision to take off before bad weather had completely cleared (thus stealing a march on his competitors).

The Orteig Prize [15] not only opened the way to much greater investment than the value of the prize itself, but it also tapped into different approaches and problem solving skills. Moreover, now that it had been proved that a non-stop crossing of the Atlantic by plane was possible, more entrepreneurs started working on building a profitable business with long distance air transportation. Thus, it is possible to state that the enthusiasm and investment that stemmed from the Orteig Prize was the point of departure of the current aviation industry.

Inspired by Lindberg's feat, Peter Diamandis set up the Ansari XPrize, which offered 10 M$ to the team who created the first reusable 3-person spaceship. In 2004, this prize was won by the Tier One, designed by Burt Rutan and financed by Microsoft co-founder Paul Allen. The technology was immediately commercialized by Richard Branson to create Virgin Galactic. Interestingly, Diamandis did not actually have the 10M$ at the time he announced the prize. He spent all his available funds on promotion and then set about obtaining the rest, which he accomplished successfully [16].

According to Diamandis [17], if properly and aggressively promoted, a prize ranges from 5X to 10X in investment the prize purse.

We know that it is not possible to offer a prize for building a Death Star. First of all, just drawing up the specific conditions for the prize would pose an enormous challenge. The key factor in our opinion resides in the phrase “properly and aggressively promoted”. Stories are the best way to spread a message as well as to create sympathies and empathy, and the construction of a Death Star is indeed a story that is easy to tell. If we are able to define objectives in a roadmap, stimulate discussion, identify the problems to be solved and specify the achievements to be gained in the construction of a Death Star, then we may have a really good story to tell.

The backstory for the building of a Death Star would involve a very easy Public Relations campaign (PR) to help promote many prizes. If young people believe (or just pretend) that they are helping to build a Death Star while at the same time solving concrete science and engineering problems, they will be more motivated to participate and to discuss it amongst themselves. In the same way, the relative ease with which this kind of PR could be set in motion is the key to obtaining the proper funding for the prizes themselves, which would be open to young people all over the world.

2.3 Pedagogical framework

The pedagogical ideas behind our proposal are based on Challenge Based Instruction (CBI), which is based on a reference framework named “How People Learn” and an instructional design named “Software Technology Action Reflection Legacy Cycle (STAR)”, developed by the universities of Vanderbilt, Northwestern, Texas, Harvard and MIT [18]. This is somewhat similar to Problem Based Learning (PBL), but the main difference is that, while PBL present students a problem to solve, CBI offers open general problems in which students themselves decide which challenge they want to tackle [19]. The Death Star Challenge is the kind of open problem that can be used in Challenge Based Instruction.

One of the most important tools we wish to promote is mentoring. Mentoring is an aspect of professional education in which a relatively more senior and experienced person (the mentor) and a more junior person (the mentee) come together in a personal and collaborative relationship; the mentor guides the mentee in the discovery and exploration of the learning process. Mentoring has already been widely used and is based on what Vygotsky called the “Zone of Proximal Development”, which can be considered the point at which students have enough knowledge to proceed independently, but are unable to make further progress without more input from a mentor [20]. We believe that the best possible structure for our proposal is a mentoring organization in which a university teacher is the mentor of a PhD student, who at the same time is the mentor of an undergraduate student (or student team), who in turn is also the mentor of a secondary school student (and so on).
Working in multidisciplinary and multicultural teams is of great importance in our proposal, since it plays a vital role in engineer education and is one of the ABET criteria for the accreditation of engineering programs [21]

3. Contest topics

The projects submitted to the contest must comply with a predefined set of topics. These topics should be in line with the research of major aerospace agencies in the world. Thus, the work done by students may result in a direct impact on space research and projects would much more likely to be implemented.

NASA has for several years been working on a project to send a man to Mars and hopes to achieve this goal by 2030. According to NASA, some of the technological hurdles to be overcome before a human being sets foot on Mars are as follows: creating an environment for humans to live and work in space; travel to distant places; manufacture products in space; landing on and taking off from planetary surfaces and establishing swift communication between Earth and spacecraft.

Any extension program of human presence in the universe requires learning to reuse resources in the places of destination as well as the natural resources arising from the exploration activity itself. The products obtained from these resources could be used to reduce the mass and cost of both human and robotic exploration. They also reduce the risk and cost of missions by allowing self-sufficiency, thereby giving rise to new mission concepts rather than transporting everything from Earth.

In order to put a man on Mars, in 2010 NASA defined a set of 14 Technology Roadmaps to guide the development of space technologies. This list was updated in 2015 by 40 experts with the support of specialists from different areas*.

* Nasa Roadmap to Mars:
http://www.nasa.gov/offices/oct/home/roadmaps/index.html

NASA shared the roadmaps with the broader community to raise awareness and to generate innovative solutions to provide the capabilities for space exploration and scientific discovery. The 2015 NASA Technology Roadmaps cover a wide range of technology candidates and development pathways up until the year 2035. Moreover, NASA states that these technologies will produce devices to improve health, medicine, transportation, public safety, and consumer goods for the general population. The 15 roadmaps are the following:

- Launch Propulsion Systems
- In-Space Propulsion Technologies
- Space Power and Energy Storage
- Robotics and Autonomous Systems
- Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
- Human Health, Life Support, and Habitation Systems
- Human Exploration Destination Systems
- Science Instruments, Observatories, and Sensor Systems
- Entry, Descent, and Landing Systems
- Nanotechnology
- Modelling, Simulation, Information Technology, and Processing
- Materials, Structures, Mechanical Systems, and Manufacturing
- Ground and Launch Systems
- Thermal Management Systems
- Aeronautics

The document also specifies different transverse technologies such as artificial intelligence and autonomous systems, avionics, space walks, on-site reuse or radiation and space weather resources areas. These technologies may also be included as topics for the contest. These topics may also be supplemented by further specific topics not considered by NASA and aimed more at the Death Star design, such as studying the impact of artificial gravity environments on the human body.

Experts who have drawn up roadmaps indicate that space exploration using robots will continue to monopolize much of the American effort in this regard. However, future missions will be much more complex and will require great machine autonomy. Distant missions will have dynamic targets, and will require robots capable of adjusting their configurations and behaviour to circumstances. These robots will be able to react in situations of uncertainty. For example, exploring near Earth asteroids will require automatic systems capable of making decisions and tracking processes autonomously.

Astronauts need spacesuits that are like small spaceships and incorporate many systems, such as vital systems, thermal control, avionics, distribution and storage of energy, impact protection, propulsion and communications. For the design of the near-future spacesuits, the needs of planetary exploration must be taken into account.

In 2015, the total mass of space junk exceeded 6,000 tons. US surveillance network of space junk is currently monitoring more than 22,000 objects larger than 10 centimeters. The data indicate that there are 500,000 pieces of trash larger than one centimeter, and more than 100 million greater than a millimeter in size. Space junk fragments of 0.2 mm pose a real hazard to both astronauts and spacecraft. The measures taken so far are insufficient to prevent the increase of space junk in the future. The NASA roadmap identifies technologies that will be needed to meet this challenge: (1) optical and radar observations, and (2) direct measurements to better characterize the population of space junk from low Earth orbit to geosynchronous orbit (about 36,000 km altitude), where many communications satellites are currently working. We must also advance in modeling both the current and future space junk environment as well as the processes of satellite fragmentation when pieces reenter the Earth's atmosphere.

It is essential to forecast space weather on the distant or long missions in which neither astronauts nor ships or space probes have the protection provided by the Earth's magnetic fields. Radiation is a problem for both human explorers and the electronic equipment they carry, so we need to improve technologies of radiation protection. Technologies that allow predicting solar flares must also be improved.

NASA has launched a call for proposals in line with the 15 defined objectives. Some proposals selected by NASA in 2016 to conduct a study phase are as follows:

- A robot shaped eel or squid, able to feed off the energy generated from the magnetic field variation. This robot could be useful for exploring amphibious worlds like Jupiter's moon Europa, which has liquid oceans;
- Two gliders connected by a wire moving at different heights without propulsion
- Small, inexpensive robots such as footballs capable of searching for water, nitrogen and hydrogen in the permanently shaded regions of planetary bodies

We believe that all contest projects should include a section indicating what other applications, not necessarily connected with the aerospace industry, might be put into practice with the technology or the ideas suggested. These applications should be clearly aimed at improving the quality of people's lives. This would induce potential private investors to finance some of the projects, since as everyday applications exist, it would be easier for investors to identify the potential return on investment. This would facilitate the involvement not only of government agencies such as ESA or NASA, which would focus on the aeronautical and spatial aspects of the project, but also of companies such as TESLA, GOOGLE, etc., which could build products based on the proposed technology or ideas in accordance with their own research lines.

4. The Death Star Challenge

The main goal of the Death Star Challenge Roadmap would be to launch the first edition of the challenge (Challenge 1) in the academic year 2018-2019. After the creation of the steering committee, in the Fall of 2017, we foresee 4 phases in our roadmap: Bootstrap (Q1-Q3 2017); Pre-challenge 1 (Q3 & Q4 2017); Challenge 1 Launch (Q1 & Q2 2018), and finally Challenge 1 Execution (Q3 2018 to Q3 2019).

The phases of this Death Star Challenge are designed as follows:

- Bootstrap (Q1-Q3 2017)
- Pre-challenge 1 (Q3 & Q4 2017)
- Challenge 1 Launch (Q1 & Q2 2018)
- Challenge 1 Execution (Q3 2018 to Q3 2019).

4.1 Bootstrap (Q1-Q3 2017)

In this phase, the steering committee would be required to undertake the following tasks:

- **Refine mission, vision and objectives**. The vision, mission and objectives presented in this paper need to be examined, revised and fully approved by the steering committee.
- **Create pitch to get backers and partners**. Funding is a key element for this project. We need to create an effective and compelling pitch to try to convince as many backers and partners as possible.
- **Create association**. We need to determine the best legal figure under which to organize the Death Star Challenge and take the legal steps to create it.
- **Define communication strategy**.
- **Setup online and social media presence.** A website with all the relevant information needs to be set up, plus we need to start a community management and online marketing campaign.
- **Get partners and backers**. Backers will be persons and organizations contributing funds for the execution of the Challenge and the Awards. Partners will be organizations that help with the organization and execution of the Challenge. Both will be extremely important for the success of the project.

4.2 Pre-challenge 1 (Q3 & Q4 2017)

In this phase, we need to define the first edition of the Death Start Challenge down to the last detail. We consider the following phases.

- **Identify problems to be solved**. The scope of themes and problems to be solved have been outlined in foregoing sections. In this phase, however, we need to define what problems need to be solved in the different categories of the first edition of the Challenge.
- **Define challenge categories and rules**. The rules of the Challenge and the categories of the competition need to be specified, written down and translated into the local languages.
- **Creation of the first challenge committee**. The Death Star Challenge Committee will be composed of 10 to 15 persons, including: representatives of 2 universities on each participating continent, representatives of space agencies and companies, 2 representatives of K12 schools and high schools, engineering and students associations (Space Generation, Euravia, BEST, ASEE, SEFI, etc.).

4.3 Challenge 1 Launch (Q1 & Q2 2018)

In this phase, preparations will be made for launching the Challenge as defined in the previous phase.

- **Form local committees**. The Challenge will take place in two spheres: Local and Global. The winners of the local Challenges will compete among other Local winners in the global final. We need to create the Local committees that will oversee the execution of the Challenge in each area.
- **Communication and dissemination**. Both in the global and local spheres we need to set up a communication campaign to raise awareness and interest in the Challenge.
- **Instructors training**. The instructors of the students participating in the Challenge will receive specific training in order to provide

support and guidance (when needed) to the students. This training will be developed and provided by the First Challenge Committee.

4.4 Challenge 1 Execution (Q3 2018 to Q3 2019)

Now we assume that the First edition of the Death Star Challenge is under way. If all the above has been carried out correctly, this should be the "easy" part. These are the tasks planned.

- Quick Off
- Process monitoring.
- Feedback and guidance
- Local finals
- Global finals
- Communication

Notification of the final results will be made during the upcoming IAC 2019, where prizes will be awarded in a public gathering.

A detailed chronogram and budget are described in Annex 1 and Annex 2, respectively, of this manuscript.

4.5 Budget previsions

On the first iteration of the challenge, we plan for 5 regions/countries mobilizing 50 schools and high schools per region. This would mean that approximately 3,750 students would be participating in the challenge.

The estimated cost for the first execution is approximately 550 K € - see Annex 2. However, the bootstrap phase could be funded for less than 100K€ while more funding is being raised.

5. Conclusions

In this paper, we have outlined the reasons why a widely-publicized, ambitious and motivating challenge is needed to attract the young to STEM studies, especially to astronautics, while transforming society's vision of space research. We propose to take advantage of the Star Wars films, which are firmly lodged in the imagination of several generations, to address enormous problems above and beyond those that the construction of the Death Star Space Station would entail.

Society needs a challenge equivalent to that of the space race, which started when the USSR launched the Sputnik and which came to a halt (for most of society) when Apollo 11 landed on the moon. An idea such as this that is able to captivate the imagination constitutes the only kind of project capable of involving students of all types (both young and senior) from all parts of the world, the final goal of which is the advance of knowledge and the solution of problems common to the whole of humanity, such as climate change. Furthermore, a world contest of this nature, in which all such problems could be discussed and debated, is the type of project that could attract partners to invest money in promoting and developing whatever ideas that might emerge.

From all the possible projects, the authors of this paper believe that there is only one area of knowledge with the potential to capture the imagination, while at the same time addressing enough real challenges that cover practically all challenges currently posed in knowledge; this is in the field of Astronautics, and the proposition of a real Sustainable Death Star Space Station.

Acknowledgements

Thanks are due to George Lucas, Lucasfilm ® and Disney ® for providing us inspiration for this pape**r.**

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ANNEX 1: Chronogram

	2016	2017				2018				2019			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	
Creation of steering committee													
Bootstrap													
Refine mission, vision and objectives													
Create pitch to get backers and partners													
Create association (legal)													
Define communication strategy													
Setup online and social media presence													
Get partners and backers													
Pre-Challenge													
Identify problems to be solved													
Define challenge categories and rules													
First challenge committee													
Challenge Launch													
Form local committees													
Communication and dissemination													
Instructor training													
Challenge 1 Execution													
Quick Off													
Process monitoring													
Feedback and guidance													
Local finals													
Global finals													
Communication													

ANNEX 2: Budget

Expected scope 1st edition					
	Local areas	5	countries/regions		
	Number of schools	50	per region		
	Total schools expected	250			
	Number of students	15	average per school		
	Total students expected	**3,750**	students		
	Total teams expected	**1,500**	teams		
Budget					
	Administrative personnel	2	person		
		3,000 €	cost person/month		
		6,000 €	administrative personeel expenses / Month		
		144,000 €	**total administrative personnel expenses**		
	Steering comitte	5	person		
			voluntary participation / no cost		
	First challenge committee	14	person	(steering comitte + 9)	
	Travel expenses	400 €	average month / person		
		50,000 €	**steering comitee travel expenses**		
		75,600 €	**Other travel expenses**		
	Offices and equipment rental	2,000 €	month rental costs		
		48,000 €	**rental costs**		
	Legal support, accounting, etc	**20,000 €**			
	Graphic Design and Web development	**20,000 €**			
	Webmaster and community management	**80,000 €**	(one full-time person 24 months)		
	Challenge management software	**20,000 €**	**(includes customization and operations)**		
	Events organization, merchandise, caterings etc	**50,000 €**			
	Travel expenses for local team finalists	**20,000 €**			
	Insurance	**20,000 €**			
	TOTAL	**547,600 €**	**PLUS AWARDS**		
Expected scope 1st edition					
	Local areas	5	countries/regions		
	Number of schools	50	per region		
	Total schools expected	250			
	Number of students	15	average per school		
	Total students expected	**3,750**	students		
	Total teams expected	**1,500**	teams		

Budget						
	Administrative personnel		2	person		
			3,000 €	cost person/month		
			6,000 €	administrative personnel expenses / Month		
			144,000 €	**total administrative personnel expenses**		
	Steering committee		5	person		
				voluntary participation / no cost		
	First challenge committee		14	person	(steering committee + 9)	
	Travel expenses		400 €	average month / person		
			50,000 €	**steering committee travel expenses**		
			75,600 €	**Other travel expenses**		
	Offices and equipement renting		2,000 €	month rental costs		
			48,000 €	**rental costs**		
	Legal support, accounting, etc		**20,000 €**			
	Graphic Design and Web development		**20,000 €**			
	Webmaster and community management		**80,000 €**	(one full-time person 24 months)		
	Challenge management software		**20,000 €**	**(includes customization and operations)**		
	Events organization, merchandise, caterings etc		**50,000 €**			
	Travel expenses for local team finalists		**20,000 €**			
	Insurance		**20,000 €**			
	TOTAL		**547,600 €**	**PLUS AWARDS**		