- *Project Feasibility Document -*

VERY LARGE SPACE TELESCOPE ELAB

Authors: Magrini, Rosa, Giamberini

Date: 17/10/2024

Version: 0.1

Circulation: Internal, Project Partners, Public

# **1** **Statement of Work**

The Very Large Space Telescope Elab project has the goal of developing advanced software that will be able to process satellite data in order to generate high-resolution images of space. Those images will be verified using a mathematical approach in order to verify their correctness and accuracy. This software will be installed into NASA’s VLST data elaboration centers and integrated with distributed computing and GPU resources to increase processing capabilities.

With this project, we will enlarge our understanding of space technology and support the analysis of space data, allying with global efforts to space exploration.

#### Project Objectives

The VLST-Elab project will achieve:

1. **Development of the software** to collect data from space and process satellite data in loco using distributed computing and GPU technologies;
2. **Training and support** for technical staff that will work with it;
3. **Security Standards** to achieve correct reception of data from the satellites and guarantee its integrity.

This project will be based on existing satellites ensuring compatibility with the infrastructure.

# **2** **Business Objectives**

As a publicly traded company, this involvement with the VLST-Elab is also commercially strategic but is more important scientifically. NASA provided initial funding to get the development of VLST-Elab software underway, but our goal here is to create a completed market-ready product that will be sold to NASA for deployment in their VLST dedicated data elaboration center.

VLST-Elab will merge technology, innovation, scientific progress, and high potential in commerce. This will allow us to provide advances in the space field and create business opportunities and societal value.

The project is targeting the space research initiative by developing advanced software that takes the data from satellites to convert them into high-resolution images of space. This work will also attempt to build a better perception of space by using mathematical techniques to validate that generated images are both accurate and intact.

The main goals of VLST-Elab include increasing resource efficiency by means of distributed computing and GPU processing for significant increases in data processing capability.

##### **The output**

The VLST-Elab project is about to produce a series of important deliverables that will extend the current capabilities for space exploration and research in large strides. Deliverables will include high-resolution imagery produced from raw satellite data through careful processing and validation for accuracy with refined mathematical models.

We will also offer enhancing computational resources using our infrastructure-as-a-service technology.

##### **Business strategy**

The business strategy of the VLST-Elab project is focused on partnerships with government institutions. Our goal is to develop a final product that will be sold to NASA for the VLST project’s elaboration needs. NASA will also provide funding to support the project along its development lifetime. The actual value of our project will be the long-term services that we will provide to the client. These services consist in the training of specialized NASA employees to correctly operate the software, and the provision of 24/7 technical support to quickly resolve any possible problem with the software. Another inherent value of this project is the increase of the capacity of scientific and research communities to gather, analyze, and interpret space data for a finer understanding of the universe.

# **3** **Summary of the Budget**

For the success of our project execution, we need professional people, starting from Project Managers with expertise in managing the project timeline and deliverables, System Administrators who will be responsible for the IT infrastructure, and Software developers (~75) who will develop the software that will be essential for processing satellite data. We will also be hiring five Cybersecurity Specialists who will contribute much to the protection of our systems and integrity, ten Machine Learning Analysts, and Astronomical Physicists, who can further contribute to data analysis and scientific insights.

There will be allocated $1,000,000 to infrastructural investments in cloud services to support our data processing. We also intend to acquire development equipment needed, such as servers and PCs, for $100,000.

In making salary estimations we applied the averages from <https://www.paylab.com/it/salaryinfo/information-technology/software-engineer?search=1&lang=en>. A PM will have an annual salary of around $43,000 and a Software Developer of around $35,000. The other positions will have the approximately same salary which will lead us to an annual cost of approximately $3,544,000

So the total amount of costs that will include personnel, infrastructure, hardware, and software will be $4,544,000 (for the first year including distributed computing infrastructure) and $3,544,000 for the next years (until the personnel is needed and the project is not finished)

# **4** **Summary of the Project Milestones**

| **#** | **Name** | **Date**  **(Months)** | **Description** |
| --- | --- | --- | --- |
| **1** | Kick-Off | 0 | The first meeting where the project and the necessary steps to complete it are defined. |
| **2** | Preliminary Operations | 1 | The hiring of the necessary personnel and the start of the base software development.  Start of the design of the infrastructure needed for future performance scaling. |
| **3** | Initial Project Review | 6 | At the end of this milestone we have completed the base requirements and the design of the project. Beginning of the coding of the Alpha version of the project. |
| **4** | Completion of the Infrastructure Construction | 12 | Completion of the infrastructure construction. |
| **5** | Second Project Review | 14 | Alpha version is completed and tested using In-House data. |
| **6** | Earth-Based Stress-Test | 22 | Beta version of the software has been tested using instruments and old data of the EHT (Event Horizon Telescope). |
| **7** | Third Project Review | 24 | Beta version is completed. |
| **8** | Deployment | 36 | Deployment of the Final version of the software |
| **9** | On-Site Stress-Test | 38 | The software has been thoroughly tested on-site. |
| **10** | Fourth Project Review | 40 | Review of the test results and analysis of eventual problems. |
| **11** | First Image | 44 | The first data has been gathered and elaborated, creating the first image. |
| **12** | Final Project Review | 48 | Final review of the project and publication of the first image. |
| **13** | Start of the Long Term Operations | 49 | The long term work begins. |

# **5** **Stakeholder Analysis**

|  | **Strong Power** | **Weak Power** |
| --- | --- | --- |
| **Strong Interest** | NASA | Universities Researchers Scientific Journal Publishers |
| **Weak Interest** | USA Government | The Public |

# **6** **Risks**

The main risks that our project will entail are:

* Respect the result’s quality threshold, because by the contract we are forced to respect them. The minimum accepted quality of the result will be discussed and decided with the client, and we must guarantee it. To this end, we’ll have to pay close attention to the “noise” cancellation part of the software and have a reliable method for receiving the data.
* Provide computational support with our infrastructure, one of the services that we’ll provide to the client is the scalability of distributed computing using our infrastructure, this means that we’ll have to build, maintain, and guarantee the connectivity of our computational infrastructure.

We also need to create a solid code, that after the deployment phase, won’t need too many software patches. This can be achieved by intensive testing and having an experienced and capable team of SW developers.

Furthermore, we will also need to build strong relationships with the client and the government, by having numerous meetings and project reviews.

# **7** **Alternatives**

The software we will produce is a one-off, custom-made for the client according to their requests and specifications. Therefore, at least for the time being, there are no existing alternatives on the market.

# **8** **Evaluation**

**Payback**: is calculated for 4 years of development

The initial starting point is to build an infrastructure in parallel to the development of the software. For such goal, 1.000.000$ is reserved and in particular will be used for building the centralized data computing lab which involves:

* 150GPUs (NVIDIA 4090); ~2700$ each = ~405.000 $
* Ventilated rooms and optimal buildings for containing such data computing labs ~300.000 $
* Control server room + labor work ~300.000$

Apart from infrastructure outgoings, the remaining money for developing the software is coming from several external companies that are active stakeholders involved in the project. The investment will fully cover the non-earning initial years which the estimated time is about 4 years of work. These active actors are:

* NASA: 15.000.000 $
* SpaceX: 2.500.000 $

For a total value of 17.500.000 $, following divided:

Estimated salaries cost per year: 3.544.000 $

| **Time** | **Coming Investment** | **Outgoings** | **Cumulative Remaining** |
| --- | --- | --- | --- |
| 1-6 month | 3.000.000 $ | - Salaries 1.772.000 $ | 1.228.000 $ |
| 7-13 month | 2.071.428 $ | - Salaries 1.772.000 $ | 1.527.428 $ |
| 14-19 month | 2.071.428 $ | - Salaries 1.772.000 $ | 1.826.856 $ |
| 20-25 month | 2.071.428 $ | - Salaries 1.772.000 $ | 2.126.284 $ |
| 26-31 month | 2.071.428 $ | - Salaries 1.772.000 $ | 2.425.712 $ |
| 31 - 37 month | 2.071.428 $ | - Salaries 1.772.000 $ | 2.725.140 $ |
| 38 - 43 month | 2.071.428 $ | - Salaries 1.772.000 $ | 3.024.568 $ |
| 44 - 48 month | 2.071.428 $ | - Salaries 1.772.000 $ | 3.323.996 $ |
| 29 - 60 month | 5.000.000 $ | - Data center outgoings 100.000 $  - Salaries 500.000 $ | 7.723.996 $ |

Beware that outgoings can be higher due to unforeseen expenses.

The incoming annual profit of 5.000.000 $ involves the payment of the working software and annual bills from the N.A.S.A for using internal distributed computing infrastructure.

**Annual profit**:

**ROI:**

Considering the inflation of around 10% each year, the actual remaining funds are:

|  | **Remaining** | **Discount factor** | **Present value** |
| --- | --- | --- | --- |
| **1-6 month** | $1.228.000,00 | 1,00 | $1.228.000,00 |
| **7-13 month** | $299.428,00 | 0,95 | $285.493,40 |
| **14-19 month** | $299.428,00 | 0,91 | $272.207,27 |
| **20-25 month** | $299.428,00 | 0,87 | $259.539,45 |
| **26-31 month** | $299.428,00 | 0,83 | $247.461,16 |
| **31 - 37 month** | $299.428,00 | 0,79 | $235.944,96 |
| **38 - 43 month** | $299.428,00 | 0,75 | $224.964,69 |
| **44 - 48 month** | $299.428,00 | 0,72 | $214.495,41 |
|  | **TOT remain** |  | **TOT present value** |
|  | $3.323.996,00 |  | $2.968.106,33 |

considering the evaluation of the where *i* is the percentage of inflation and *n* is the year (or half year, depending on the semester).

In this case, we were forced to evaluate the discount factor for each semester (6 months). We have evaluated the actual remaining costs as present values, taking into account inflation. For this purpose, the $5,000,000$ are not taken into account because they are spread over 30 months, and it is hard to calculate the actual value of that money.

**S.W.O.T Analysis**

| **Strengths** | **Weaknesses** |
| --- | --- |
| Experience with image elaboration softwares.  Large team and experts pool.  Big interest from external investors in the project capabilities. | A large amount of money is required to start the development phase.  Difficulties in handling such a big mole of data.  Initial difficulties in coordinating internal groups during the development phase, for example: great team building is required among programmers and physicists. |
| **Opportunities** | **Threats** |
| Society's active interest in space argumentation leads to more investments in space missions and goals.  Future collaboration for space achievements with NASA/SpaceX/ESA. | Economic instability due to the shift of public interests.  Due to the continuous improvements of technologies, the current technology may be replaced before the launching date or it can have a short lifetime since the launch date. |