

***Project Charter***

***Digital Twin Simulation***

***Lockheed Martin Space***

**Prepared by CU Boulder Capstone Team**

**October 16, 2020**

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## 1. Introduction

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### Executive Summary

- In order to aid in the validation of machine learning models in spacecraft modeling, the CU Capstone Team is tasked with writing a software application that reads I/O of a telemetry informed subsystem model and an external model and translates between the two.

### Business Problems/Opportunities

- Lockheed Martin is a global security and aerospace company that is principally engaged in the development, manufacture, integration and sustainment of advanced technology solutions. LM Space is at the forefront of the Space Industry. They anticipate, adapt, and innovate to ensure their customers remain at a technological advantage far into the future. Through the power of data, this project will help further the endeavor to set new expectations in how space systems are developed, produced, tested and operated.

## 2. Objectives and Scope

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### Business Objectives

- Automate the translation of data between Tb&s and non-Tb&s models:
  - Improve Digital Twin Simulator Performance
  - Optimize Translation of Data Between Models
  - Strengthen Dynamic Model Discovery/Execution

### High Level Requirements

- This project will be primarily executed in an agile context with LM Space acting as the Product Owner. All work will be completed on laptops/development environments provided by LM Space.
- This project will embrace early prototyping in the design phase which will be carried out in the first semester of the project. The tool will be built, tested and validated against an existing model in the second semester.
- The software tool will examine the Tb&s behavioral model and non-Tb&s model to identify inputs and outputs. It will then automate the translation of data between these two models.

### Project Scope

#### In Scope:

- CU will define, design and deliver a software-based tool that reads I/O of the simulator and the I/O of the external model, and translates between the two.
- CU will develop and deliver a validation method and run results against an LM Space owned thermal desktop model and align its inputs & outputs to the Simulator.

#### Out of Scope:

- Modifications to Digital Twin software outside of those mentioned above.
- Modification of any existing behavior models.

### 3. Project Approach

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#### **General Approach – Solution Delivery Process**

- Team will consult with technical contacts in bi-weekly meetings to review working prototypes and receive Lockheed feedback about changes or specifics.
- Our team will design this application with an agile development timeline that will lead the team to be experienced with Lockheed TB&S resources by the end of first semester.
- By the end of the two-semester capstone period, our team will deliver our final application with all concerns and modifications incorporated.

#### **Assumptions**

- Once a preferred solution is identified, Lockheed Martin software engineers will maintain full support for the implementation plan.
- Our implementation will be validated against their existing manual methods for translation.

#### **Project Risks and Issues**

- Our team will need to get familiar with the Lockheed Martin TB&S resources in order to begin, so there is a large overhead in understanding and knowledge gain that needs to be invested before the team can begin developing a solution.
- During this project, as issues arise that put the success of the project at risk, the issues and risks will be documented in the **Project Log** and tracked through resolution. As we learn more about what our project will entail, we will find and address these potential issues.
- There is potentially no solution that we can find to meet our objectives.

#### **Project Changes**

- Changes to project scope and requirements will be reviewed by the project governance team (Technical Points of Contact from LM along with subsections of our team working on affected features). This team will assess the potential impact of the change on schedule and resources, then provide a decision for approval/disapproval. The Project Manager, Jonathan Klingel, will also be involved in any major scope changes since he is the administrative contact. All scope/requirements changes will be documented in the **Project Log**.

### 4. Project Plan

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#### **CU Boulder Team Steps**

1. **Meet POC for Lockheed**
  - Understand project missions and goals
  - Outline next steps
2. **Acquire Appropriate Equipment**
  - Access Lockheed proprietary resources
  - Maintain security of company secrets
  - Establish appropriate workspace for development environment

- 3. Set up Development Environment**
  - Get access to LM Network
  - Train in data protection
  - Develop in CU specific environment
- 4. Setup Agile Workplace Environment**
  - Ability to analyze product development efficiency
  - Develop clear product goals and features
  - Use appropriate organizational software
- 5. Prototyping**
  - Begin end of 2020
  - Develop clear and detailed design
  - Amendments expected as the project progresses
- 6. Implement Product**
  - Develop Solution in C++ and Java
  - Amendments expected as the project progresses

### **Key Deliverables to CU Boulder and Lockheed Martin Space**

#### September 2020 - December 2020:

- Project Charter
- Work Breakdown Structure
- Functional/Non-Functional Requirements
- Project Plan
- Scrum Reports

#### January 2021 - April 2021:

- Project Architecture Plan
- Formal Project Status Report
- Project Risk Mitigation Plan
- Detailed Design Specifications
- LM Only: Prototypes/Designs
- LM Only: Final Software Solution
- Scrum Reports

*\*\* All deliverables will be given to Lockheed Space pending approval before handing off to CU \*\**

### **Projected Timeline**

<u>Deliverable</u>	<u>Due Date</u>
Project Charter	October 2020
Project Plan	November 2020
Functional/Non-Functional Requirements	November 2020
Formal Project Status Report	November 2020
Detailed Design Specification	December 2020

*\*\* 2021 Deliverables will be specified at a later date \*\**

## **5. Team Member Roles & Responsibilities**

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<b><u>Stakeholder</u></b>	<b><u>Role/Responsibility</u></b>
Jonathan Klingel	Project Manager
Eric Huber	Technical Lead
Adam Austin	Technical Point of Contact
Cindy Venturin-Salber	Technical Point of Contact
Jared Gorthy	Team Coordinator/Software Engineer
Owen Fulton	Software Engineer
Matt Janc	Software Engineer
Karthik Venkatram	Software Engineer
James Douthit	Software Engineer
Brian Jackman	Software Engineer
Brandon Roemer	Software Engineer