

MUGSEY V&V Goal

The goal of the V&V project is to assure that the software maintains the system's health, acquires and maintains operational data and is adequately developed to efficiently enable future missions.

The goal is very high-level but it is concise; it suggests that the V&V team is going to assure that the software is capable of maintaining the health of the system as well as maintaining the science data that is collected. Clarity is added as the V&V team refines the goal into achievable objectives. That when combined and met shall satisfy the goal.

The second step is to identify the stakeholders, those entities that have a vested interest in the V&V effort. For the V&V effort on MUGSEY 0x01, the following list of stakeholders has been identified.

- MUGSEY 0x01 Management
- MUGSEY 0x01 Developers
- MUGSEY 0x01 Operations Team
- University Scientists
- Society of Gravitational Studies (SOGS)
- University Network Administrators
- University Software Engineering Department

The following list of items depicts the requirements that each stakeholder has for the V&V effort. These requirements are followed by some rationale to further explain the stakeholder's expectation. These requirements do not have to be formal requirements (i.e. written with shall statements) they represent the stakeholder's need or their expectation that they have for the V&V effort. These were acquired by meeting with the stakeholders and discussing their responsibilities and concerns.

MUGSEY 0x01 Management

- I need all the interfaces verified that the observatory segment has with other segments in the system.

Rationale: The project manager anticipates a decoupled architecture that relies on communication between software modules. This will allow different university students to work on different modules of the system. In addition, MUGSEY's architecture is going to leverage a modularized design so that scientists that use MUGSEY can easily integrate and swap out their scientific experiments. To that extent, the project manager wants additional assurance that the interfaces will not cause a problem when they integrate the system.

- I do not want the V&V team to slow down or adversely affect the production of my development team.

Rationale: The project manager has had some bad experiences with previous V&V efforts and does not want the V&V effort to impede development.

- I want all V&V issues resolved with the development team directly.

Rationale: The project manager does not want to waste time on the formality of resolving issues. He wants valid issues that the V&V team identifies to be resolved efficiently. Also, he does not want to create a hostile environment between V&V and development. Developers may get the wrong impression if the V&V team takes all the issues to management.

- I want all V&V results communicated to me directly (monthly status and technical reports for each task).

Rationale: The project manager wants timely feedback on the quality of the system. Also, he wants technical documents that come out of the V&V effort to be entered into the project's artifact repository.

- I need the fault management system on MUGSEY to work flawlessly so that we can recover the system in real time.

Rationale: The project manager has envisioned several failure scenarios and wants, without question, to recover from any fault. His concern is that the balloon may get away from the operations team and possibly fall at a high rate of speed and damage something. As such, they are building a fault management system that maintains awareness of the systems health and responds appropriately.

- I need all the data to be recovered so that collaborating scientists can use it.

Rationale: The project manager stated very bluntly that without the science data then there is no use in funding the mission.

- I need the software to be able to be reused with minimal effort.

Rationale: The project wants to be able to fly again in one week after each mission. Also, each mission may have different science experiments

plugged into the observatory. They make such changes.

- I need the software to be easily maintainable so that graduate students can bring on graduate students.

Rationale: The project manager wants the software to be easily maintainable. It will take longer than expected to maintain. As such, different students will be employed on the project.

MUGSEY 0x01 Developers

- We need to easily resolve the issues.

Rationale: Schedules are tight and graduate engineering students are needed. They believe the V&V project will have a high priority.

- We need access to the V&V team.

Rationale: The development team wants to be able to verify that they have fixed them. They want to see the models used by the V&V team.

MUGSEY 0x01 Operations Team

- We need to recover all telemetry data so that we can be able to communicate with the balloon.

Rationale: The operations team wants them to be able to maintain sufficient contact. They are concerned that the balloon will get away from them and they will not be able to maintain contact.

- We need the mission to be able to be reused with minimal effort.

Rationale: During operations the balloon will be in different zones of the balloon. Accuracy is needed for work arounds.

- We would like to see the V&V team's work arounds needed for work arounds.

plugged into the observatory. The software has to be easily maintained to make such changes.

- I need the software to be easily understood by other developers so that I can bring on graduate students in the future.

Rationale: The project manager is using university students to develop the system. It will take longer than one semester and it will need to be maintained. As such, different students with varying levels of experience will be employed on the project.

MUGSEY 0x01 Developers

- We need to easily resolve the issues that the V&V team identify.

Rationale: Schedules are tight and the development team consists of graduate engineering students. They actually fear the V&V effort and believe the V&V project will have an adverse affect on their production.

- We need access to the V&V tools and models.

Rationale: The development team needs to be able to not only understand the issues that the V&V team raise but they'll need to reproduce them and verify that they have fixed them. As such, they want access to the tools and models used by the V&V team.

MUGSEY 0x01 Operations Team

- We need to recover all telemetry sent by the launch package. We need to be able to communicate with the launch package any time we need to.

Rationale: The operations team has a very strict requirement levied on them to be able to maintain safe conditions at all times. One of their fears is that the baloon will get away from them and they won't be able to maintain contact.

- We need the mission to be able to avoid hazardous zones.

Rationale: During operations the team is going to infer flying and landing zones of the baloon. Accuracy is needed to assure they avoid hazardous areas.

- We would like to see the V&V results in case operational procedures are needed for work arounds.

Rationale: If any problems or risks are accepted by the project and not fixed the operations team needs to be aware of them so that procedures during flight could be put in place to avoid those issues from surfacing during operations.

University Scientists

- We need to be able to plug our science experiments with minimal difficulty into MUGSEY.

Rationale: Scientists are going to be able to build their experiments separately from the main development team and then just plug their experiments into the observatory segment. They are building their experiments against the interface specification as well as an engineering emulator of the observatory segment. They don't want to find out there are problems when it is too late, meaning they don't want the problems to surface when they try to integrate the experiment.

- We need to be able to extract our science results with minimal difficulty.

Rationale: The scientists work is totally dependent on getting the science data. They need all the data that they capture returned to them.

Society of Gravitational Studies (SOGS)

- The project has to come in on cost and on schedule.

Rationale: This is the funding source for the development project and they are concerned with the management of resources.

- The mission has to recover all the data captured during operations.

Rationale: Not only is the funding source concerned about resources they want a good return on their investment, which translates to scientific data.

- The mission needs to do everything possible to avoid harming anyone or damaging any property or other material.

Rationale: They want to protect their image as well as protect individuals and property.

These requirements capture the expectations of those that may interact with the V&V team. These requirements need to be studied and then fil-

tered. Why filtered? Well let's first examine why we even executed this step. Why did we even identify who the stakeholders were and what their needs were? You may even be an independent V&V (IV&V) team that is chartered to do what the V&V team thinks they should do and not be constrained by the stakeholders and as such should not be concerned with their needs. With that I would say that you are foolish. Any good engineer knows that they have to manage the expectations of all entities that are associated with the system. As such, it is beneficial to the V&V team, no matter their organizational structure, to understand what it is that other people are expecting or would like to see come out of the V&V effort. That doesn't mean that you have to do everything the stakeholders need, just understand their needs and use them appropriately. The filtering mechanism is one that is associated with the organizational model the V&V team is assuming. If they are an embedded V&V team then the stakeholder requirements may be written in stone and those are the requirements that the V&V team shall fulfill. If the V&V team is independent then it is advantageous for them to understand what others would like to get out of the V&V effort and they could manage these expectations appropriately.

The stakeholder requirements, the project's system requirements, and the project's operational needs will then be used to develop the objectives for the V&V effort. The V&V team needs to identify five to seven results that define what it means to be successful when complete. Take note that these objectives will later be used to define the scope of the V&V effort. The objectives of the MUGSEY 0x01 V&V effort are to:

- Provide assurance that the system software adequately analyzes and maintains the system's health.
- Provide assurance that the system software adequately identifies and handles faults.
- Provide assurance that the system software adequately acquires, stores, and retains data.
- Provide assurance that the system software can reliably communicate with the ground.
- Provide assurance that the system software is maintainable.

To recap, these objectives are the factors that the V&V team is going to strive to meet. They clearly articulate exactly what the V&V team is going to achieve as they are doing their assessments as well as when they have completed.

Let's just take a moment to assess the systems engineering approach to planning the V&V effort. As stated before, one of the objectives of the