Model-Based Structured Requirements

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Purpose
- To demonstrate the advantages of transitioning from text-based documentation of system requirements to an architectural model.
- An architectural/abstract model - describes relationships between the system's structure, behavior, and rules.
- Defines systems engineering (SE) activities, such as test processes.
- Evidence already supports the use of model-based structured requirements (MBSR) in enabling more efficient system development. [1]
- The goal of this project has been to create an example with a UAV model [2] using MBSR to further demonstrate its effectiveness and quality.

Method
- This example was created through the Cameo Systems Modeler tool that uses the Systems Modeling Language (SysML), an object-oriented language enabling component interaction within diagrams and other structures. [3]
- The structure used for requirements in this example is:

Results
The UAV System Overview diagram (right) displays a partial structure of the UAV system with three subsystems and their related requirements.

The Flight Control Requirements diagram (below) displays the requirements and constraints for the flight control subsystem.

Discussion
- This UAV example worked on in this project is not a complete model.
- Specific constraints or verification means were intentionally left blank due to a lack of pertinent information.
- Some spaces were filled in with a non-specific component that should be precisely defined.
- An important function of MBSR is the ability to examine complete models and ensure the knowledgeable person(s) define necessary components and behaviors.

Next Steps
- This example can be expanded further.
- Many more requirements can be included.
- More diagrams can be used to describe components.
- Additional subsystems need to be modeled.
- More test diagrams are needed to verify current and future requirements.
- The modeling tool also offers state machine, sequence, and use case diagrams, to name a few.
- Beyond this UAV model, other examples need to be created so to demonstrate the concept of MBSR on more systems.

Conclusions
This UAV model demonstrates the advantages of an architectural model (which can be compared to its derived text description) [2]... these benefits include:
- Clearly defined requirements,
- Understandable component relations,
- Clear activity diagrams modeling test processes,
- More diagrams to dynamically describe behaviors of the system,
- The [WHO] shall [WHAT] [HOW WELL] under [CONDITION] text statement is a clear way to structure requirements.

References
[4] The Requirements Table (below) is a more complete overview of the model’s relationships.

What benefits did you get from your SURE experience?
The SURE experience has enabled me to learn new skills and educate myself on a topic of my own interest (UAVs). I learned some basics of SysML, in addition to the opportunity to experience systems modeling with a tool I would not have otherwise had access to. Through the creation of this UAV example, I developed a new way to look at engineering systems through the lens of structured requirements. This perspective will be extremely beneficial in the future and help me to design systems that are complete and organized.

How do you plan to apply what you have learned?
I plan to continue working with Dr. Herber to develop examples of MBSR. Modeling UAV subsystems in this project has given me skills to dynamically organize and understand complex engineering systems. I can utilize these skills in my future work as a Computer Engineer.

Figure 1: An example of a structured requirement representing the who-what-how with condition format. [2]

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