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INCORPORATING TECHNICAL MEASURES OF PERFORMANCE INTO PROJECT METRICS

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Incorporating Technical Measures of Performance into Project Metrics

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Measuring Technical Work

The Key Question: What Defines "Done"?

General Definition: A shared understanding across the team what must be completed for a user story, feature, or product to be considered finished.

Systems and Mission Engineering Definition: Completion of delivered capabilities through the measurement of units of effectiveness and units of performance within project framing assumptions defined by program-specific key performance parameters and technical performance measures.

Contractual Definition: Completion of a definable measure of work, effort, or deliverable required under the terms and conditions specified in a contract.

Measuring Technical Work

Key Elements of Technical Performance Measurement – Identification & Definition

Key Performance Parameters: A critical subset of programmatic framing assumptions representing those capabilities and characteristics so significant that failure to meet the threshold value of performance can be cause for the concept or system selected to be reevaluated or the project to be reassessed or terminated.

Technical Performance Measures: Attributes that determine how well a system or systems element is satisfying or expected to satisfy a technical requirement or goal.

Measures of Performance: The measures that characterize physical or functional attributes relating to the system operation, measured or estimated under specified testing and/or operational conditions.

Measures of Effectiveness: The "operational" measures of success that are closely related to the achievement of the mission or operational objective being evaluated, in the intended operational environment under a specified set of conditions; i.e., how well the solution achieves the intended purpose.

Measuring Technical Work

Effectiveness vs. Performance – What is the Difference?

Performance: The Quality of Doing Something. Performance within the context of an MoP indicates what something is actually capable of doing. It is evaluated against the program goals for performance, but is not necessarily an indication of fitness for service on its own merits.

Effectiveness: The Quality of Fitness for Service or for producing intended results. The MoE reflects the program's intention. It defines the properties a potential solution must possess in order to meet the requirements of the program in service.

Measuring Technical Work

Interdependence of Technical Measures of Performance

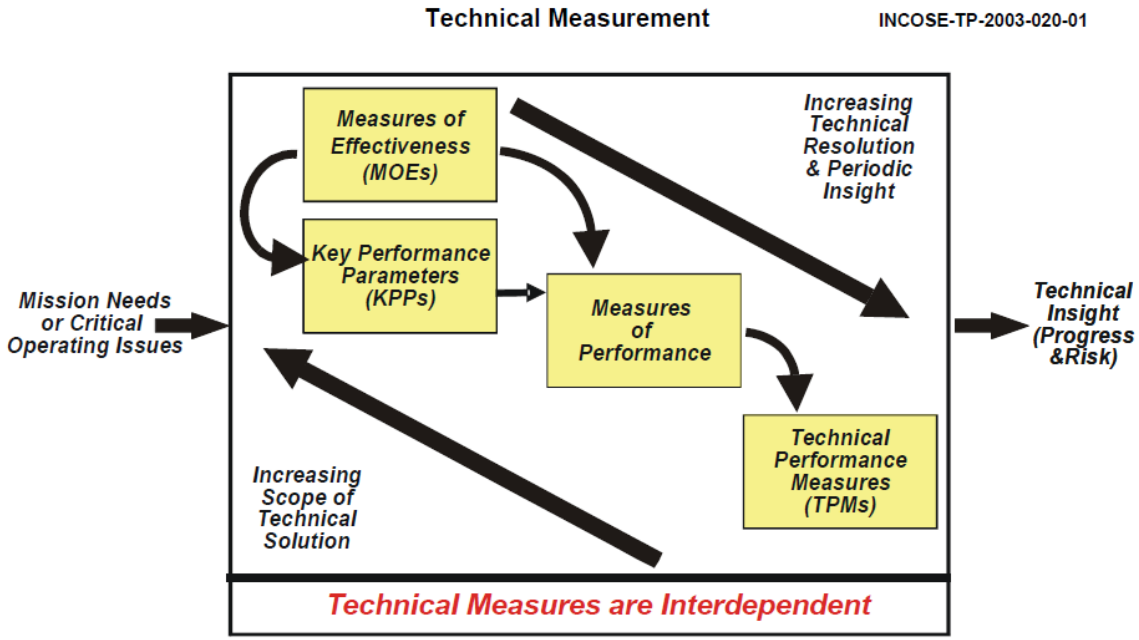

Figure 1-1 Relationship of the Technical Measures

Incorporating Technical Measures into the Project

Practical Processes and Outputs

Define Done in Units of Measure Meaningful to Decision-makers – Create a WBS Dictionary

The WBS Dictionary. Stakeholder (government and contract) WBS for program reporting purposes and includes all program elements (for example, hardware, software, services, data, or facilities), which are the contractor's responsibility. It includes the contractor's discretionary extension to lower levels, in accordance with Government direction and the contract Statement of Work (SOW).

The detailed WBS Dictionary is a document that describes each element work package in a project component of the WBS. These elements can include milestones, deliverables, activities, scope, resources, costs, quality. The main purpose of the WBS dictionary is to define and communicate the work in more detail to help those working on an element or work package understand what needs to be done.

Incorporating Technical Measures into the Project

Practical Processes and Outputs

Define Done in Units of Measure Meaningful to Decision-makers – Create an Integrated Master Plan (IMP)

The Integrated Master Plan (IMP). The IMP is an event-based plan consisting of a sequence of program events, with each event being supported by specific accomplishments, and each accomplishment associated with specific criteria to be satisfied for its completion. These IMP elements are defined as:

- **Event**: a key decision point or program assessment point that occurs at the culmination of significant program activities.
- **Accomplishment**: is the desired result(s) prior to or at completion of an event that indicates a level of the program's progress.
- **Criteria**: provides definitive evidence that a specific accomplishment has been completed. Entry criteria reflect what must be done to be ready to initiate a review, demonstration, or test. Exit criteria reflect what must be done to clearly ascertain the event has been successfully completed.

Incorporating Technical Measures into the Project

Practical Processes and Outputs

The Integrated Master Plan (IMP)

- Identify and assess actual progress vs. planned progress
- Monitor the program Critical Path and help to develop a workaround to problem areas
- Assess the status of risk management activities based on the inclusion of program Risk Mitigation activities in the IMP and IMS
- Assess the progress on selected technical measures
- Provide an objective, quantitative basis for the contractor's performance and award fee, if applicable
- Help develop and support contingency exercises and identify and assess candidate problems workarounds

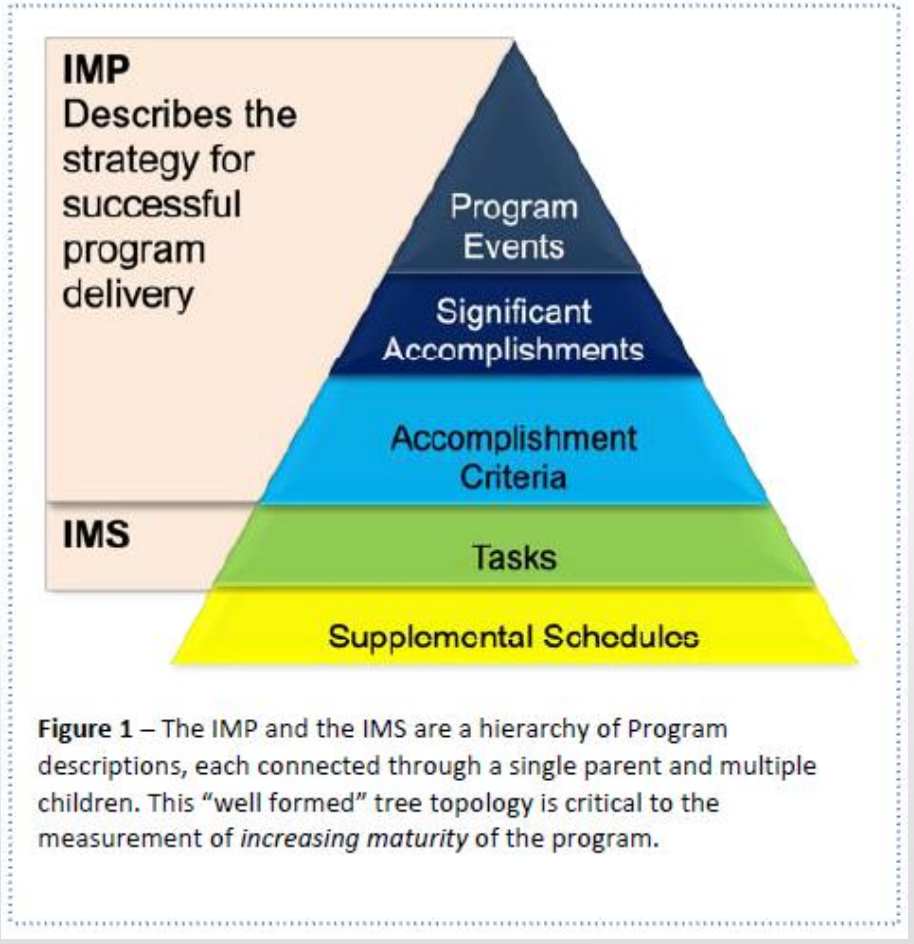

Figure 1 – The IMP and the IMS are a hierarchy of Program descriptions, each connected through a single parent and multiple children. This "well formed" tree topology is critical to the measurement of *increasing maturity* of the program.

Incorporating Technical Measures into the Project

Practical Processes and Outputs

The Integrated Master Plan (IMP).

The 5 Steps in Developing the Integrated Master Plan (IMP)

- **Step 1:** Determine the IMP structure and organization
- **Step 2:** Identify events, accomplishment and criteria
- **Step 3:** Prepare the introduction and narrative section
- **Step 4:** Complete the numbering system
- **Step 5:** Iterate events, accomplishments, and criteria with the Integrated Product Team (IPT) during IMS development

Figure 1 – The IMP and the IMS are a hierarchy of Program descriptions, each connected through a single parent and multiple children. This "well formed" tree topology is critical to the measurement of *increasing maturity* of the program.

Incorporating Technical Measures into the Project

Practical Processes and Outputs

Develop the Plans and Schedules to Reach Done as Planned – Create a Systems Engineering (Management) Plan (SEMP/SEP)

Systems Engineering (Management) Plan. The SEMP or SEP is to help program technical managers develop their systems engineering approach—providing a firm and well-documented technical foundation for the program. A rigorous technical planning process forces thoughtful consideration and debate, allows for integration and coordination of technical activities across all levels of management, and results in a sound systems engineering strategy commensurate with the program's technical issues, life cycle phasing, and overall objectives. Within the SEMP/SEP is the **Technical Measurement or Performance Plan**.

Incorporating Technical Measures into the Project

Practical Processes and Outputs

Develop the Plans and Schedules to Reach Done as Planned – Create a Technical Measurement or Performance Plan.

Technical Measurement or Performance Plan. Provides the time- or event-based plan of anticipated and actual achievement of technical parameters. The elements of measurement of the plan are:

- Achieved-to-Date. Measured technical progress or estimate of progress plotted and compared with planned progress at designated milestone dates.
- Current Estimate. The value of a technical parameter that is predicted to be achieved using remaining planned resources.
- Milestone. Point in time when an evaluation of measure is accomplished.
- Planned Value (Target). Predicted value of the technical parameter for the time of measurement based on the planned profile.
- Planned Performance Profile. The projected time-phased demonstration of a technical parameter requirement.
- Tolerance Band. Alert limits placed across the planned profile to indicate the degree of variation allowed.
- Threshold. The limiting acceptable value of a technical parameter, usually a contractual performance requirement.
- Variances. The difference between planned value and achieved-to-date along the planned performance profile.

Incorporating Technical Measures into the Project

Develop the Plans and Schedules to Reach Done as Planned – Create a Technical Measurement or Performance Plan. – The INCOSE model

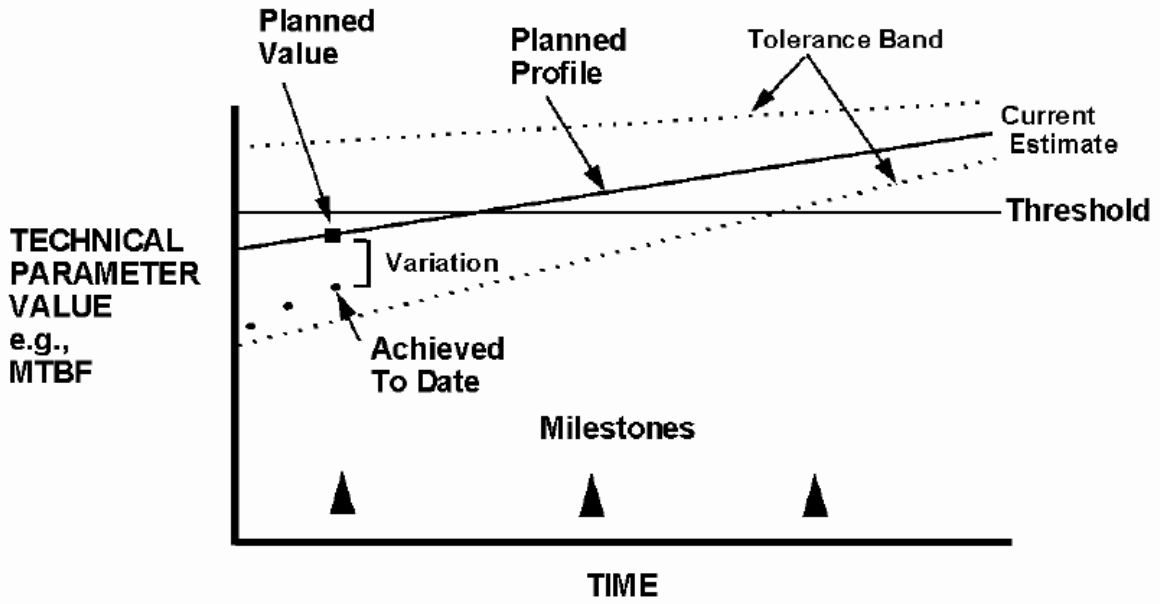

Figure 3-1 Technical Measurement Profile Illustration

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Incorporating Technical Measures into the Project

Develop the Plans and Schedules to Reach Done as Planned – Create a Technical Measurement or Performance Plan. – NASA Technology Readiness Levels and Risk Bands of the TPM

One of the major factors affecting the defined tolerance and risk bands on the TPM is the maturity of technology incorporated into the design of the technical solution. TRLs describe the maturity of technology being used to meet requirements for which the TPMs are indicators. Just as progress on TPMs is a precursor to project management success, TRLs are a precursor or indicator of potential difficulty in meeting technical performance. The less certain the knowledge and more risky performance, the more likely the project plan will show stress (re-plan, re-budget, re-schedule). The earlier this is known, the less likely the need for a re-baseline.

Technology Readiness Level (TRL)

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Incorporating Technical Measures into the Project

Develop the Plans and Schedules to Reach Done as Planned – Create a Technical Measurement or Performance Plan. – The NAVAIR model adds risk and assessment to next probable result

Technical risk management addresses risk identification, analysis, mitigation planning, mitigation implementation, and tracking. Technical risks should be quantified and implications reflected in the program's Integrated Master Schedule and Integrated Master Plan. – DoD 5000.2I

Under this model the Current Estimate is restricted to an assessment of the probability of achievement to the next technical milestone.

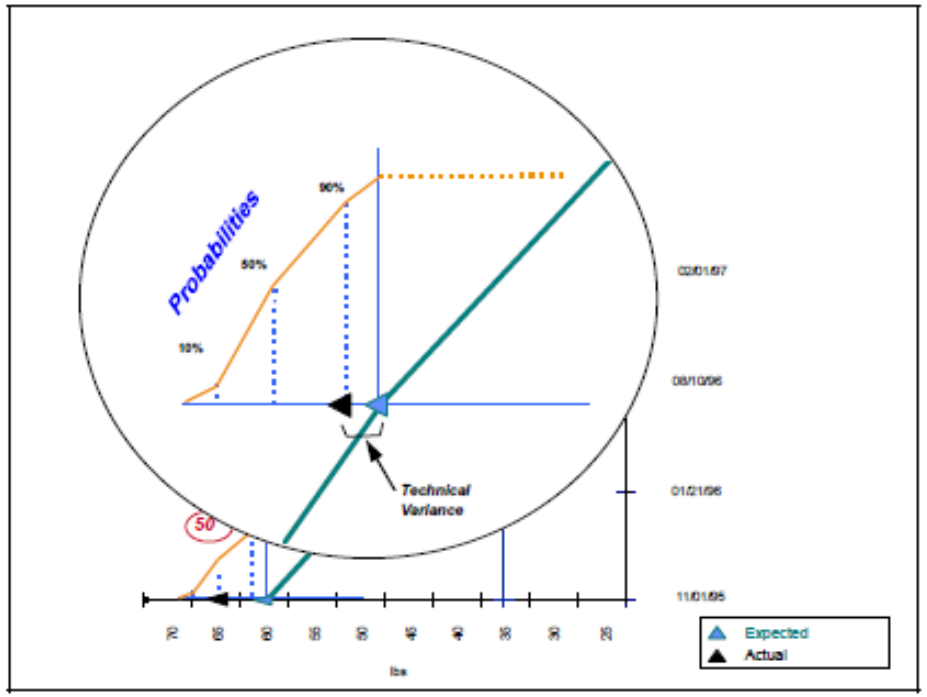

Figure 3: Progress Plan with Risk Profile

Incorporating Technical Measures into the Project

Practical Processes and Outputs

Develop the Plans and Schedules to Reach Done as Planned – Create an Integrated Master Schedule

The Integrated Master Schedule (IMS). The Integrated Master Schedule is derived directly from the IMP. It is not – nor should ever be – built bottom up during the first round of IMS construction. In the IMP/IMS paradigm, all the work needed to move the program forward in its maturity is defined by the Significant Accomplishments and their Accomplishment Criteria. Once these are defined in the IMP, the physical work needed to produce the Accomplishment Criteria is obvious.

Each technical performance parameter that is associated with a planned milestone. Each technical element will be associated with a WBS element at the appropriate level of work and be reflected as an IMS task.

The final process within IMS development is the construction of the **Basis of Estimate (BOE)**.

Integrating Technical Measures into Project Performance

Organic Measures

- Technical Performance (variances) against the Planned Performance Profile
- Assessment of Technical Readiness Level at Each Major Milestone and Design Review
- Assessment of Technical Risk and Probability of Achieving the Current Estimate to the next milestone or, alternatively, to-complete using existing resources

First-line Integrated Measures

- Schedule impact traced through WBS within IMS schedule tasks assigned to the performance parameter
- Resource impact traced through IMS schedule tasks assigned budget through BOE

Extended Integrated Measures

- Earned Value Management assessment
- ETC/EAC assessments informed by risk analysis

Integrating Technical Measures into Project Performance

Integration of Technical Achievement and Earned Value

- Properly capture technical measures in the IMP
- Properly reflect technical measures found in the IMP in the IMS tasks
- Assign resources to each technical element found in the IMS either through resource-loading or association with the BOE cost profiles
- Associate the technical element tasks within the IMS with the Performance Management Baseline (PMB)
- Assess completion of work under the PMB using EIA-748 approved methods*

*Note that EVM method of % complete represents an assessment of technical achievement in terms of work completion. This method is different than either technical estimate to complete or schedule percent complete

Integrating Technical Measures into Project Performance

Integration of Technical Achievement and Earned Value – Issues Surrounding Percent Complete

- What is the value of a failed test?
- In assessing the probability of achievement to the next measured milestone, how do we translate that into the value of work accomplished to date?
- Kinds of variances
- Expert opinion, data-driven models, risk informed models

PUTTING IT INTO PRACTICE

Case study of the Electrified Powertrain Flight Demonstration project of NASA

- NASA is partnering with industry to develop megawatt class electrified aviation powertrains with the goal to commercialize them by 2035
- Contract is in 2 phases: an initial firm fixed price portion and a second cost sharing portion.
- During the FFP portion, technical measures are regularly reported by the industry partners to NASA
- These technical measures form the basis of project evaluation of whether to proceed to the cost sharing phase

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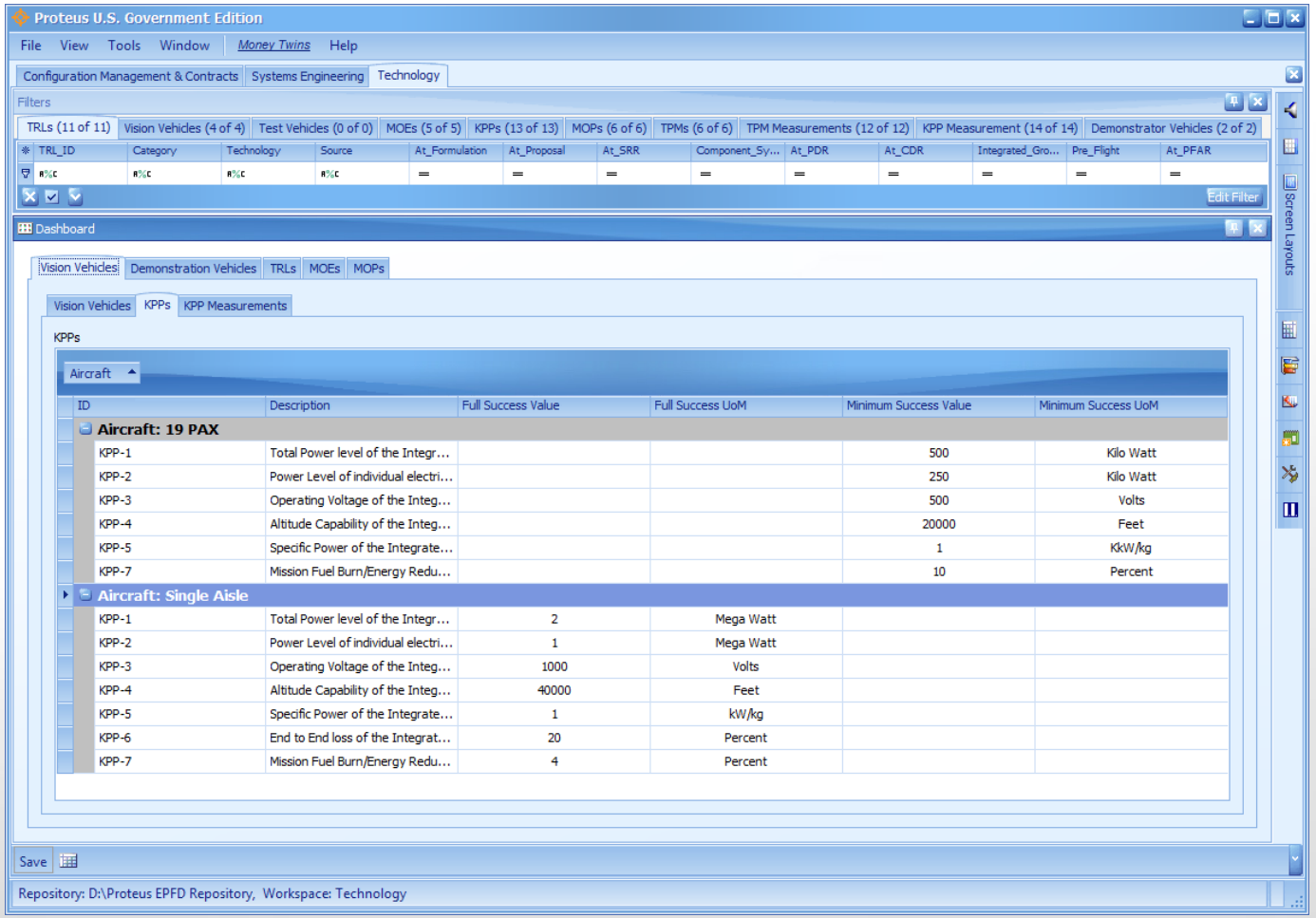
Putting it into Practice

Technology Workspace

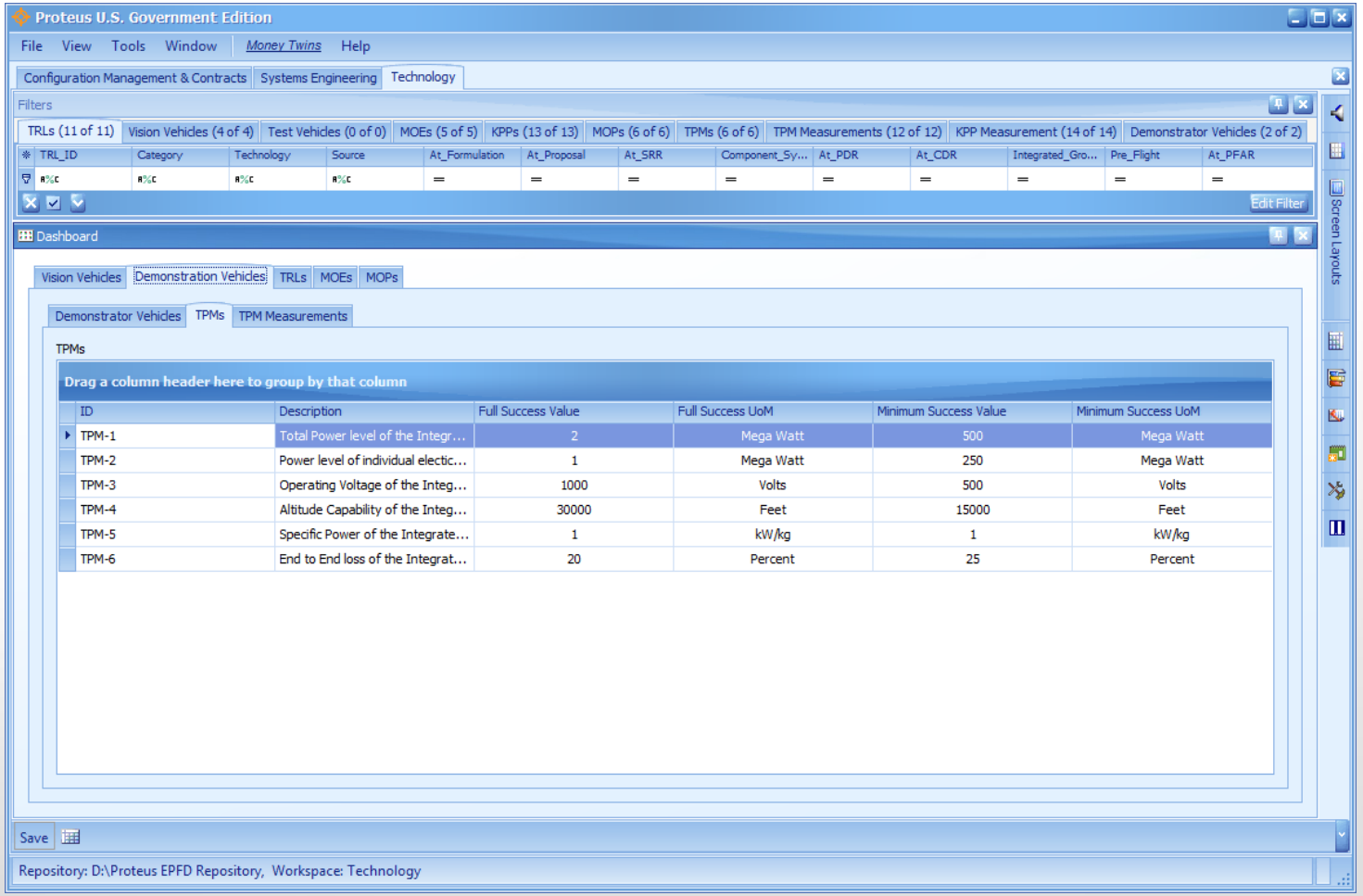
- Key Performance Parameters



Putting it into Practice

Technology Workspace

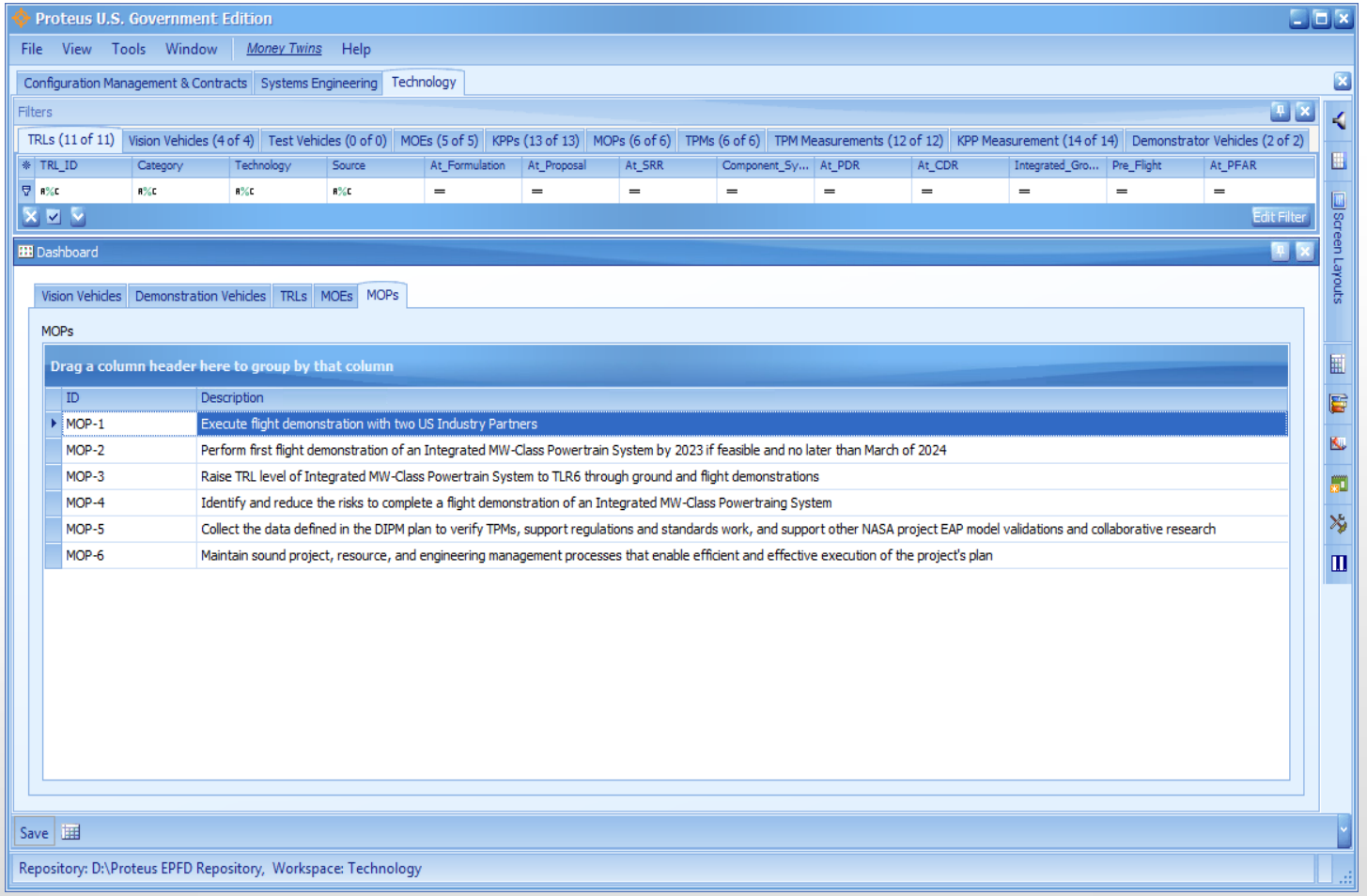
- Technical Performance Measures



Putting it into Practice

Technology Workspace

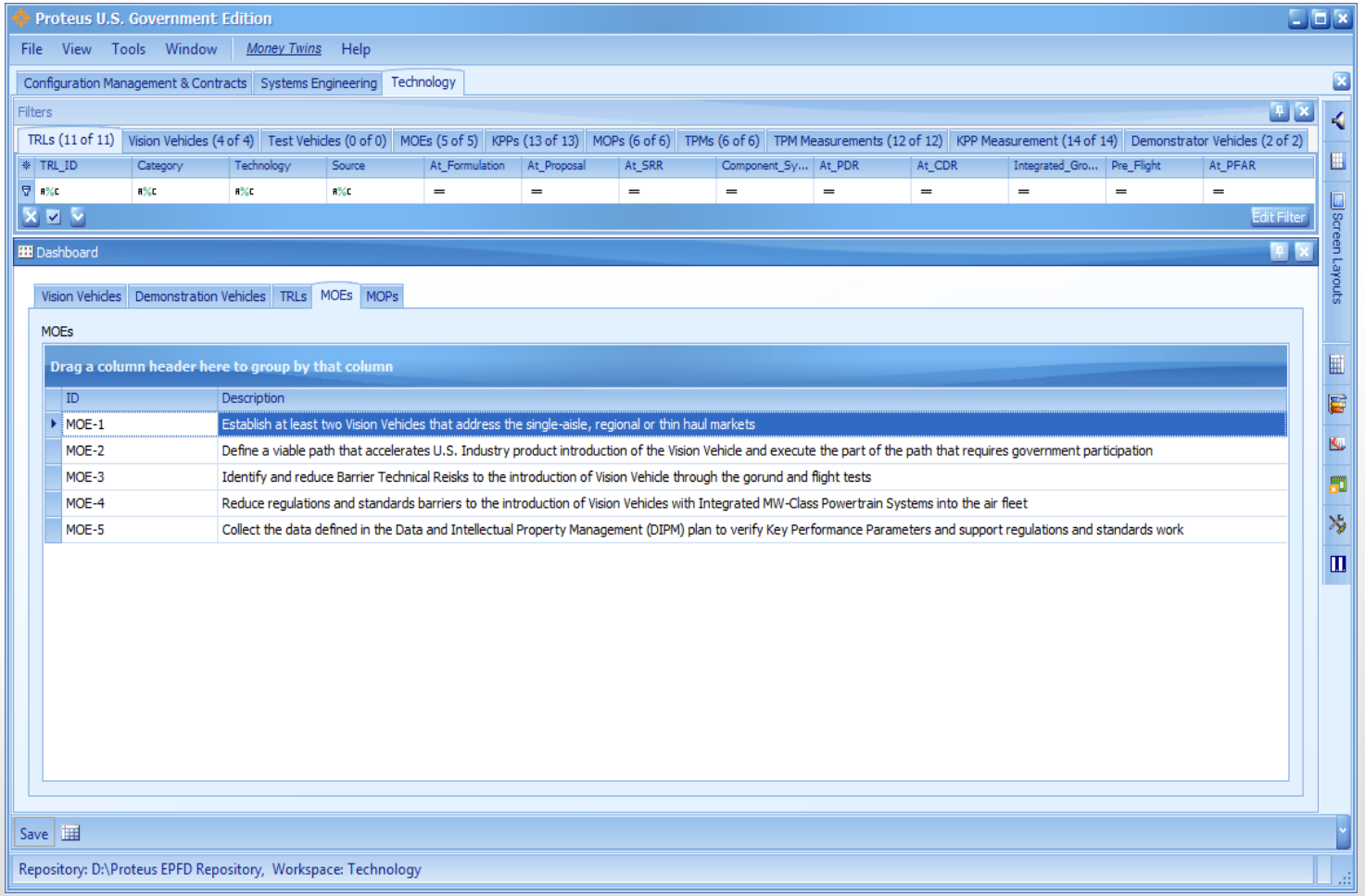
- Measures of Performance



Putting it into Practice

Technology Workspace

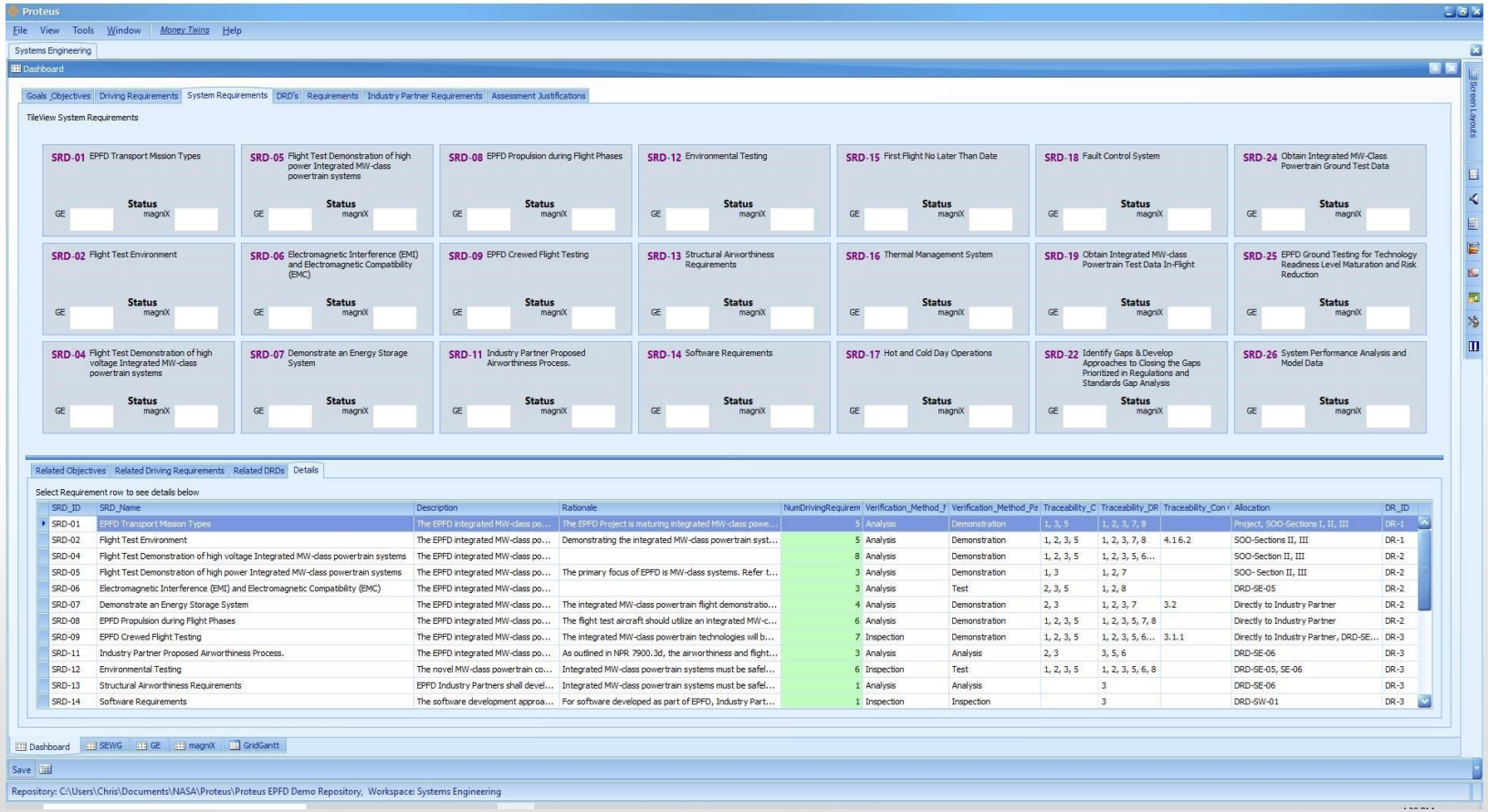
- Measures of Effectiveness



Putting it into Practice

Systems Engineering Workspace

- System Requirements
- Requirements color coded for health



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THANK YOU!!!

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Please visit our booth for more information or questions

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