

Space and Missile Systems Center

SMC and Space Flight Worthiness Certification



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Overview



- History of OSS&E leading to Space Flight Worthiness Certification (SFWC)
- Current SMC SFWC Process Summary
- Current Use of Digital Engineering within SFWC
- Short Term Opportunities for Digital Engineering for SFWC
- Long Term Opportunities for Digital Engineering for SFWC
- Summary



History of OSS&E leading to Space Flight Worthiness Certification (SFWC)

- 1997 – Gen Babbitt, AFMC/CC, chartered an IPT to establish Operational Safety, Suitability and Effectiveness (OSS&E) for the Air Force along with Air Worthiness Certification Process due to increasing trend of mishaps
- SMC simultaneously created the Space Flight Worthiness Certification (SFWC) process applicable to the space domain after consulting with the Air Worthiness Certification team
 - Created during Acq Reform era where government policy was deemed burdensome and cost prohibitive
- SFWC creation preceded the launch failures of the 1990s and was used extensively in SMC Back to Basics effort to return to flight



Current SMC SFWC Process Summary

(1 of 4)



- Current SMC SFWC process governed by two documents:
 - SMCG 1202, Space Flight Worthiness Criteria (SFWC), 7 October 2009.
 - Space Flight Worthiness Criteria (SFWC) Planning, Verification, and Certification Guide, Aerospace Report No. TOR-2012(1315)-5, 10 August 2012.
- Written to encompass both launch vehicles and space vehicles and critical ground systems that support both vehicles. Routinely used on all space vehicles and small launch vehicles
- National Security Space Launch (NSSL) program uses their internal command media and two tools for certification:
 - Launch Verification Matrix (LVM) for non-recurring engineering verification
 - Mission Verification Matrix (MVM) for recurring engineering verification
 - Both are performed on each mission as tailored
 - NSSL Command media, LVM and MVM together have been cross-walked against SFWC and satisfy all criteria



Current SMC SFWC Process Summary Cont'd (2 of 4)



- SMCG 1202 Organization

- Operational Safety Criteria

Defined by SMC as: The condition of having acceptable risk to life, health, property, and environment caused by a system or end-item when employing that system or end-item in an operational environment. This requires the identification of hazards, assessment of risk, determination mitigating measures, and acceptance of residual risk.

- Operational Suitability Criteria

Defined by SMC as: The degree to which a system or end-item can be placed satisfactorily in field use, with consideration given to availability, compatibility, transportability, interoperability, reliability, wartime use rates, maintainability, full-dimension protection, operational safety, human factors, architectural and infrastructure compliance, manpower supportability, logistics supportability, natural environmental effects and impacts, and documentation and training requirements. (Note: In SMC's application the system could be a satellite, launch vehicle, or critical ground system. In addition, consideration would include launch rates and operational software.)



Current SMC SFWC Process Summary Cont'd (3 of 4)



- SMCG 1202 Organization

- Operational Effectiveness Criteria

Defined by SMC as: The overall degree of mission accomplishment of a system or end-item used by representative personnel in the environment planned or expected (e.g., natural, electronic, threat) for operational employment of the system or end-item considering organization, doctrine, tactics, information assurance, force protection, survivability, vulnerability, and threat (including countermeasures; initial nuclear weapons effects; and nuclear, biological, and chemical contamination threats).

- Mission Certification

Defined by SMC as: the final certification process for all mission critical elements, including the launch vehicle and spacecraft, that ensures that the integrated system has been properly tested and processed so that the entire system will perform its required functions and is ready for launch.



Current SMC SFWC Process Summary Cont'd (4 of 4)



- Space Flight Worthiness Criteria (SFWC) Planning, Verification, and Certification Guide, Aerospace Report No. TOR-2012(1315)-5
 - Written to provide practical guidance in satisfying SMCG 1202
 - SMCG 1202 is a self-assessment by program office of criteria satisfaction. Summary is provided to SMC/CC at the Flight Readiness Review. Coordination performed with SMC/ECM to assist with self assessment to ensure standard application of criteria.
 - SFWC TOR also written to improve lifecycle application of SFWC
 - Huge benefit to programs from the four appendices:
 - Appendix A. “Gold Standard” Questions
 - Appendix B. SFWC Criteria Broken Down by Type of Program Review
 - Appendix C. Criteria Broken Down by Discipline
 - Appendix D. Suggested Format for a SFWC Compliance Report



Current Use of Digital Engineering within SFWC



- Digital Engineering or Model Based application currently resides in at least one area within the current SFWC process
- Operational Effectiveness Criteria 3.1
 - 3.1 Requirements identified, validated, and translated into the system specification
- SMC Programs almost universally use the DOORS tool to capture system requirements and show traceability to the system specification
- DOORS initially populated from US Govt and handed to contractor who translates the requirements into the system specification



Short Term Opportunities for Digital Engineering for SFWC



- Near term wins are possible for applying digital engineering to improve the speed and accuracy of verifying SFWC satisfaction than current process
- Will conduct a survey of the criteria for existing digital products used within the current acquisition system to look for opportunities for standardization and delivery of these products
- Can then update the Aerospace TOR to provide exemplars for future application



Long Term Opportunities for Digital Engineering for SFWC



- Longer term wins are possible for applying digital engineering to improve the speed and accuracy of verifying SFWC satisfaction than current process
- Will conduct a survey of the criteria for opportunities to automate and link government and contractor acquisition processes to provide standardization and delivery of these products
- Can then update the Aerospace TOR to provide exemplars for future application



Summary



- SFWC originated out of USAF need for OSS&E in late 1990s
- SFWC governance provided in two documents:
 - SMCG 1202, Space Flight Worthiness Criteria (SFWC), 7 October 2009.
 - Space Flight Worthiness Criteria (SFWC) Planning, Verification, and Certification Guide, Aerospace Report No. TOR-2012(1315)-5, 10 August 2012.
- NSSL uses different, but equivalent, process to certify SFWC
- SFWC is a self-assessment by program offices with assistance from SMC/ECM for certification to SMC/CC at Flight Readiness Review
- SFWC is a lifecycle process from acquisition through launch
- Digital Engineering already in use to satisfy aspects of SFWC
- Improvements can be made in the near and long terms to improve speed and accuracy of satisfying the SFWC



Questions??



Near and Far Term Opportunities for Launch



Input from Mr. John Wong, ECLE

- Digital Engineering/MBSE may offer means to avoid cost and schedule impacts from mission integration issues and redesign on both sides of SV and LV interfaces
 - SMC/ECL has experimented with Early Integration Study (EIS) proof-of-concept modeling
 - SMC/ECL investigating how to provide requirements in digital form/models
- Vision
 - LV enablers: access to data (IaaS) for EIS; build LV configurations as govt reference models (GRM)
 - SV enablers: provide SV allocated baseline models, connect to LV GRMs, run as often as needed or practical from PDR through launch
- Goal: 'automate' study workflows with MBSE and create Agile opportunities, early-in-lifecycle changes that save cost and schedule