

AVIATION SOFTWARE SYSTEMS FOR THE SECOND CENTURY OF FLIGHT: RESEARCH AND ROADMAP THOUGHTS

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Abstract

This position paper identifies challenges, research needs, and roadmap considerations for Aviation Software Systems for the Second Century of Flight: Design for Certifiable Dependable Systems (HCSS-AS) as seen by the author.¹

Introduction

Frederick Brooks reaffirmed status of the illusive quest for a silver bullet in 1995 with “Net on bullets – position unchanged” [1]. In trying to identify the most important challenges in Aviation Software Systems for the Second Century of Flight, it became apparent to me that, not only does no silver bullet exist, but, in complex systems, no one theme is the problem child nor does a single theme exist in isolation from the others.

Given that, I chose to discuss the theme “System Issues” since this forms the umbrella under which other themes and related issues associated with complex systems can be categorized.

“Systems Issues” Challenges

The top three challenges of “System Issues” in complex systems are, as I see them:

1. Requirements Issues
2. Integration Issues
3. Change Management

1. Requirements Issues

a. Validation of requirements where validation ensures building the “right” system and answers the

question: when are requirements complete and sufficient?

b. Verification of requirements to ensure the system is built “right” and answers the question: were the requirements implemented correctly?

c. Management of requirements and component commitments across developers, suppliers, and integrators.

d. Distinction between system requirements, hardware requirements, and software requirements to readily enable development and use of the proper standards, policy, and guidance.

e. Requirements implementation targeted toward reuse and product certification.

2. Integration Issues

a. Integration of components to form a highly complex system comprised of COTS and other modules from multi-developer/supplier sources.

b. Identification and recognition of inter-component commitments and resulting impact.

c. Verification of integrated modular avionics (IMA).

3. Change Management

a. Change management of the individual system or module for which a change impact analysis would be performed, all under the purview of the party initiating the change.

b. But, in a highly integrated modular environment, change management may also impact a system outside the purview of the initiator, i.e., across suppliers/developers.

c. Change management of requirements and related requirements issues and commitments.

¹ This paper does not represent the official Federal Aviation Administration (FAA) position. The author is an FAA employee, and while the paper is intended to be consistent with FAA policy, it has not been coordinated through the FAA’s approving officials and represents solely the opinions of the author.

Information Technology Research Needs

As indicated in the challenges enumeration, the challenges do not exist independently of one another as each of the three challenge areas has impact on the other areas. Underlying research needs include:

1. How to safely certify products that use or incorporate COTS.
2. Means to easily and safely reuse products/tools previously certified/qualified.
3. Means to validate and verify complex, highly integrated systems to ensure that requirements are complete, correct, consistent, and communicated to affected users.

Roadmap Considerations

Authorities and industry must work cooperatively to:

- maximize scarce resources (time and money), experience, and entrepreneurship;
- minimize stove-piping while recognizing and respecting proprietary efforts and a capitalistic system;
- understand and recognize crosscutting impact of software (and human factors) issues across disciplines.

Summary

Software-related issues have been and continue to be the “Achilles Heel” of aviation system development. At issue is the development of high confidence systems in an increasingly complex environment. This paper identifies some “system issues” challenges and research needs in preparation for discussion at the national HCSS-AS workshop.

References

[1] Brooks, Frederick. *The Mythical Man-month*. Anniversary Edition, 1995.

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About the Author

Barbara Lingberg is a Software Program Manager in the FAA's Aircraft Engineering Division and is the program sponsor for FAA's Software and Digital Systems (SDS) Research and Development Program. Ms. Lingberg is the chair for the international Certification Authorities Software Team (CAST) who seeks to harmonize positions on software and complex electronic hardware issues, and is the federal representative to RTCA/SC-205 “Software Considerations in Airborne Systems” which is revising DO-178B. Prior to work in aircraft certification, she was Software Lead for the Wide Area Augmentation System. Ms. Lingberg holds a master's degree in Software Systems Engineering and a bachelor's degree in Mathematics.