Benefits of Security-informed Safety-oriented Process Line Engineering

Barbara Gallina [1],
(With contribution from Laurent Fabre [2])

[1] School of Innovation, Design and Engineering,
Mälardalen University, Västerås, Sweden
barbara.gallina@mdh.se

[2] Critical Systems Labs, Vancouver, Canada
laurent.fabre@cslabs.com

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Context

- Aircraft connectivity increasing
- New aircraft systems (networks) / New aircraft architecture (IMA)
- Pervasiveness of COTS

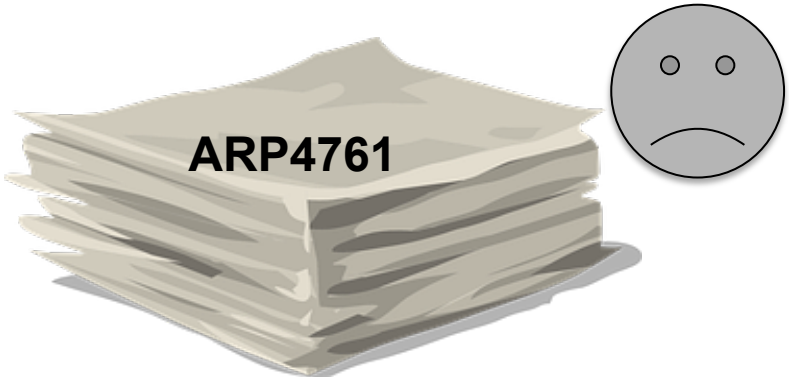
➔ Favorable grounds for cyber-security attacks

Adapted from:
https://pixabay.com/en/airplane-plane-aircraft-vehicle-26560/
https://pixabay.com/en/wifi-wi-fi-wireless-web-internet-43872/

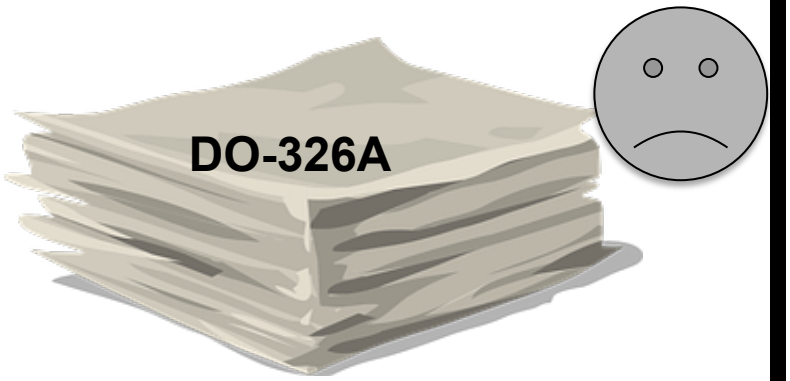
security-informed safety is crucial

Motivation

- Process engineer addressing the safety process



- Process engineer addressing the security process



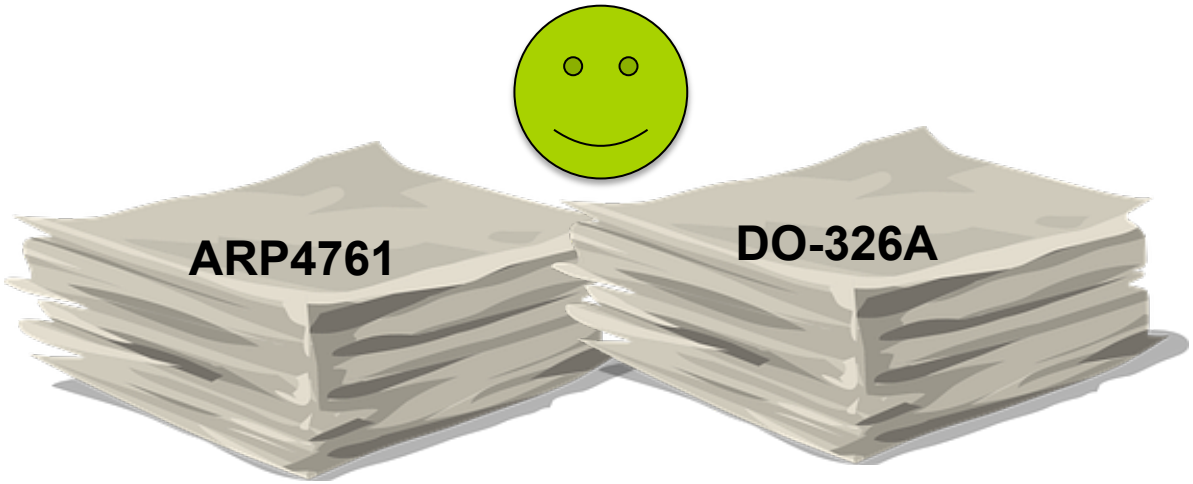
→ **Redundant and conflicting documentation/solutions**
→ **Waste of time and money**
→ **Risk for lower quality**

Motivations for aligning the safety and security assessment processes

- If security assessment is performed without ties to the safety assessment, it may be performed inadequately and potentially not completely
- Security threats or causes to threats may need to be fed back into the safety process
- Avoid interference between Safety and Security decisions regarding mitigations and architecture
- Allow presenting a combined safety-security picture to Certification Authorities. Faster approval!

Vision

- Process engineer(s) addressing the security & safety process



→ **Synergically conceived documentation/solutions**
→ **Saving of time and money**
→ **Increased quality**

Talk outline

- Background
  - Safety, security, and security-informed safety
  - RTCA DO-326A/ED-202A
  - ARP4761
  - Safety-oriented process lines engineering
  - Safety-oriented process line modeling
- SiSoPLE
- Applying SiSoPLE: an example
- Related work
- Conclusion and future work

Safety, security, and security-informed safety

[Avizienis et al 04] , [Bloomfield et al 13]

- Safety- absence of catastrophic consequences on the user(s) and the environment
- Security is defined as a composite attribute:
  - Availability - readiness for correct service
  - Confidentiality - absence of unauthorized disclosure of information
  - Integrity - absence of improper system alterations

- Security-informed safety – notion aimed at indicating:

  "For a system to be safe, it also has to be secure"

RTCA DO-326A/ED-202A

- Document (Published 2014) that provides guidance to handle the threat of intentional unauthorized electronic interaction to aircraft safety
  - Defines the Airworthiness Security Process through a set of:
    - risk assessment activities and
    - security architecture / measures development activities
  - Security risk assessment
    - Preliminary Aircraft Security Risk Assessment (PASRA), aimed at identifying threat conditions and threat scenarios and assessing all security risks at aircraft level

Remark: DO-356 describes methods to perform security-focused activities described in DO-326

SAE ARP4761

- Document that provides guidance to perform system safety assessment
- Defines the Airworthiness Safety Assessment Process:
  - Functional Hazard Assessment (FHA), aimed at identifying failure conditions and assessing all safety risks at aircraft level
  - Preliminary System Safety Assessment (PSSA): systematic evaluation of the proposed architecture and design to ensure that it can meet the safety requirements.
  - System Safety Assessment (SSA): verification that the system, as implemented, meets the system safety requirements established by the FHA and the PSSA

Safety-oriented process lines engineering

- Concurrent engineering of a set of safety-oriented processes
  - Why? To reuse systematically!

- Which consists of:
  - Scoping
  - Domain engineering (full and partial commonalities, variabilities)
  - Process engineering

Gallina et al 2012

Gallina et al 2014a

Gallina et al 2014b

Safety-oriented process lines modeling

- S-TunExSPEM (SPEM2.0 extension)

Task	Role	Tool	Work product	Guidance	Phase
					

Gallina et al 2014c

- vSPEM (SPEM2.0 extension)

Concept	Variation point	Variant
Task		

Talk outline

- Background
- SiSoPLE
  - Overview
  - SiS terminological framework
  - SiSoPLE modeling
- Applying SiSoPLE: an example
- Related work
- Conclusion and future work

SiSoPLE: Overview

- SoPLE extension aimed at addressing SiS-related processes

Why?

To realize our vision!

SiSoPLE: SiS terminological framework

- Mapping between terminologies used by
  - safety community
  - security community

- Examples:
  - Incompetence fault ←→ vulnerability
  - External fault ←→ attack

SiSoPLE modeling

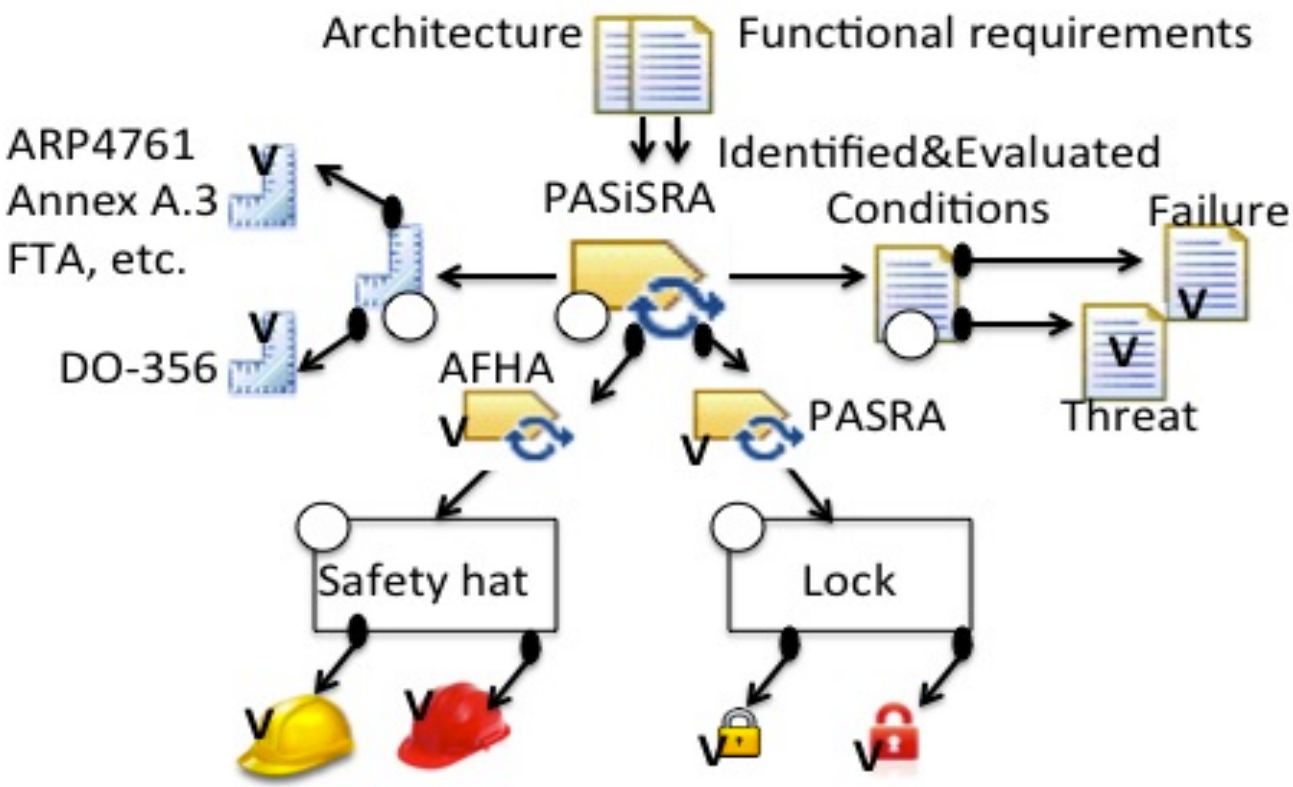
- Extension of the combination of S-TunExSPEM and vSPEM
  → Towards SiS-TunExSPEM

Novel language construct: security lock 

Applying SiSoPLE: an example

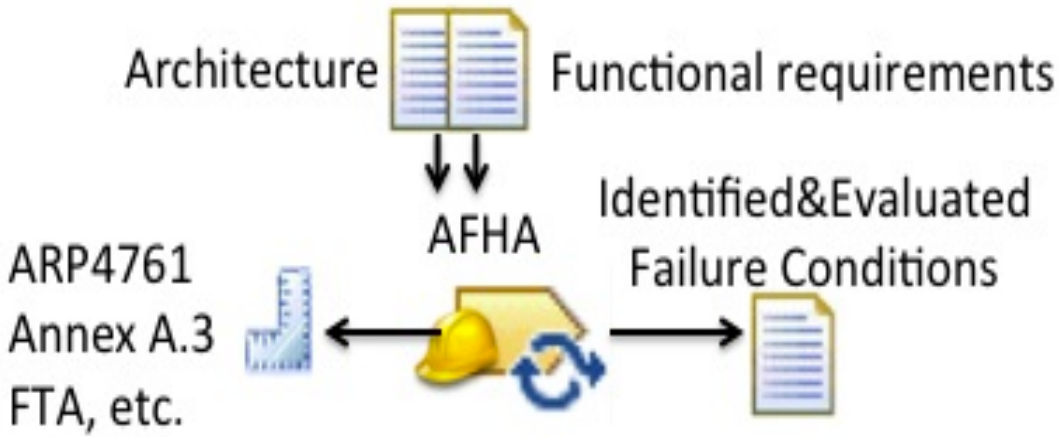
- SiSoPL – scoping
  - AFHA
  - PASRA
- Domain engineering
  - identification and comparison of certification-relevant process elements (tasks)
  - identification of commonalities and variabilities
- Single-process engineering

Applying SiSoPLE: an example



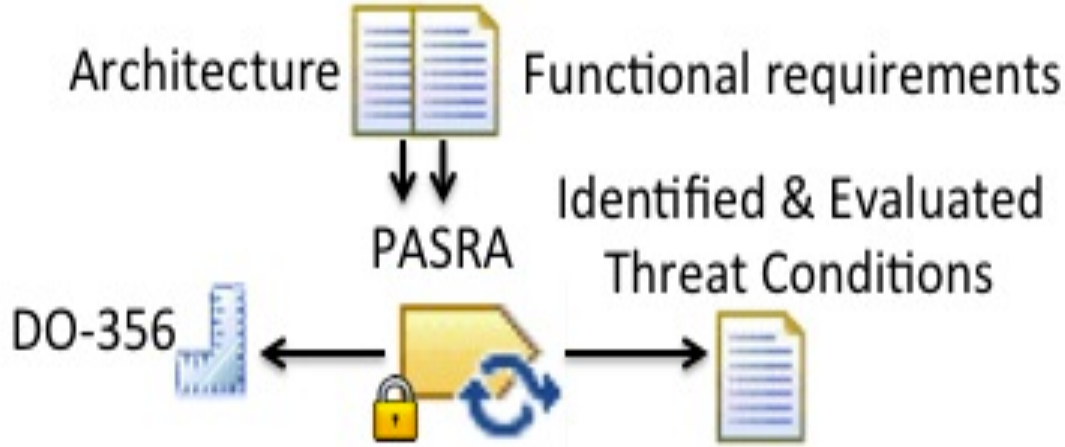
Applying SiSoPLE: an example

(AFHA derivation)



Applying SiSoPLE: an example

(PASRA derivation)



Lessons learnt

- General soundness
- Scalability
- Effectiveness
- Applicability

Related work

- Within the MAFTIA project [MAFTIA], researchers have worked on a common terminological framework to harmonize/cross fertilize safety&security

- Within the SafSec project [SafeSec], researchers have worked on common methodology for security accreditation and safety assurance

Conclusion and future work

- SiSoPLE: SoPLE extension for dealing with multi assurance concerns and enabling time and cost reduction during the provision of process-related deliverables via reuse
  - Benefits:
    - Duplication reduction
    - Synergies creation
    - Quality increase

- SiSoPLE further development
  - Clearly scoping and fully engineer our SiSoPL
  - Defining metrics
  - Investigating modelling capabilities targeting SiSoPLs
  - Enabling model-based certification

AMASS

AMASS

Architecture-driven, Multi-concern and Seamless Assurance and Certification of Cyber-Physical Systems

- PhD student in Applied Ontology and Knowledge Engineering http://www.mdh.se/hogskolan/jobb/phd-student-in-applied-ontology-and-knowledge-engineering-1.86385
- PhD student in Variability Modeling and Management http://www.mdh.se/hogskolan/jobb/phd-student-in-variability-modeling-and-management-1.86388
- Postdoc in Applied Ontology and Knowledge Engineering http://www.mdh.se/hogskolan/jobb/postdoc-in-variability-modeling-and-management-1.86403
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Thank you for your attention!

Discussion time…