The required paradigm shift for Turkish Defense Industry

TÜRKHAVACILIK UZAYSANAYİİ

Türk Havacılık ve Uzay Sanayii A.Ş., 'nin bağlı ortaklığı ve 'nin iştirakidir.

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Hamid Alper Oral, PhD

- 1981 – 1985 BSME Istanbul Technical University, Gümüşsuyu, İstanbul
- 1987 – 1989 MSE University of Michigan, Ann Arbor, Michigan
- 1989 – 1993 PhD University of Edinburgh, Scotland, UK
- 1993 – 1997 Assistant Professor in ITU Aerospace Engineering Dept.
- 1997 – 2018 Modeling/Controls development and testing in USA
  (LuK, Ford, Chrysler, Burke E. Porter Machinery, Magna Powertrain, General Motors, Bosch-Rexroth, Siemens PLM)
- Since June 2018 Turkish Aerospace Industries, İstanbul, Turkey

Turkish Aerospace

HISTORY

1974

Establishment of TUSAŞ

- 100% Turkish

1984

Establishment of Turkish Aerospace

- 51 % Turkish Aerospace
- 49 % General Dynamics

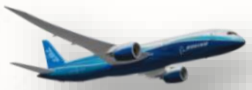
2005

Merging of TUSAŞ and Turkish Aerospace

2018

Indigenous Products

Product Portfolio

AIRCRAFT	HELICOPTER	UAS	SPACE SYSTEMS	AEROSTRUCTURES
 HÜRKUŞ	 T129 ATAK	 ANKA	 TÜRKSAT 6A	 A350XWB Aileron
 HÜRKUŞ-C	 T70	 ANKA-S	 GÖKTÜRK-1	 B787 Elevator
 TF	 T625		 GÖKTÜRK-2	 F35 Center Fuselage
 HÜRJET	 10 Ton Utility		 Small-GEO	
 HÜRJET-C	 ATAK II			 A400M

Overview

- Strategy
- Challenges
- Solutions

Strategy*: What should be done

- Execute procurements for the defense industry primarily from domestic suppliers
- Build an infrastructure to enable the domestic suppliers design and manufacture beyond their current technical capabilities
- Enable domestic organizations to conduct internationally recognized certification and validation tests
- Establish checks and balances to insure the development and production of defense systems match international standards in terms of performance, quality and sustainability
- Provide fundings for the technical vocational schools, universities, research labs and other such institutions to pave the way for the required manpower with specific skills and know-how for defense industry
- ..

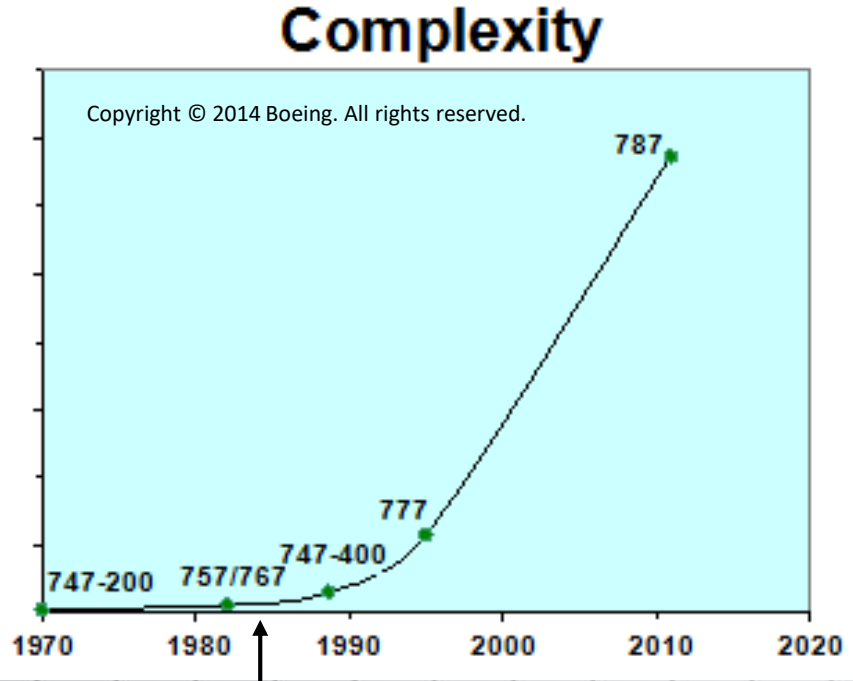
*Reference: https://www.ssb.gov.tr/

Challenges

- Being able to change the way we work to adopt new methods to be able to handle the increased complexity of defense systems
- Acquiring and accumulating know-how and leveraging it for relevant projects
- Gaining and maintaning the discipline to work as a team to avoid duplication of effort and waste of resources
- Having testing capabilities at component, subsystem and system level to protect the intellectual properties and gain critical first hand domain knowledge
- Being able to execute mission simulations at very early design phase to find out conflicting requirements among different devices attached to air/land/sea/space-crafts in theater of war
- Being able to predict the minimum defense requirements of the country given all potential threats in its neighbourhood and beyond
- Meeting the project deadlines with acceptable solutions
- Having skilled workforce to meet the project's demands

Challenge: Adopting new ways to handle the complexity

Increased complexity of systems are beyond the limits of decades old development methods to handle



1984 TAI merging with General Dynamics

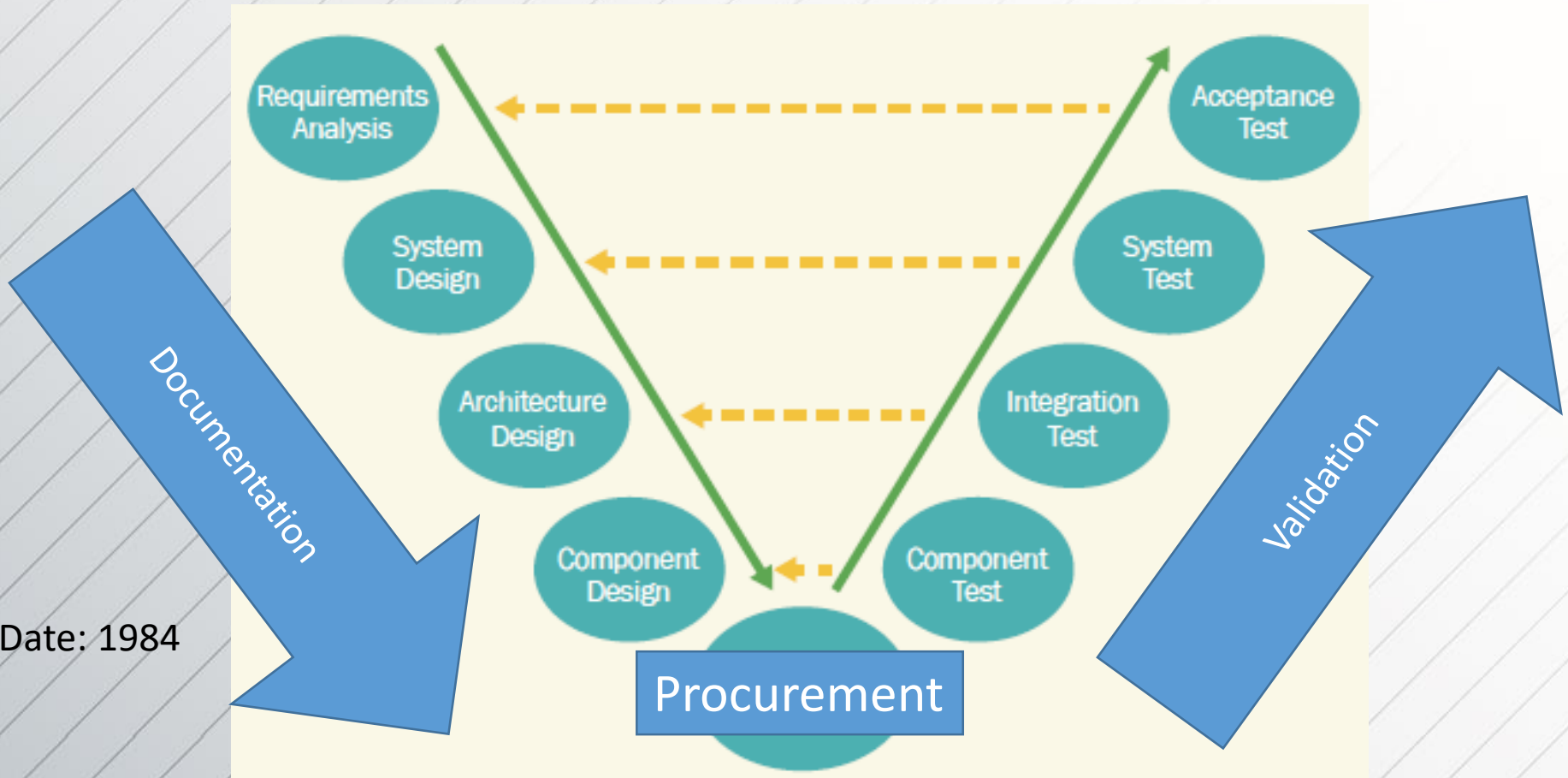
The Boeing Company

- **Example Boeing Commercial Airplane System Architecture Model Volume (~14 GB)**
  - **~2,300 functions**
  - **~10,000 data flows**
  - **~5266 equipment installations with data interfaces**
  - **~1,000,000 data parameters**
  - **~9490 electrical connections**
  - **~ 60,000,000 objects in data base (~ 3 relationships (links) per object)**

~1300 users are required to produce this dataset

Challenge: Adopting new ways to handle the complexity

Document Based Systems Engineering:

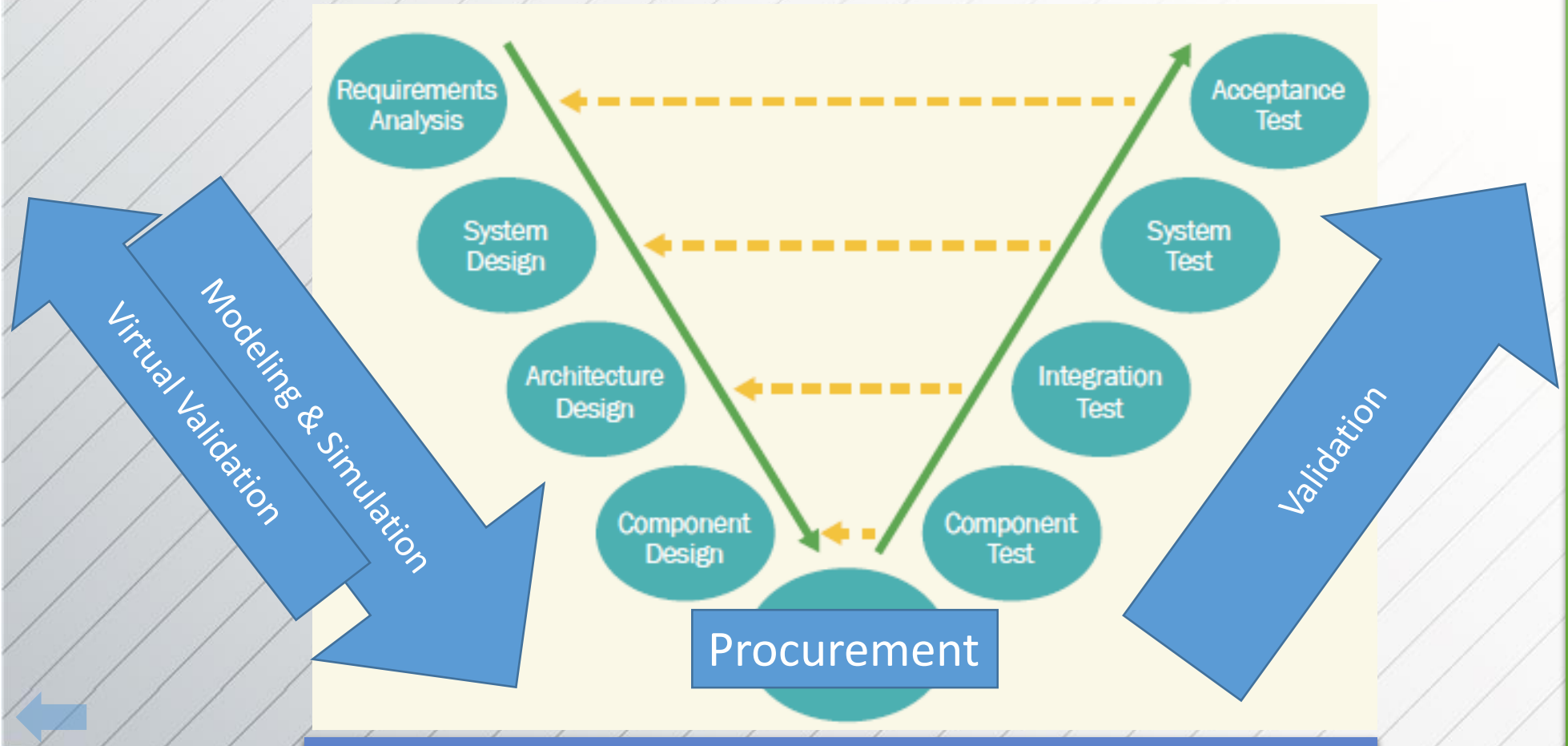


Date: 1984

Document based systems engineering method works for projects involving structural tasks. However for modern aircraft systems the process cannot handle the associated complexity.
Many issues arise during integration and performance testing causing major delays especially due to lead times associated with procurement of replacements.

Challenge: Adopting new ways to handle the complexity

Model Based Systems Engineering:



Model based systems engineering method works for projects involving complex subsystems. Before procurement of any component, applicable tests are completed on the virtual system through simulation of components, subsystems and the integrated system using their corresponding models built at required complexity. This approach helps reduce the integration issues faced after procurement.

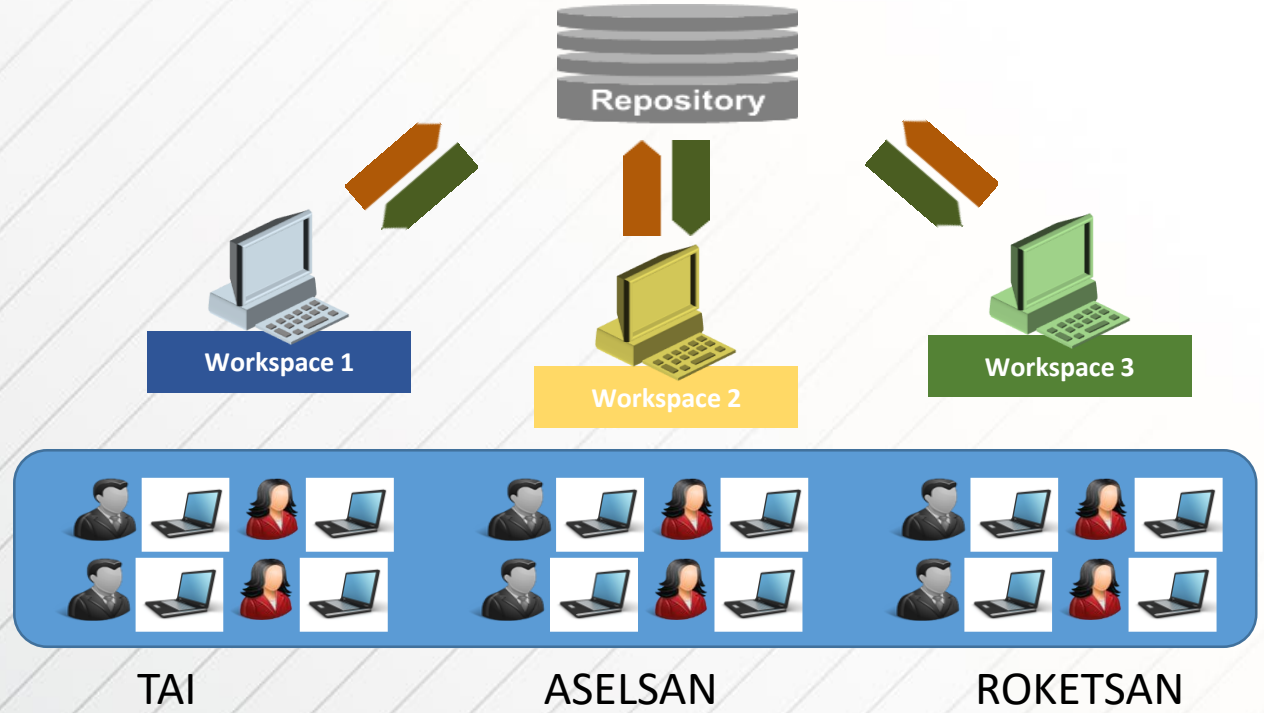
MODELS ESPECIALLY VALIDATED MODELS ARE EXTREMELY VALUABLE SINCE THEY ENSURE A SMOOTHER VALIDATION PHASE.

Challenge: Acquiring, Accumulating the know-how and leveraging it for other projects

The acquired know-how ends up in the hands of the workforce which moves around and even leave the country whereas it should be common asset to be shared within projects when applicable.

Establish a common model repository including utilities. The developed models should be accessible to all parties working on relevant projects.

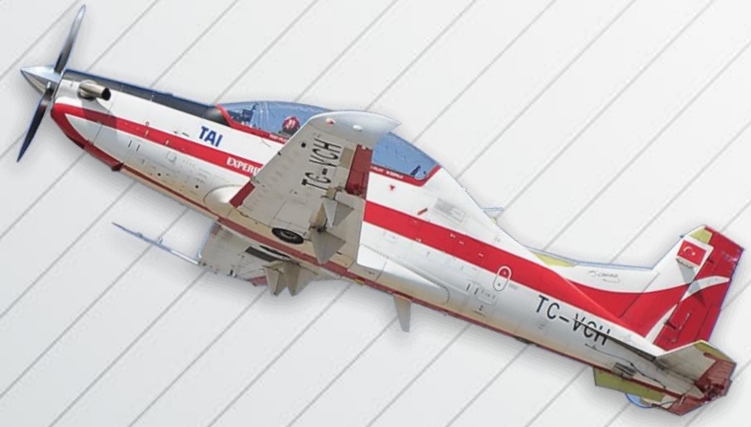
Establish **a joint MBSE task force** among experienced users to insure the optimum utilization of the model resources and successful execution of the projects.
This team can also help educate the workforce in their respective company in regards to MBSE methods customized for Turkish Defense Industry.

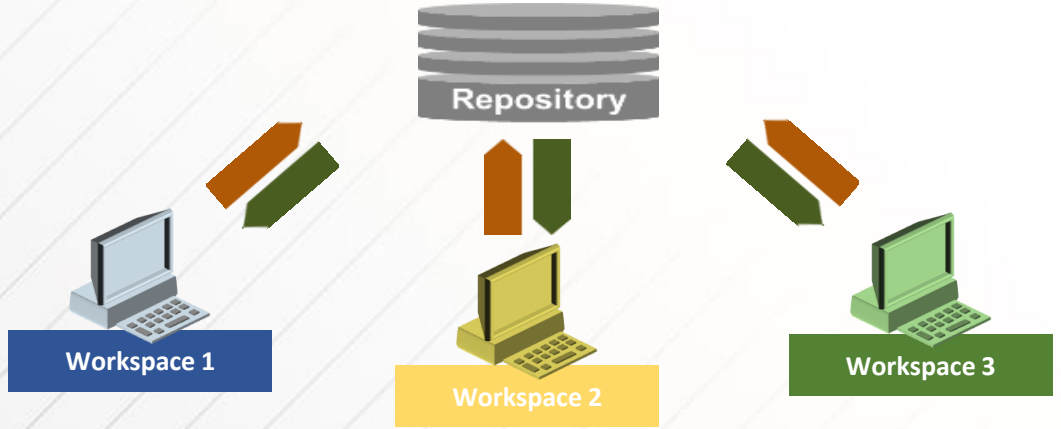


The task force could be extended further to include the navy and ground forces.

Challenge: Working as a team

The similar tasks are executed and the similar problems are solved many times over causing waste of time since we do not work as a team but as separate groups unaware from each other.





Build utilities for common tasks and enhance them as needed

Plan and execute projects using the models and the common utilities from the repository

Challenge: Developing and protecting the IP while gaining the domain knowledge

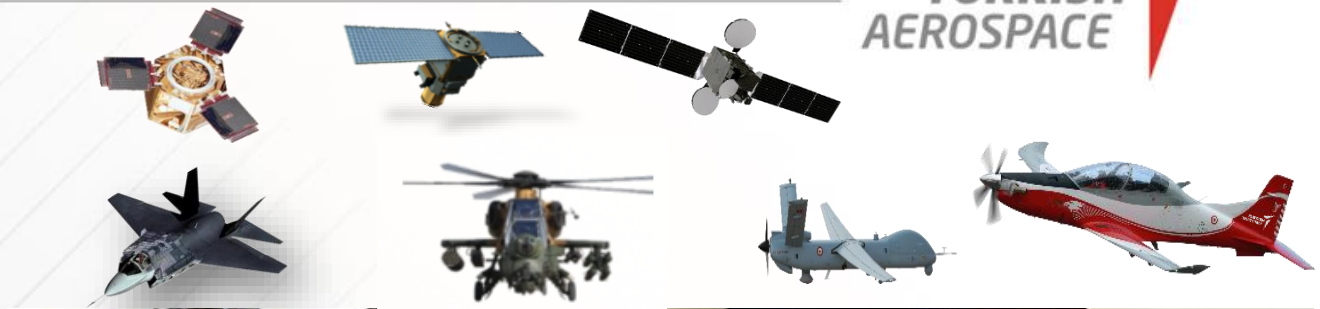
The testing at component, subsystem and system level are critical since this is where know-how and intellectual properties are verified, validated and sometimes even discovered. Procuring the testing services from abroad are probably among the worst decisions made.

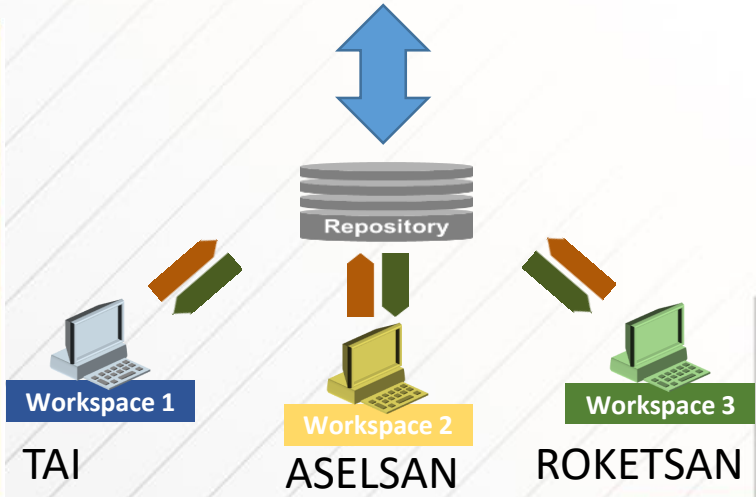
The joint MBSE task force should also be in charge of building model libraries in the repository with enhanced fidelity per validation testing results executed in test beds. Validated models mean a smoother validation phase.

Challenge: Early detection of conflicting requirements in theater of war

Discovering some of the issues due to conflicting requirements of devices placed on air/land/sea/space-crafts running a joint mission are very challenging, unless they can be tested in a realistic war scenario. It is extremely important to detect these conflicts early before running into them in theater of war.

Simulations of various war scenarios executed by actual pilots would help assess the performance of the systems, subsystems and even components early in the development phase.
As the missions get more complicated it becomes easier to find the conflicting requirements early in development phase.
The next step is to find the optimum solution for the best survivability rate.





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