A Model-Based Testing Process for Enhancing Structural Coverage in Functional Testing

Yanjun Sun, Gérard Memmi and Sylvie Vignes

CNRS LTCI, Télécom ParisTech, Université Paris-Saclay

yanjun.sun@telecom-paristech.fr

Feburary 26, 2016

Outline

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- Initiated by French nuclear industry since 2012, the "CONNEXION" project proposes a unique tool chain to automate as much as possible the functional verification on models of the I&C (Instrumentation & Control) system.
- This article presents a new MBT process leveraging model checking to enrich functional verification. Coverage based test generation is combined with functional requirements to ensure the functional reality of new test.

CONNEXION: key figures

CONNEXION: partners

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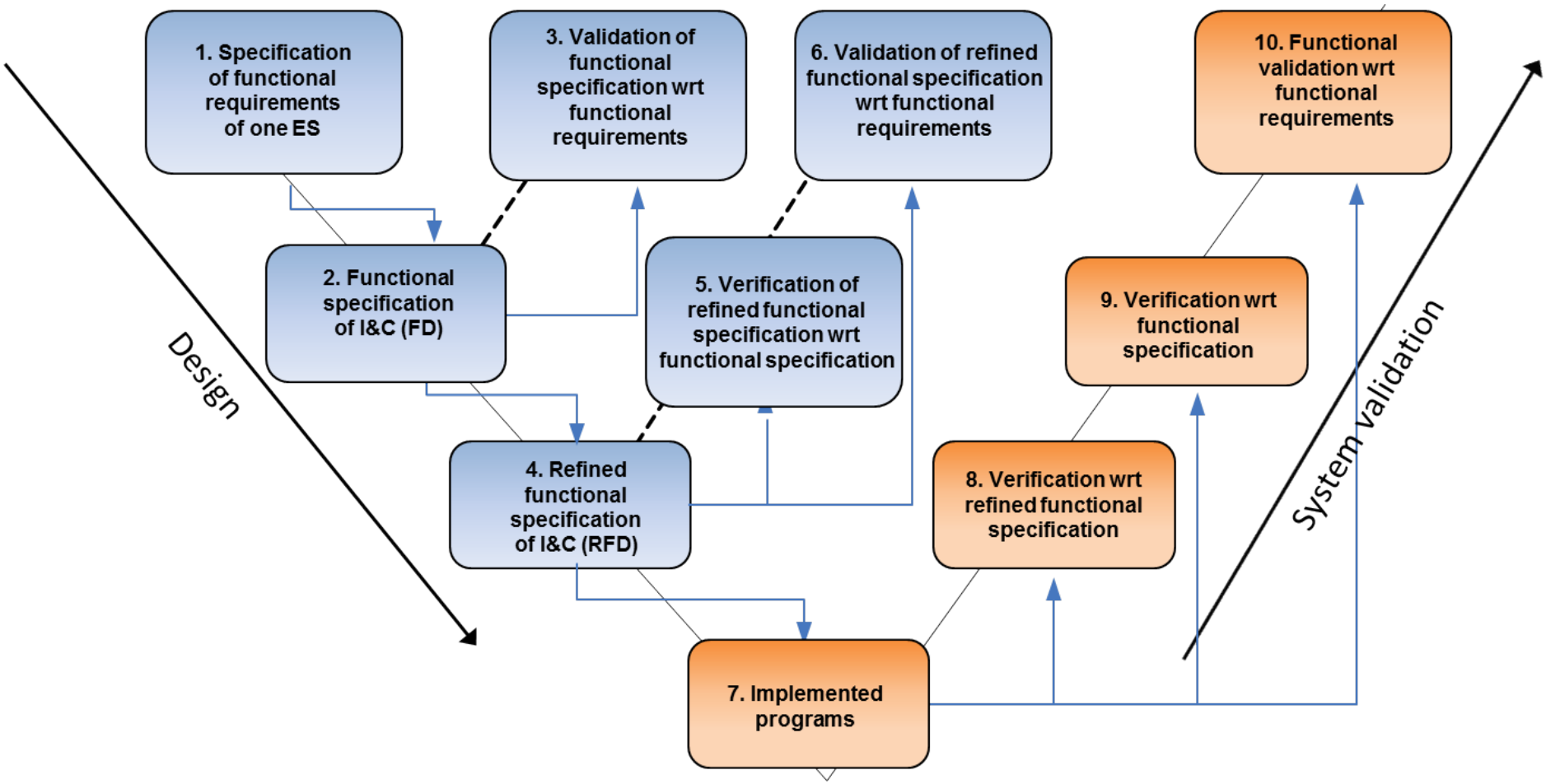
  - **Refined Functional Diagram** (**RFD**)

Triple V life cycle of one ES

The traditional V cycle is enriched by two sub-cycles:



A unique tool chain

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System modelling tool	*Papyrus/SysML*
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Functional test generation tool	*Interval*
	MaTeLo
Model checker	*GATeL*
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- A rich literature on coverage based test generation with model checking:
  - Rayadurgam et al.(2001): formalization of various structural coverage criteria to challenge a model checker
  - Eniou et al.(2013), Heimdahl et al.(2003): automatic test generation by model checking to satisfy structural coverage criteria

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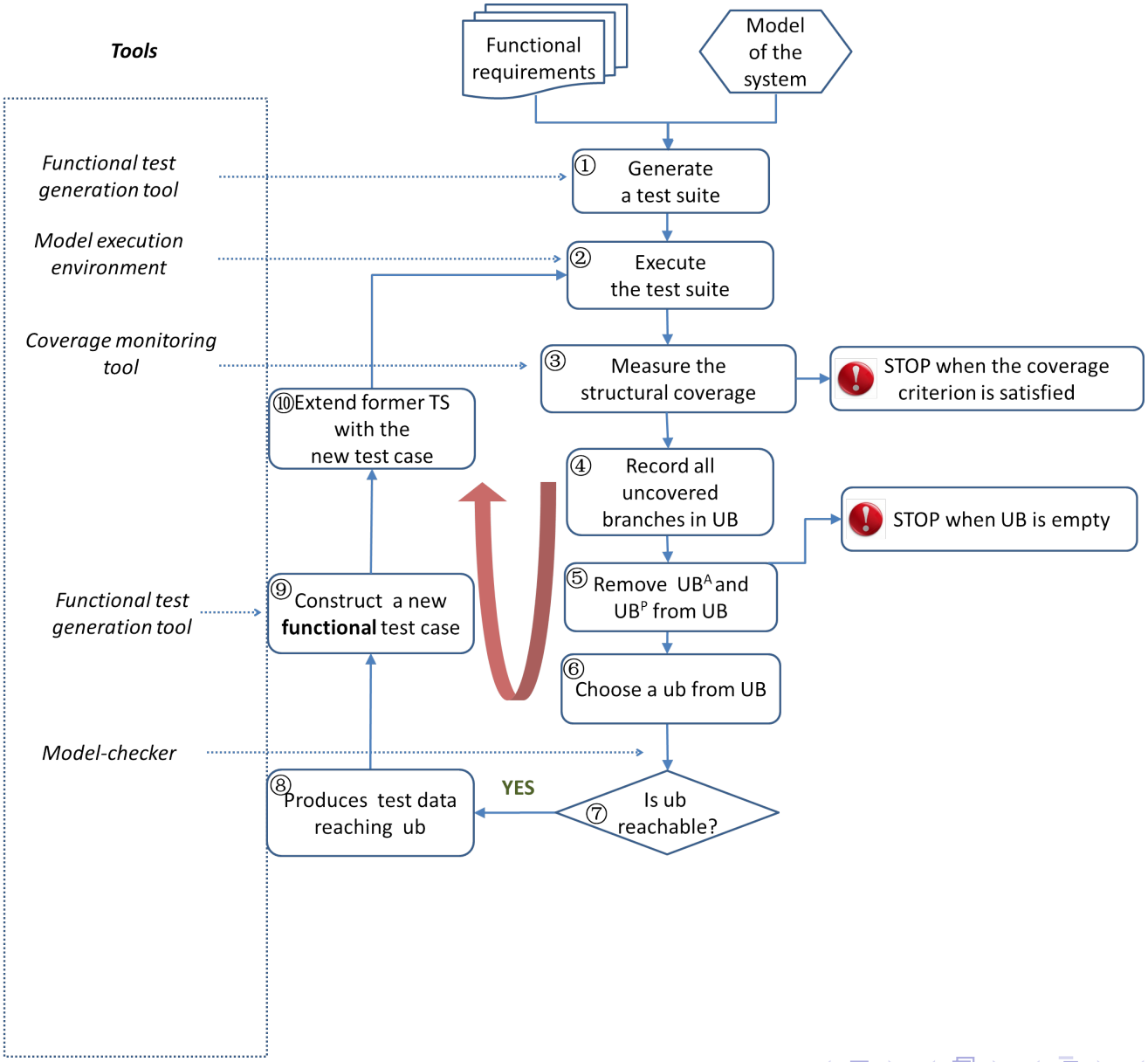
- Fantachi et al.(2004) proposes a procedure to perform reachability check on every uncovered branch. Either establishes that the branch can not be covered, or produces a test case that covers the branch.
- In addition to this procedure, our process:
  - highlights the functional reality of the coverage based test generation by model checking;
  - takes into account that the model checker can have a "time out";
  - designed in particular for a complex system composed of sub-systems modeled in different formats.

A new model-based testing process (2)



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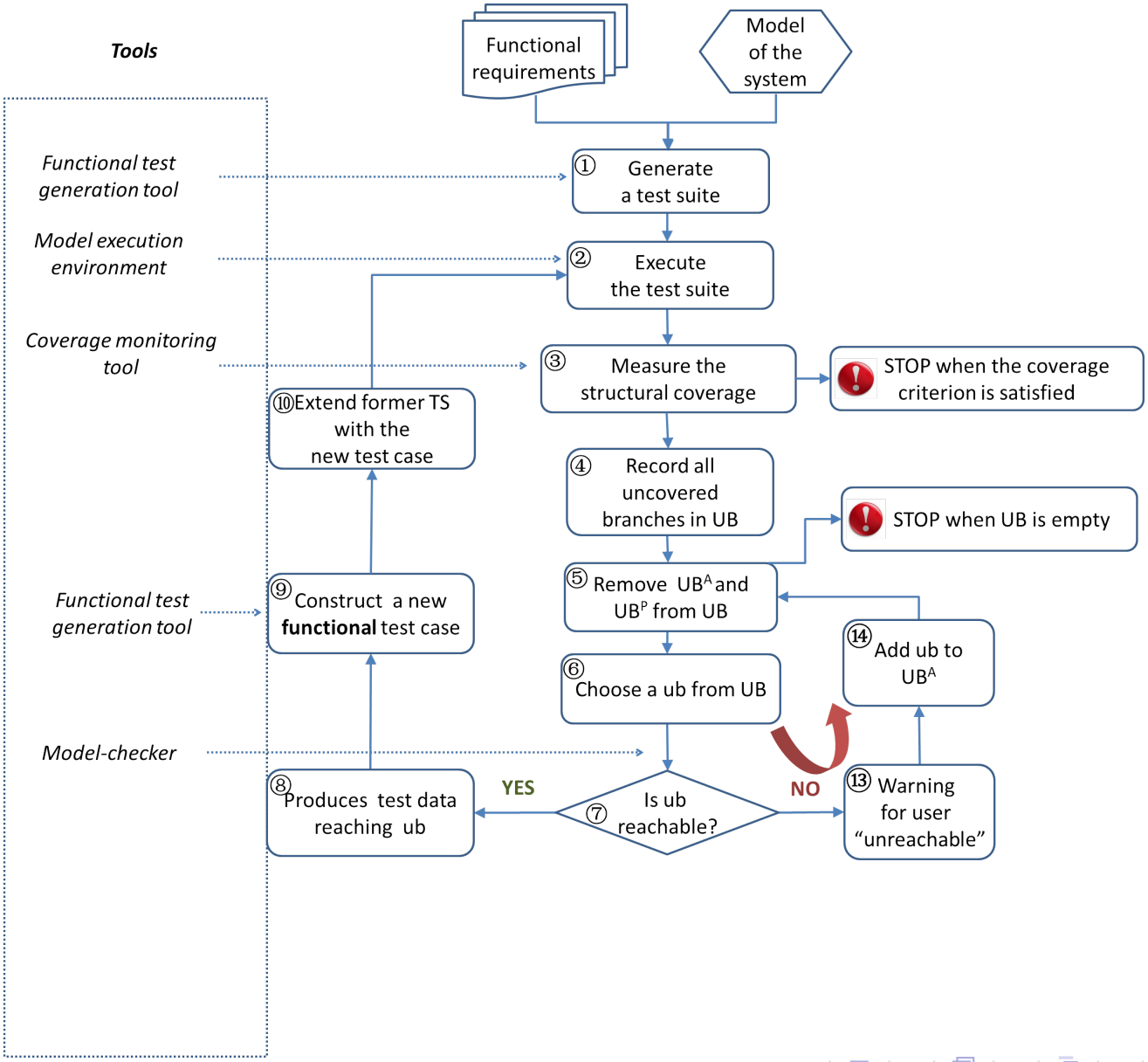

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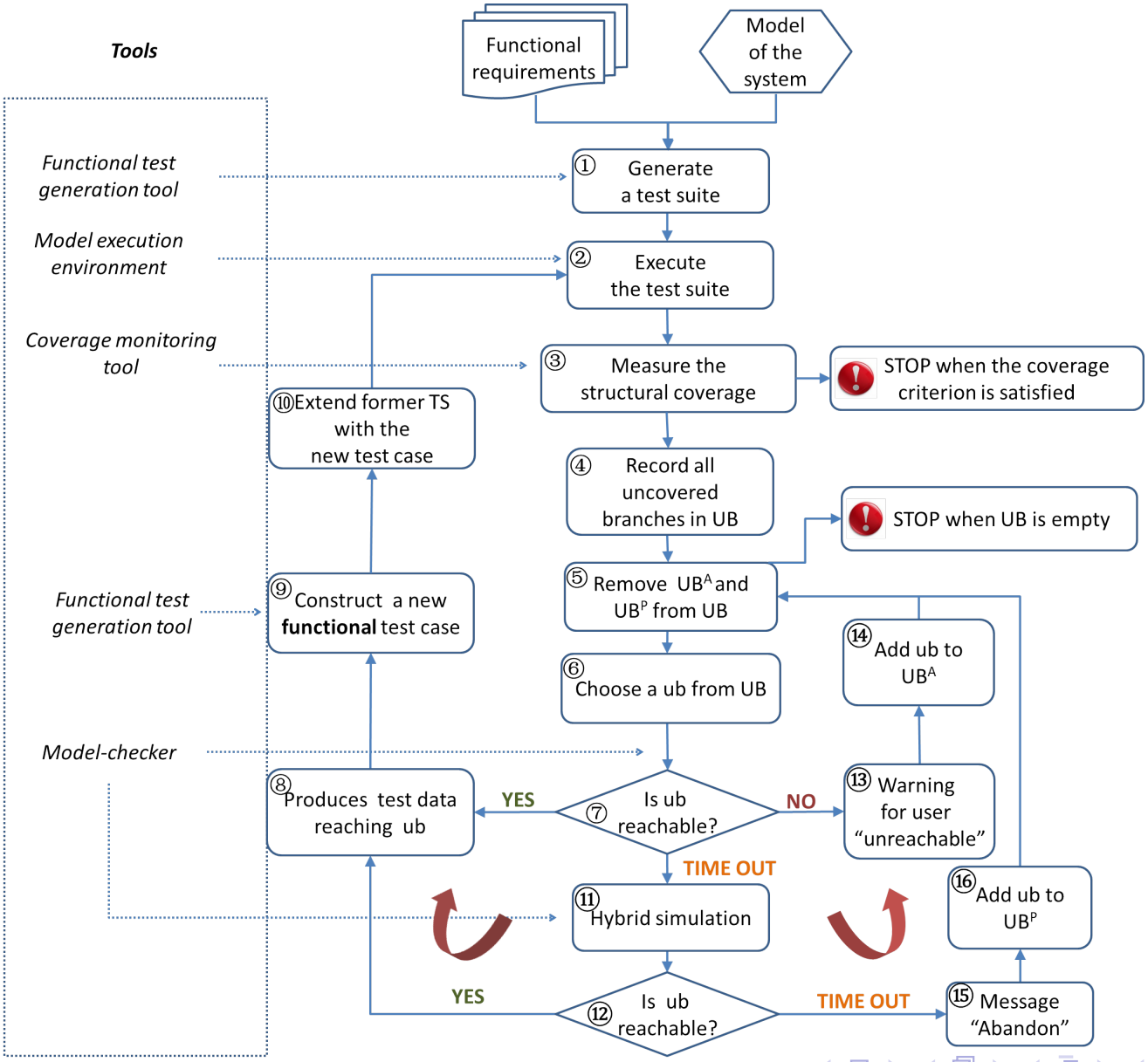

Challenges with respect to "CONNEXION"

- Construct a test case at the ES level from test data generated by GATeL requires knowledge of both the functional requirements and the testing techniques and tools.

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- Equivalence of transformation between models:
  - recreate FD and RFD in *SCADE Suite*
  - transforme Scade models into Lustre models

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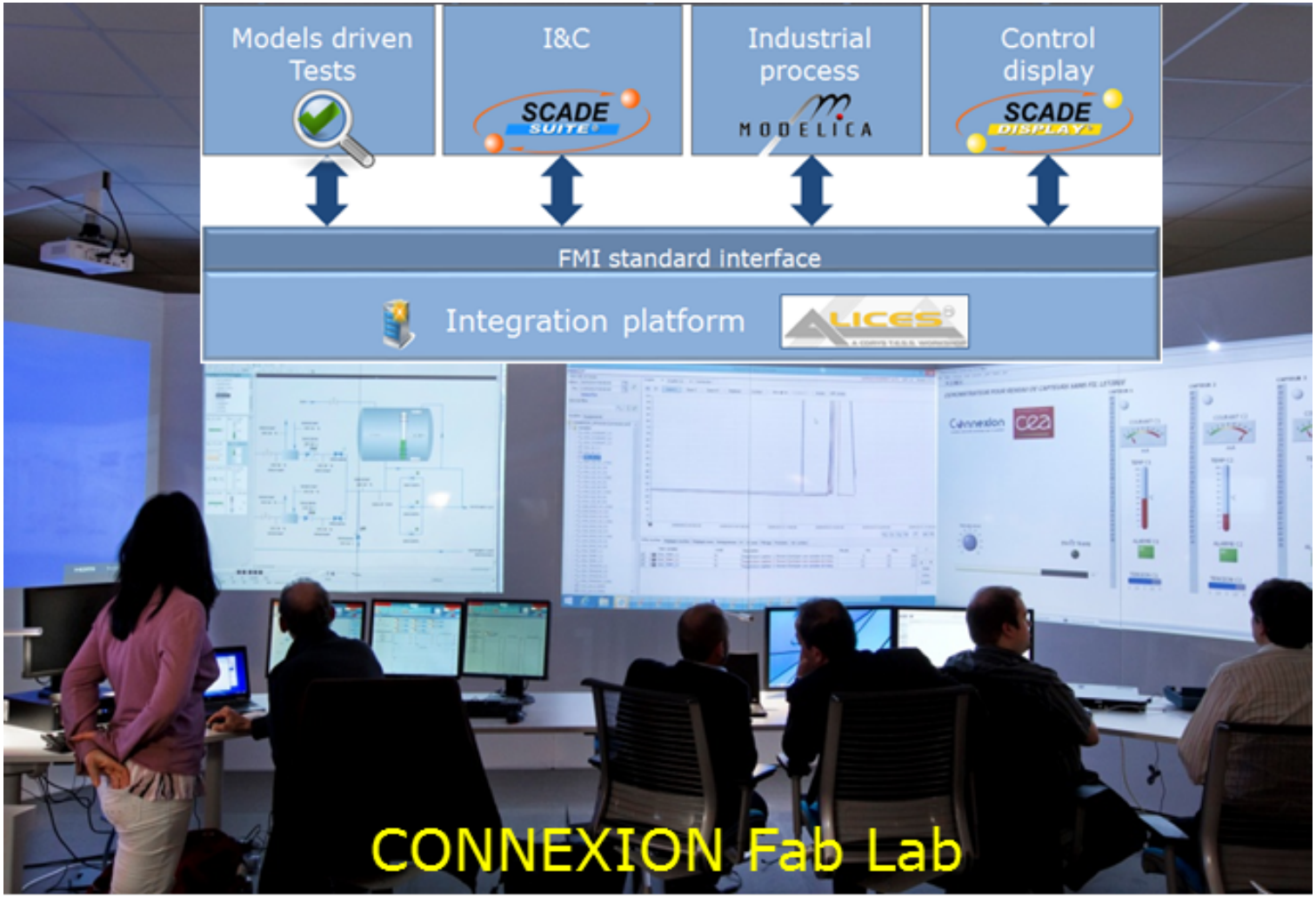
- This article presents a model-based testing process directed by structural coverage and functional requirements. The unique tool chain provided by "CONNEXION" enables our process.
- The "CONNEXION" project has determined a progressively complex case study where our process is being applied.
- Future work includes research on reducing test cost by reusing some test cases after changes being made to the system. The proof of model transformation equivalence remains an open question.

CONNEXION Fab Lab: a step toward Industry 4.0



Acknowledgment

The authors would like to thank the engineers of EDF who are part of the "CONNEXION" project: Maxime Neyret and Gaëtan Robin as well as other project partners providing tools and valuable advice: Benjamin Blanc from CEA (*GATeL*), François-Xavier Dormoy and Luc Coyette from Esterel Technologies (*SCADE* tool set), François Chastrette from ALL4Tech (*MaTeLo*).

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The End
Thank you!