SCOLA: a Scenario Oriented LAnguage for railway system specifications Context Formal model System specifications

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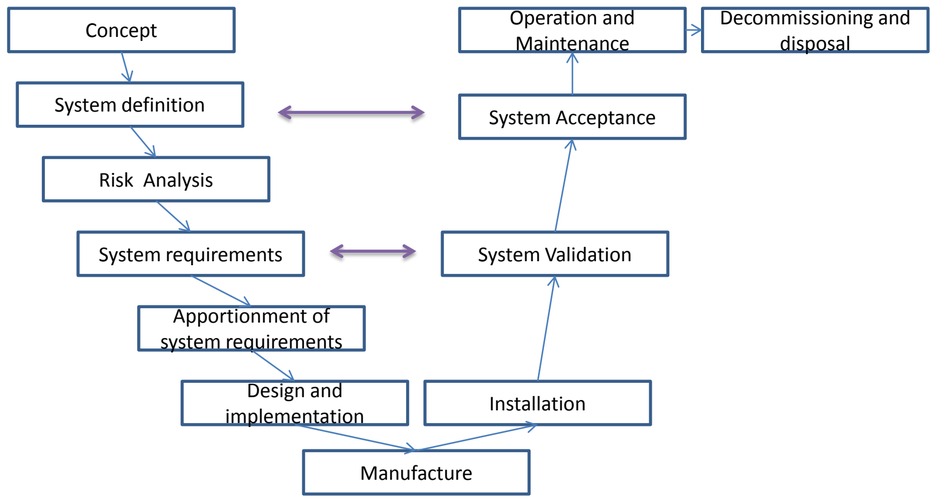
1. Context



Siemens Railway Automation solutions

- PA 135 (Paris, Mexico, Lyon, Santiago, Caracas, Praha)
- SACEM (Paris, San Juan, Mexico, Hong Kong)
- Trainguard MT CBTC (Paris, New York, Barcelona, Budapest, Algiers, Sao Paolo)

System specifications

- Written in a natural language.
- Ambiguous.
- Non-modular.

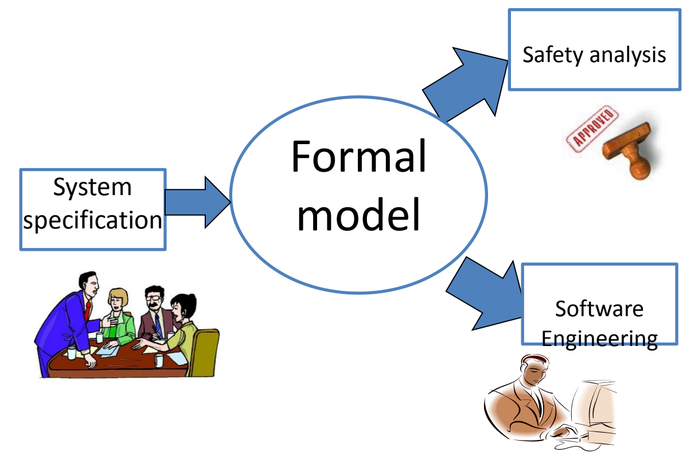
System engineering process

- Unlinked phases.
- Each phase uses a different process which increases its runtime.

System validation

- Late detection of the errors:
  - Expensive
  - Lack of automation

2. Objective



Formalize the informal

Unify the system description

Link with formal tools

Obtain a graphical representation

3. The idea

- System architecture:
  - Functional view
  - Structural view
  - Behavioral view
- Functional scenarios

Where?

- Identifying the abstract concepts of the system and their relationships

How?

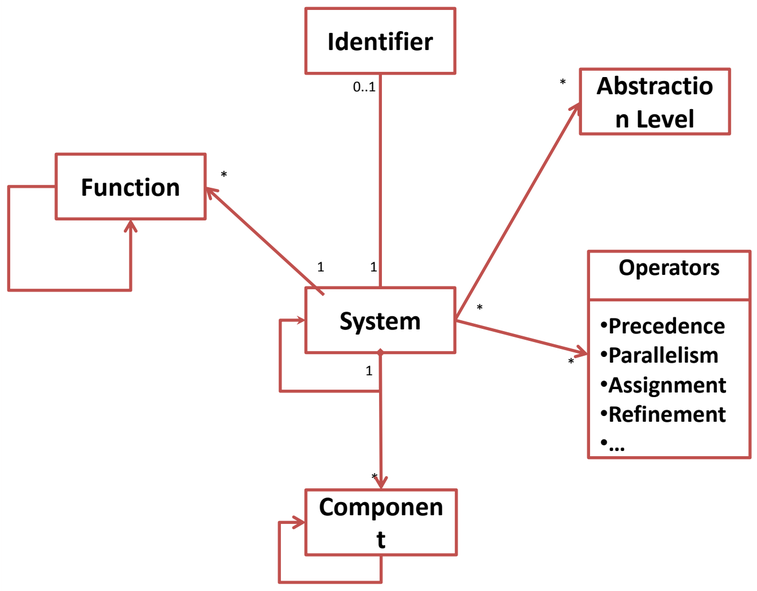
- At the very first steps of the system design

When?

❑ Instead of looking at systems **options**, we must identify systems **concepts**

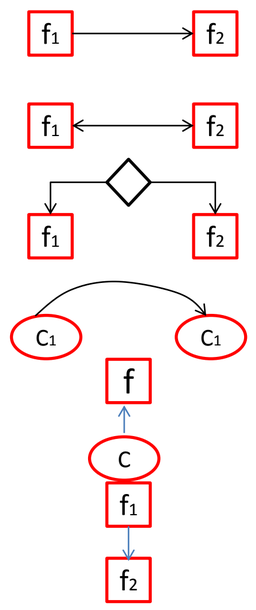
❑ Build a formal modeling language based on the concepts and that fits the behavior of the system

4. A system in SCOLA

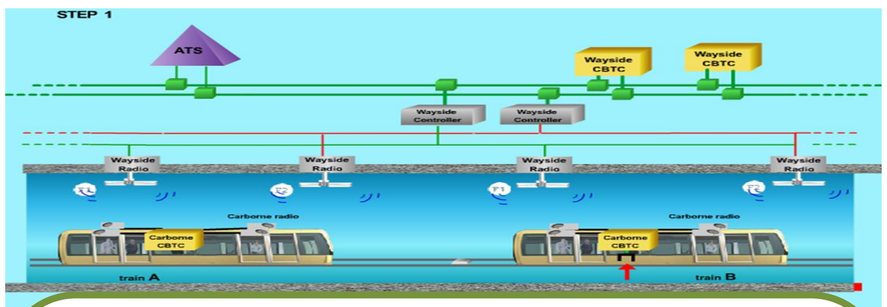


5. The concepts of SCOLA

	Textual	Graphical
Precedence	$f_1 \rightarrow f_2$	
Parallelism	$f_1 \,\|\|\, f_2$	
Choice	f_1 or f_2	
Cooperation	from C_1 to C_2	
Assignment	by C	
Refinement	$L_n \downarrow L_{n+1}$	



6. Case Study



The Arrival At Station Scenario

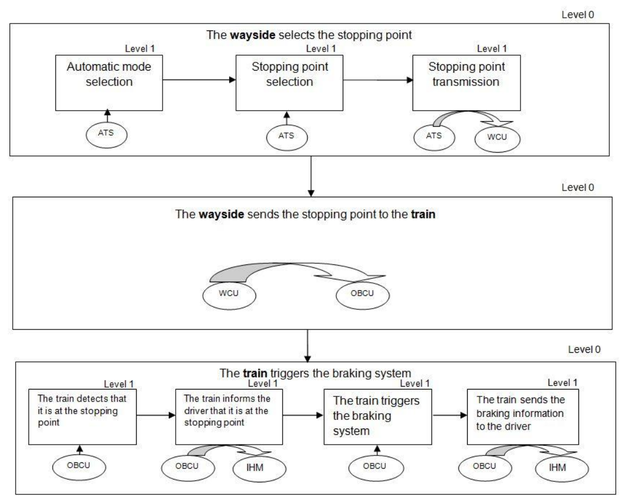
$f_{0,1}$: The **wayside** selects the stopping point

$f_{0,2}$: The **wayside** sends the stopping point to the **train**

$f_{0,3}$: The **train** triggers the braking system

- $f_{1,1}$: The **train** detects that it is at the stopping point
- $f_{1,2}$: The **train** informs the **driver** that it is at the stopping point
- $f_{1,3}$: The **train** triggers the braking system
- $f_{1,4}$: The **train** sends the braking information to the **driver**

7. Graphical Representation



8. Textual Representation

```
Scenario system with TGMT {
    Scenario F01 = "The trains calculate their positions"  {

        Action F11 = "Train1 determines its position" By TGMT.obcu1 ;
        Action F12 = "Train2 determines its position" By TGMT.obcu2 ;
        Script F11 || F12 ;
    }
    Scenario F02 = "The trains send their position to the wayside" {
        Transfer F11 = "Train1 sends its position to the wayside" From TGMT.obcu1 to TGMT.wcu ;
        Transfer F12 = "Train2 sends its position to the wayside" From TGMT.obcu2 to TGMT.wcu ;

        Script F11 || F12 ;
    }

    Action F03 = "The wayside determines the space limit between the two trains" by TGMT.wayside ;
    Scenario F04 = "The wayside transmits the safe distance limit to the trains" {
        Transfer F11 = "The wayside transmits to train1" from TGMT.wcu to TGMT.obcu1 ;
        Transfer F12 = "The wayside transmits to train1" From TGMT.wcu to TGMT.obcu2 ;

        Script F11 || F12 ;
    }
If test = "Limit Reached" {Action F05 = "Emergency brake of the train2" By TGMT.obcu2 ;}
else {Action F06 = "the train determine their speed limit plan" By TGMT.obcu1 ;
    Action F07 = "the train determine their speed limit plan" By TGMT.obcu2 ;}

Script F01 -> (F02 -> (F03 -> test -> (test.F05 or (test.F06 -> test.F07)))) ;
}
}
```

9. Conclusion

❑A novel scenario based modeling formalism

❑Relies on a formal semantics

❑Provides multiple levels of abstraction

❑Generic enough to be used for all the complex systems

❑A stepping stone for the dysfonctional scenarios modeling

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Séminaire Doctoral, Forum académie-Industrie AFIS

INCOSE International Council on Systems Engineering AFFILIATE