Exploring Situation Theory Using InfonLab

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Agenda

- Objective and Approach
- Situation Theory: Why, What
- MBE Based on Situation Theory
- Empirical Assessment
- Conclusions

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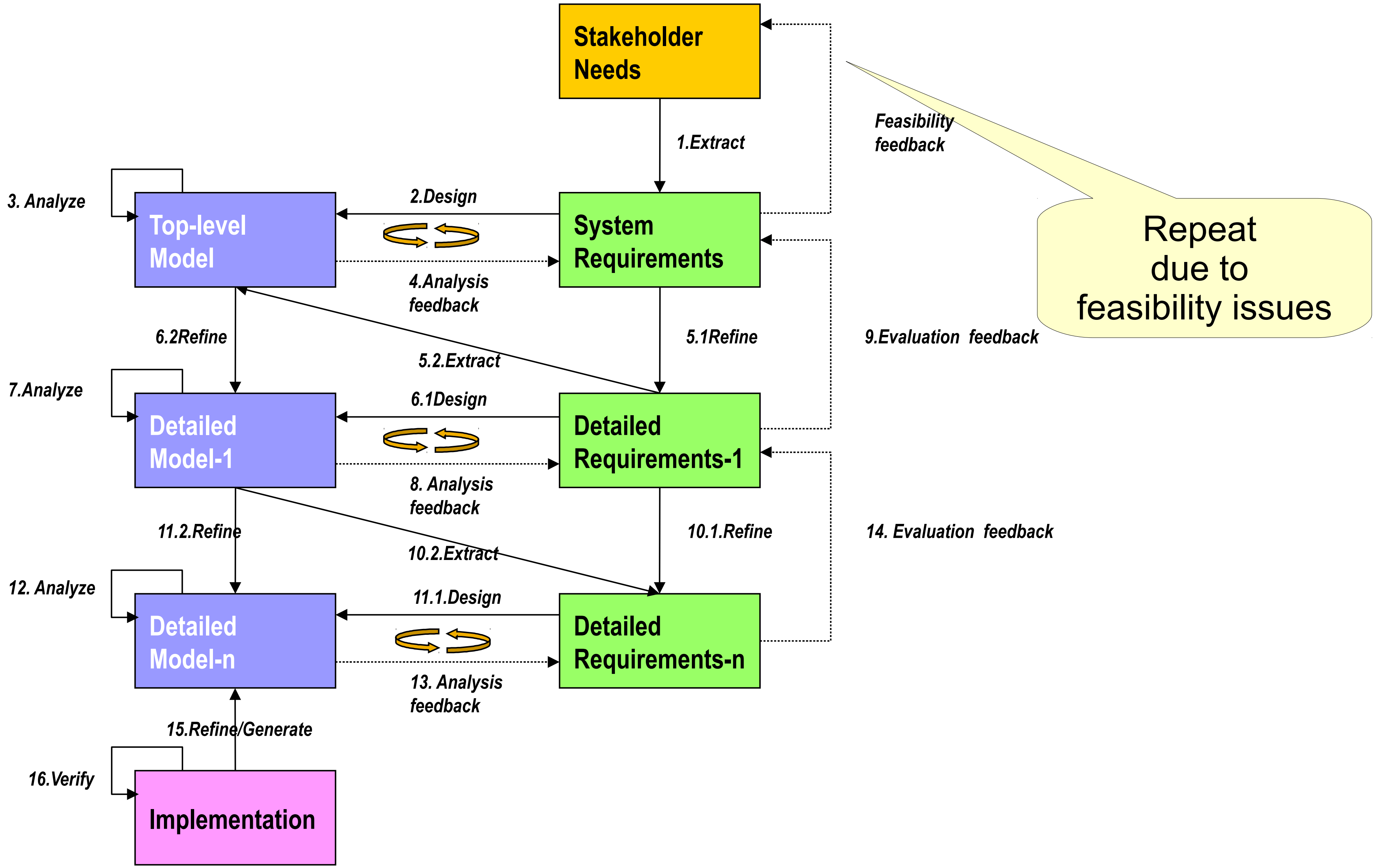
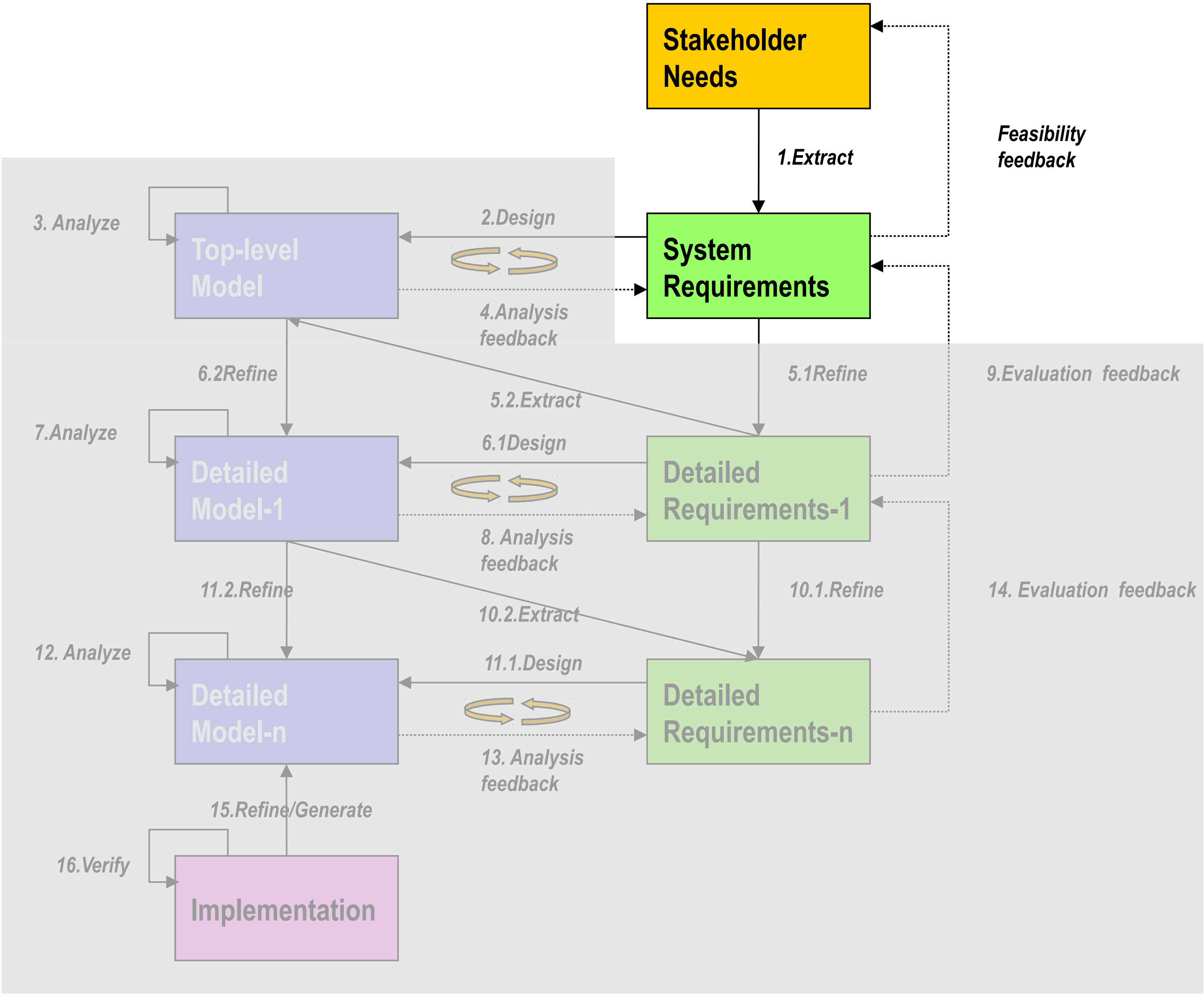
Objective

Transform requirements that are expressed in natural language to formal design specifications or programs that realize those requirements.

Agile / Iterative Development

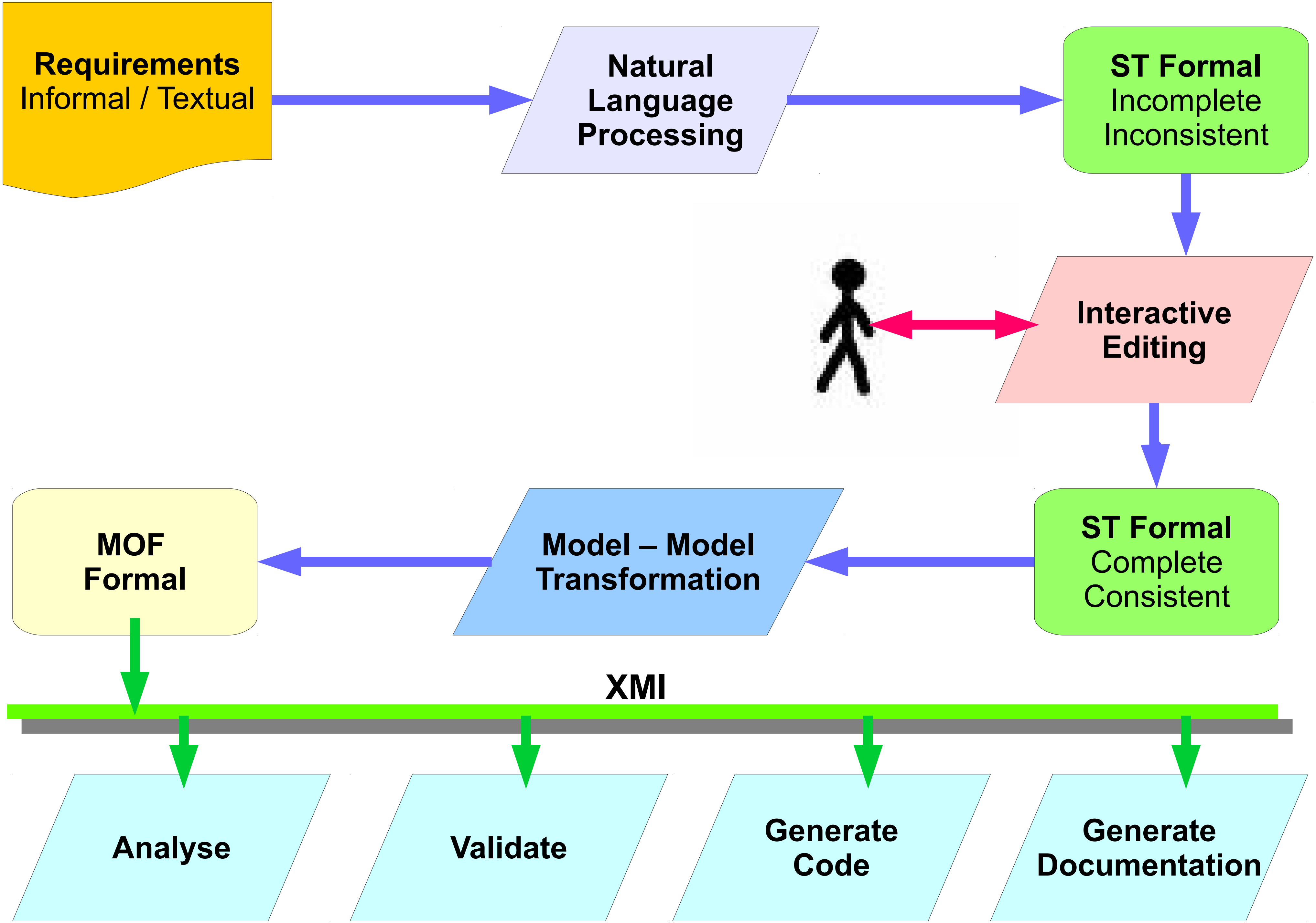


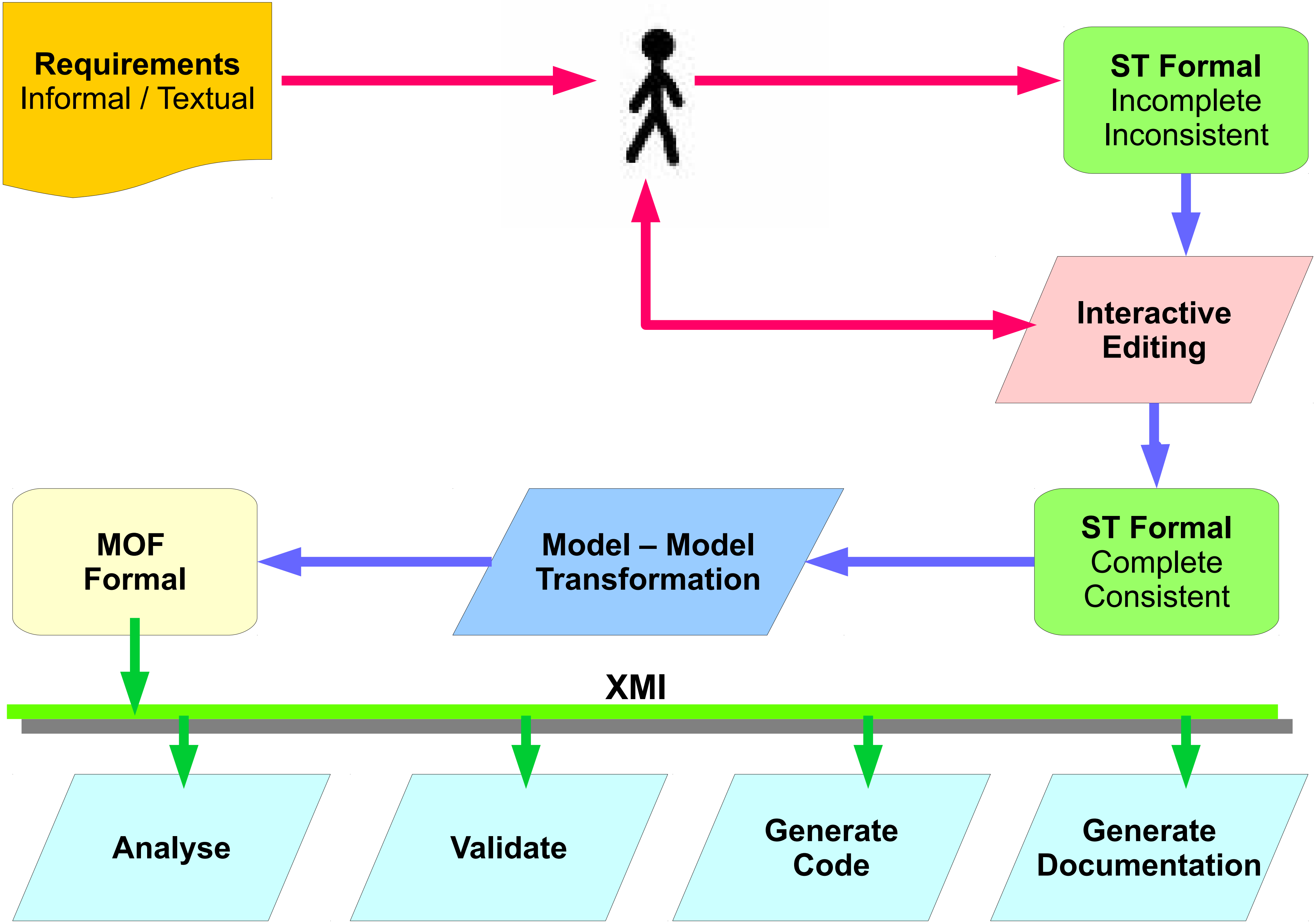
Agile / Iterative Development



Approach

Identify and investigate an area of study which provides for the analysis and formalism for the content and meaning of natural language.


Requirements
Informal / Textual
Natural
Language
Processing
ST Formal
Incomplete
Inconsistent
Interactive
Editing
ST Formal
Complete
Consistent
Model – Model
Transformation
MOF
Formal
XMI
Analyse
Validate
Generate
Code
Generate
Documentation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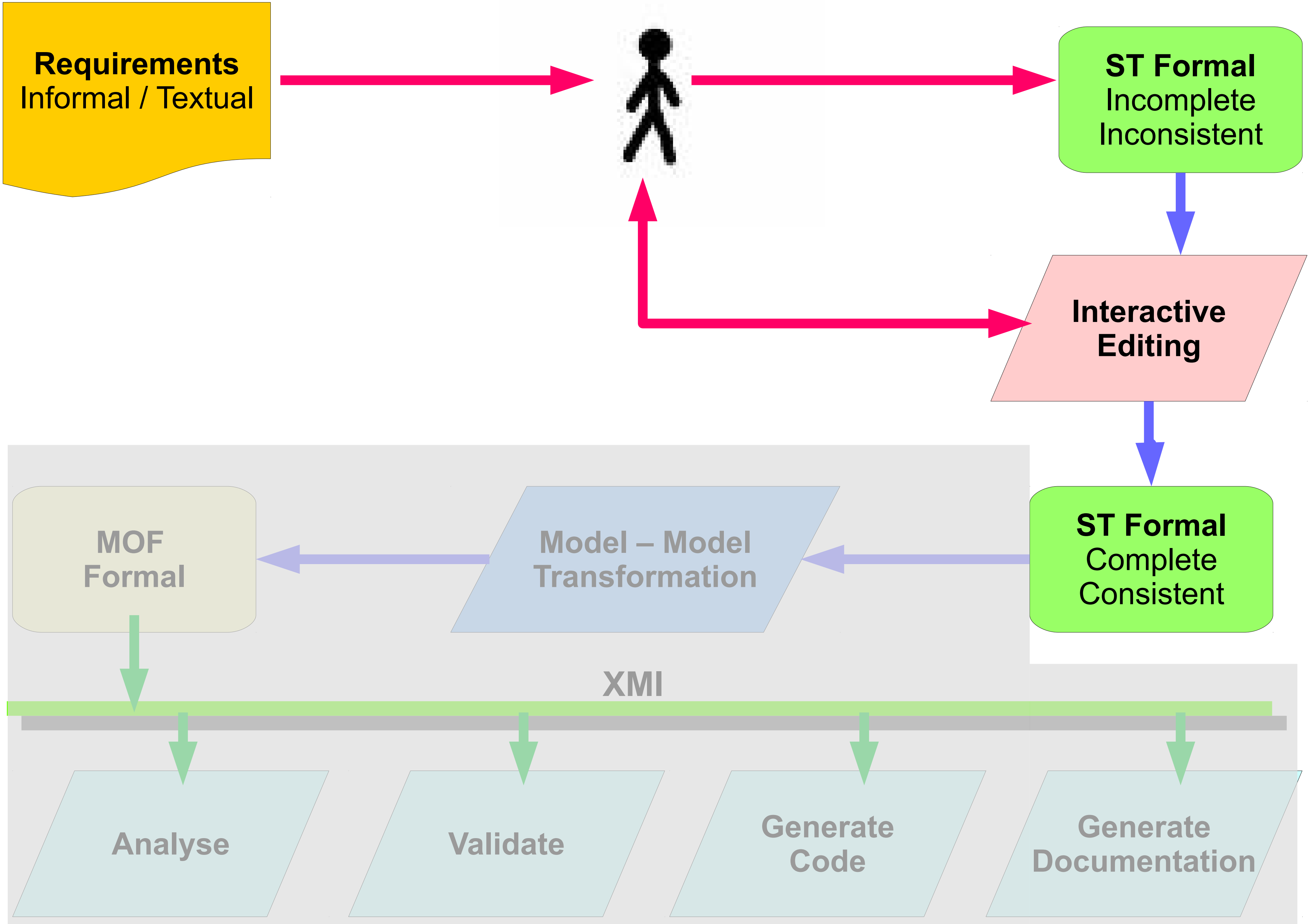

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Linguistics

(analysis of natural language)

+

Logic

(cast into a formal framework)

=

Situation Theory

Foundations of Situation Theory

- Jon Barwise – logician
- John Perry - philosopher / linguist
- Centre for the Study of Language and Information, Stanford University

- "Unified mathematical theory of meaning and information content"

Goal of Situation Theory

To identify and capture information content in natural language within some *scoped aspect of the world.*

A Sketch of Situation Theory

- "The world is viewed as a collection of objects, their properties and relations"
- Infons - $\langle\langle r, a_1, a_2, \ldots a_n; p \rangle\rangle$

  r : relation

  a_n : attributes

  p : polarity

➢ <<waitingOn, car, light ;1>>

Built-in Types

Type	Description
TIM	Temporal location
LOC	Spatial location
IND	Individual
REL	Relation
SIT	Situation
INF	Infon
TYP	Type (user introduced types)
PAR	Parameter
POL	Polarity
STYP	Situation type
ROLE	Role (of attribute in a relation)

STML - domain specific lang.

- INF(LOC, 'FirstAve')
- LOC('FirstAve')
- TYP('Road')

Relations & Roles

```
REL('waitingOn',
    ROLE('waiter', TYP('Waiter'),
    ROLE('controller',
      TYP('Controller')
    )
)
```

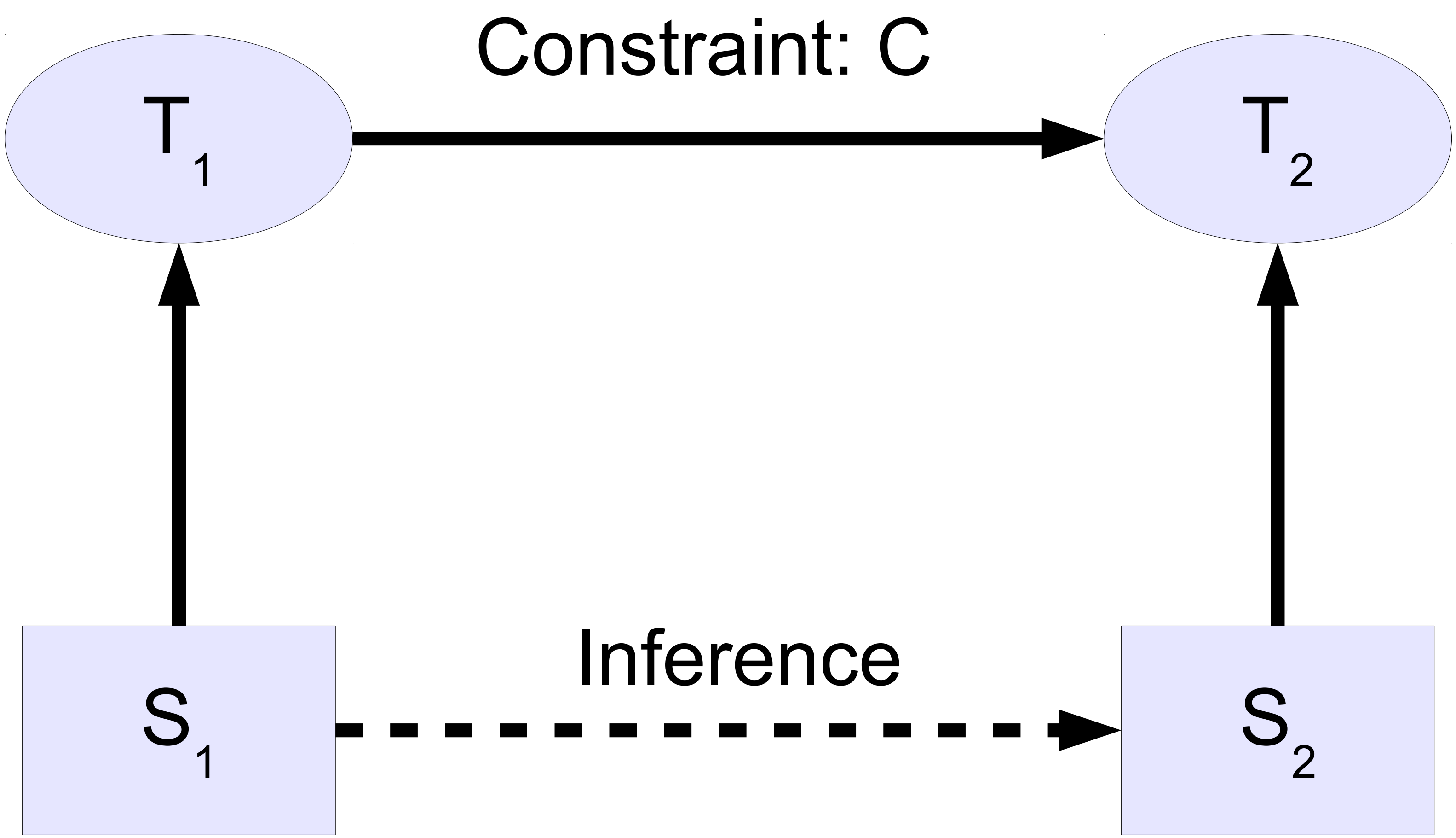
Situation

- SIT('FirstAveGreenLight',
  INF(LOC, 'FirstAve'),
  INF(On, green),
  INF(Off, amber),
  INF(Off, red)
)

Situation Type

- STYP('greenLight', PAR('Road'),
  INF(LOC, PAR.Road),
  INF(On, green),
  INF(Off, amber),
  INF(Off, red)
)

Constraints & Inference



Inference example

T_1 := STYP('greenLight', PAR('R1')

T_2 := STYP('redLight', PAR('R2')

C := CONS((R1, R2), T_1(R1), T_2(R2))

S_1 := INF('greenLight', 'FirstAve')

------>

S_2 := INF('redLight', 'ThirdSt')

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Model Based Software Engineering

- Abstraction
- Understandability
- Accuracy

Domain Specific Language

- Specify
- Analyse
- Predict
- Validate

Formalism

Everything is a Model

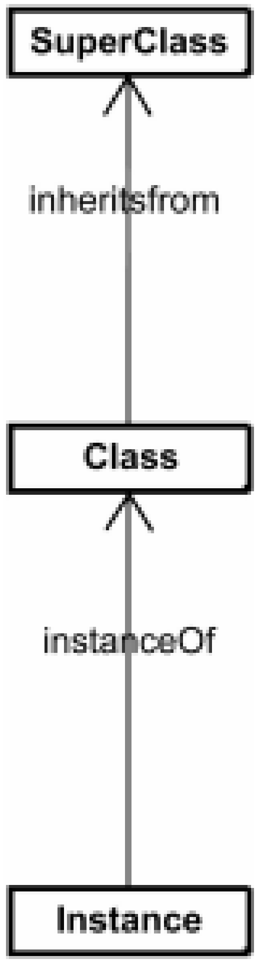


Fig. 1. Basic notions in object technology [P1]

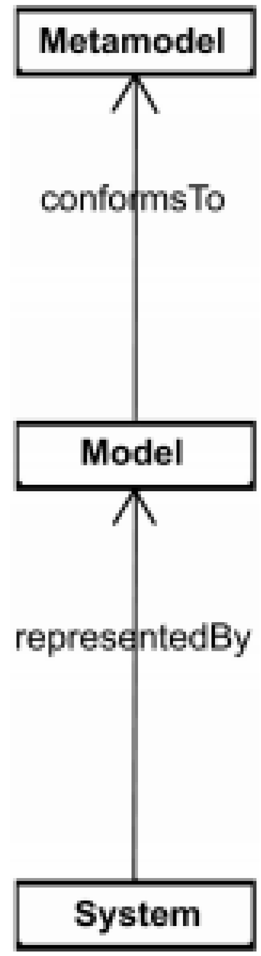


Fig. 2. Basic notions in MDE [P2]

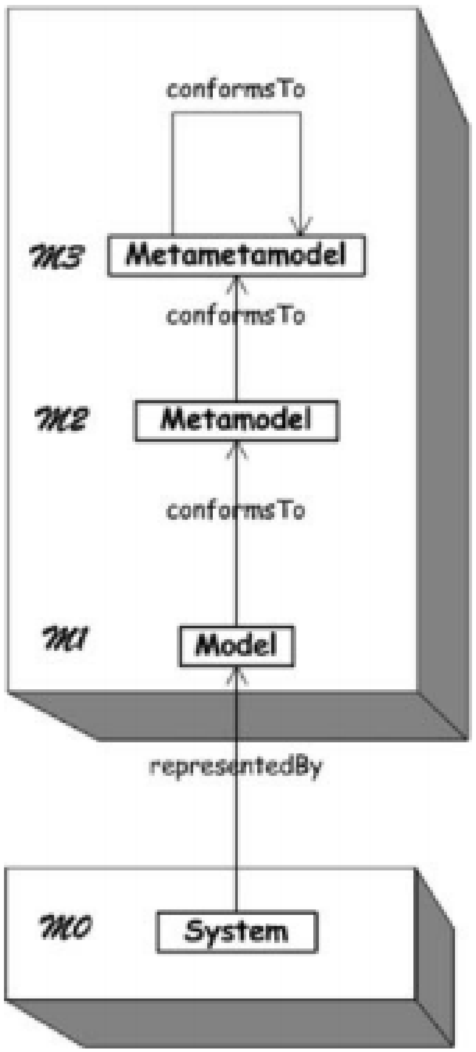
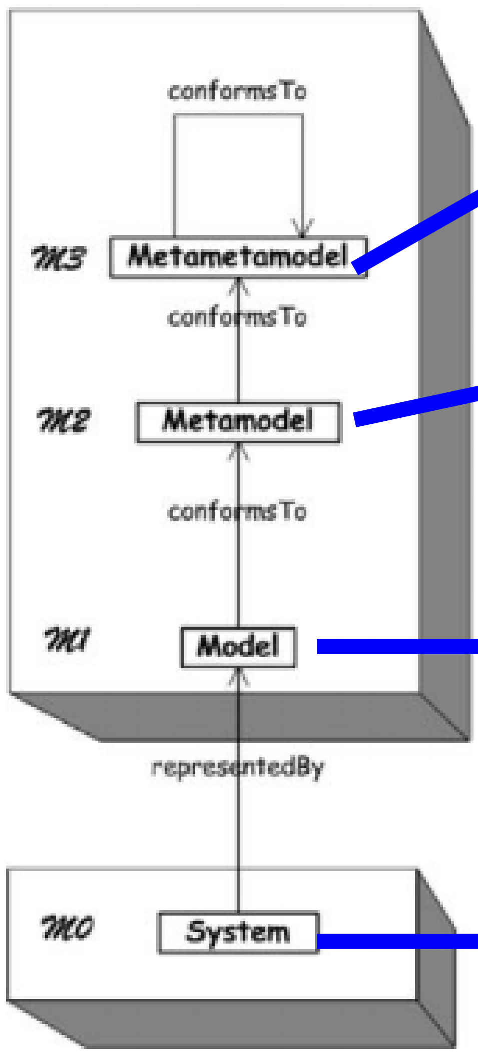


Fig. 7. The 3 + 1 MDA organisation

Source: Bézivin,J. "On the unification power of models" Software System Modeling 4(2) 171-188

Methodology



STML

STLCML

First Ave & Third St

First Ave & Third St

Meta-meta-model

Elements with which to create **Meta-models**

- Domain = meta-models
- Identify abstractions
- Define Domain Specific Language
  - Abstract syntax
  - Concrete syntaxes
  - Semantics

Meta-model

Elements with which to create **Model(s)**

- Locate domain
- Identify abstractions
- Define Domain Specific Language
  - Abstract syntax
  - Concrete syntaxes
  - Semantics

Defining Meta-model

- Types
  - define domain specific object classes
- Relations
  - define relationships between object classes
- Situation types & constraints
  - define semantics

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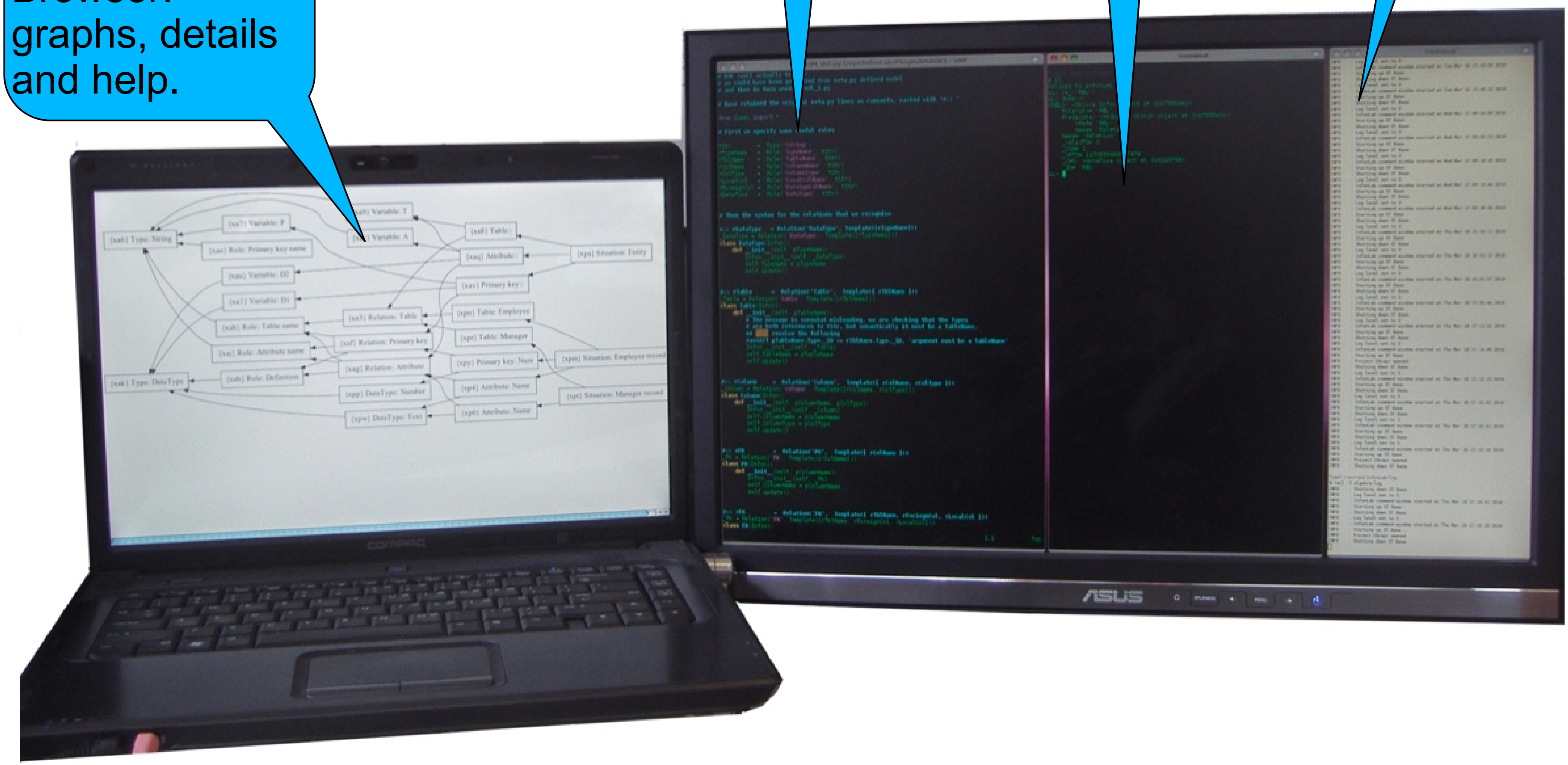
InfonLab

Workspace & editor

Interactive commands

History & log

Browser: graphs, details and help.



Empirical Assessment

- Informal text to infons transformation
  - possible to perform manually
- Situation theory
  - used to define meta-model (DSML)
- Model (in DSML) mapped to infons

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Conclusion

- Situation theory found to be capable of
  - defining meta-models
  - representing models
  - defining some domain semantics
- Situation theory = linguistics + logic
  fit for analysis & modeling tasks
- Natural language processing and situation semantics analysis front-end essential

Conclusion ...

- Tooling needs many improvements
  - InfonLab needs improved error handling
  - InfonLab GUI needs more work

- With above improvements could attempt more complex examples

- Need to export (XMI) to existing tooling for artifact generation, etc.

Thank you !

Questions

&

Discussion