Model Driven Engineering

Myths, reality and potential

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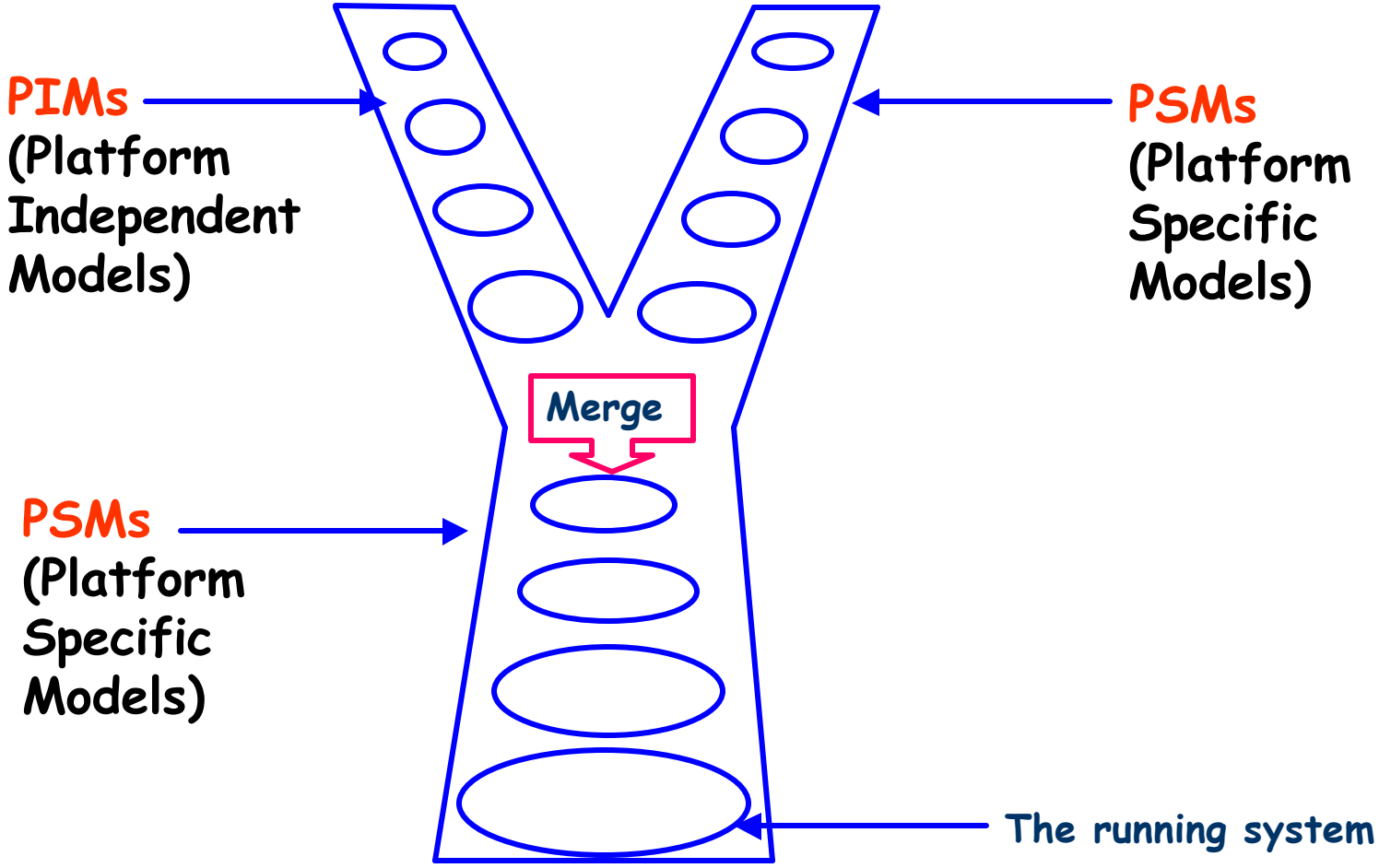
with slides and ideas from Jean Bezivin, Jean-Marie Favre

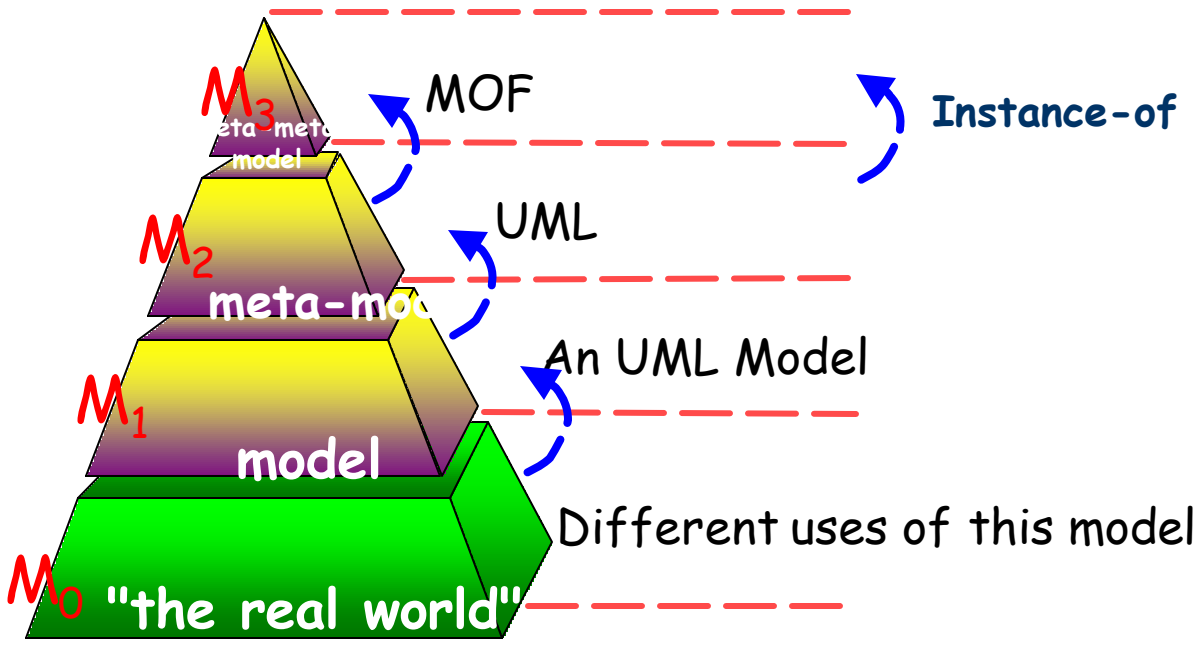
The OMG initiative in November 2000

- The concerns
  - No unique technology.
    Platform are and will remain heterogeneous.
  - Too much Complexity.
    Specialist shortage.
  - Technologies are evolving too fast.
    Application are obsolete to fast, porting is too expensive.
  - ….. (nothing new)
- THE solution : MDA (Model Driven Architecture)
  - Separate
    - The business part (PIM : Platform Independent Model)
      Stable, does not need computer specialist …
    - Implementation on a platform (PSM Platform Specific Model)
  - Transform automatically a PIM into a PSM ….

Myth 1 :The Y cycle



Myth 2 : A unique 3 levels architecture

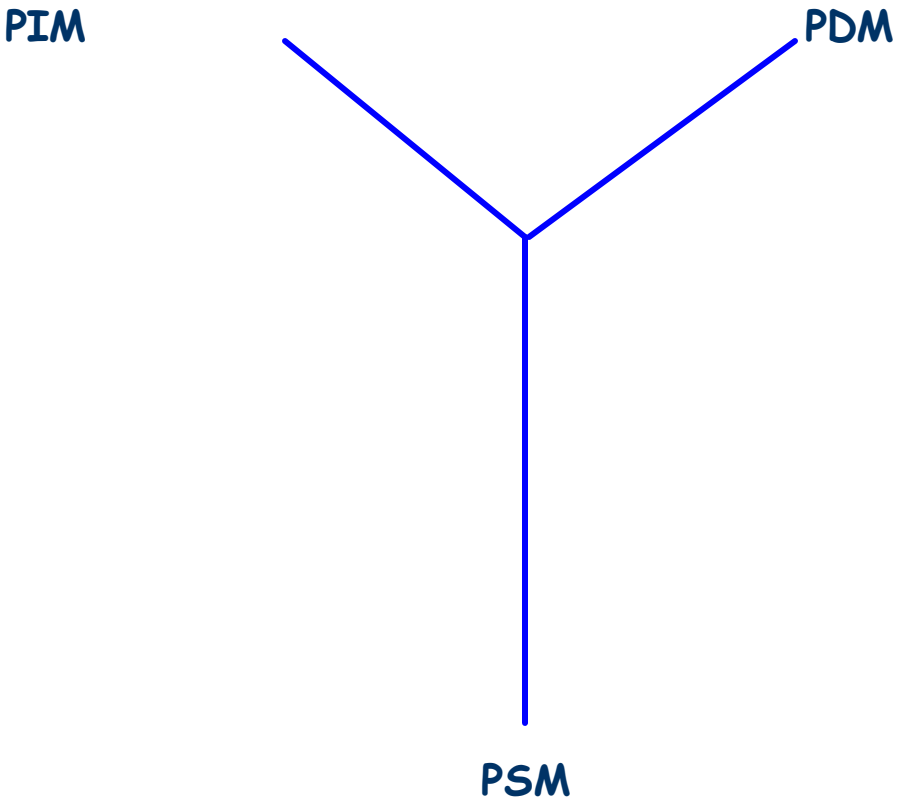


A few characteristics of models

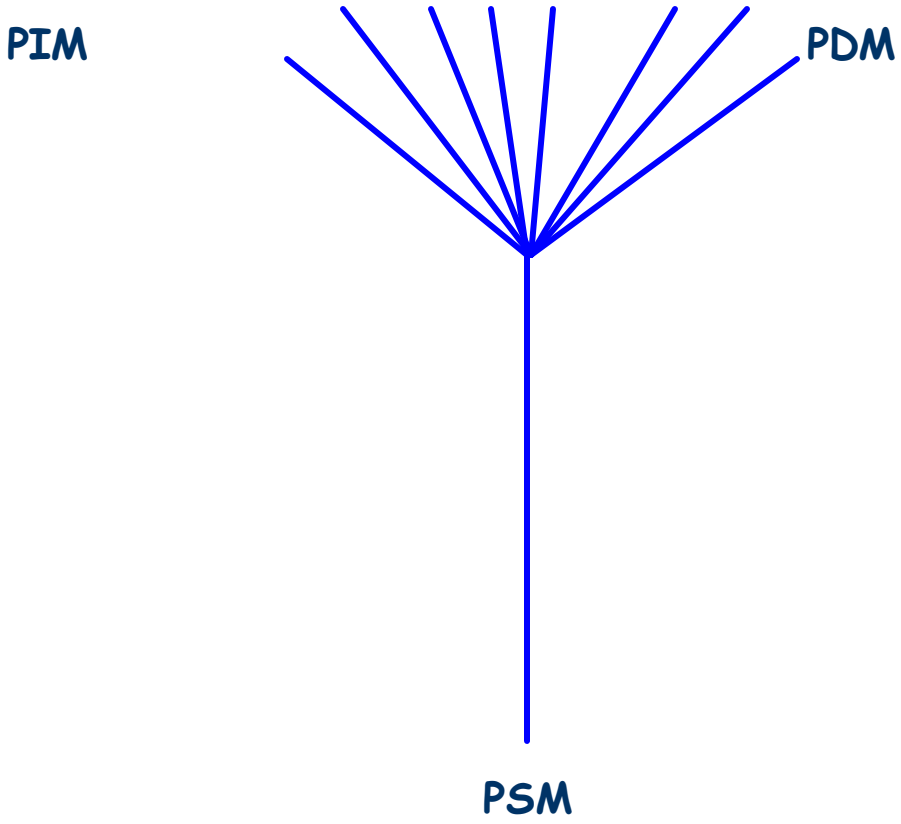
- A model is an abstraction of a system
  - Built with an intention in mind
  - Can answer questions on the system.
  - Is a set of facts on the system.

- A model represents an aspect of a system
- Each system admit an infinite number of aspects
- A complex system can only be described by a large number of models
- The characteristics of the aspect captured in a model must be clearly defined by a metamodel

The Y revisited

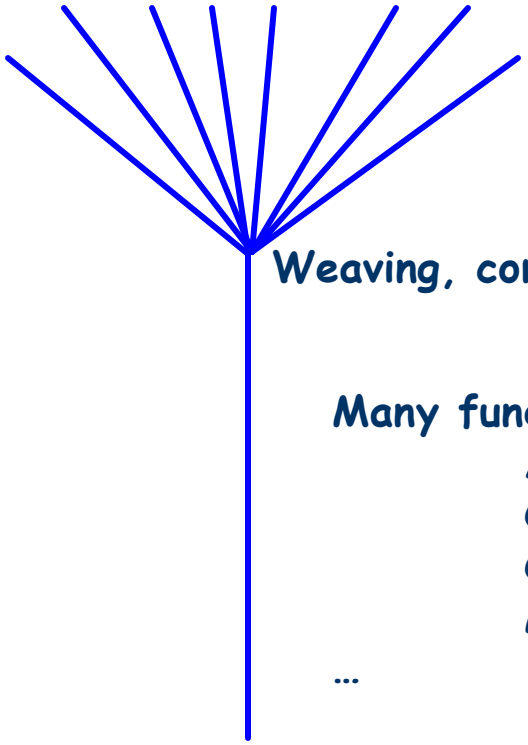


Many aspects (Business and platform)



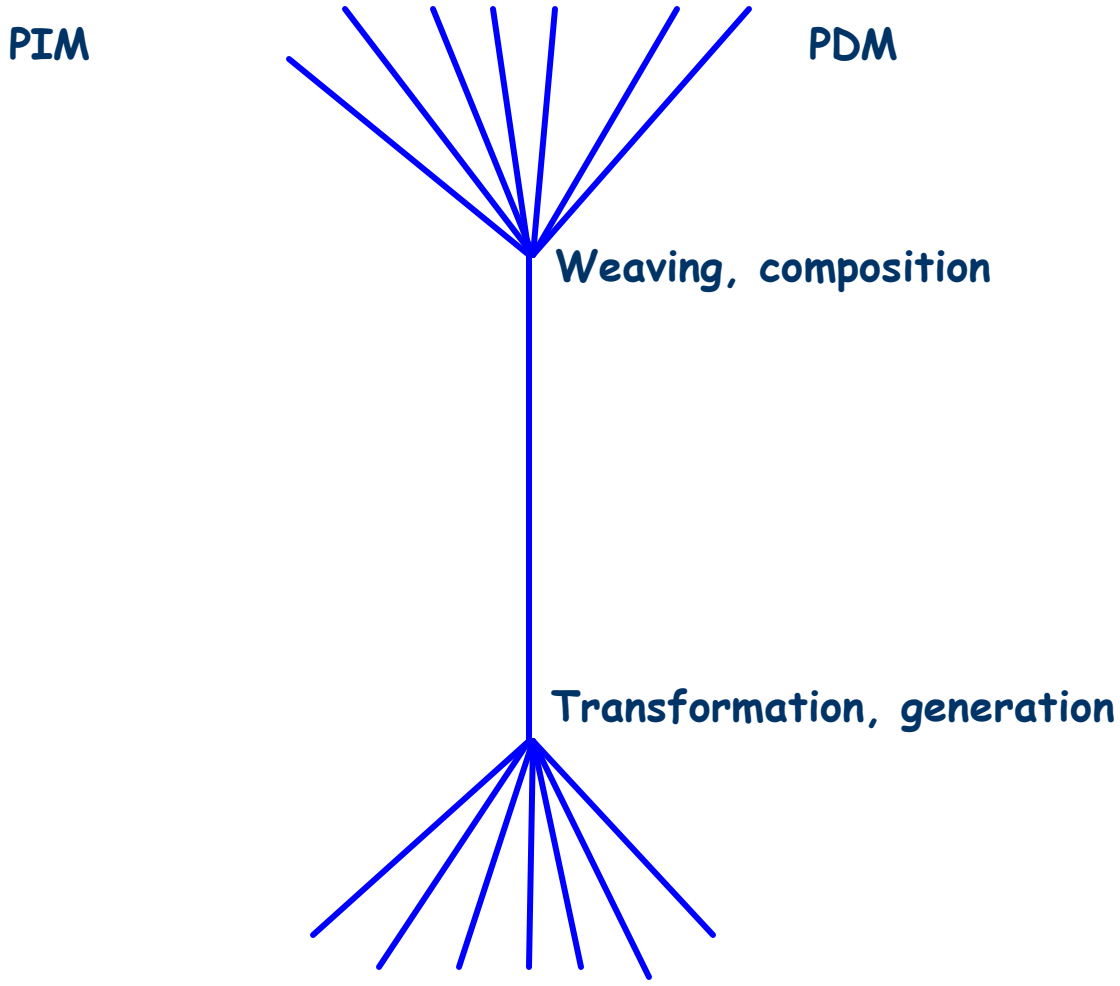
Many aspects. Aspect Oriented Modeling v.s. AOP

Separation of concerns => composition of concerns



Composition, weaving and correspondances are key issues

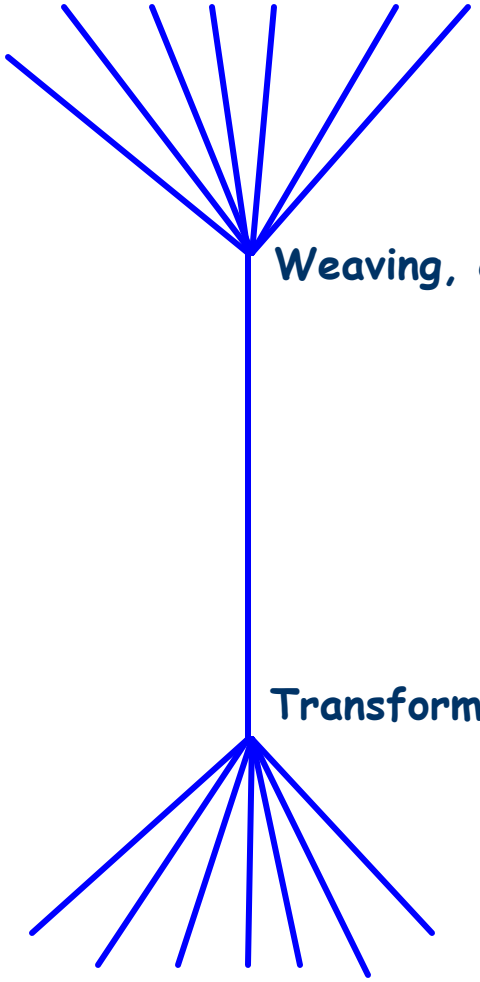
Transformations



Transformations

PIM

PDM



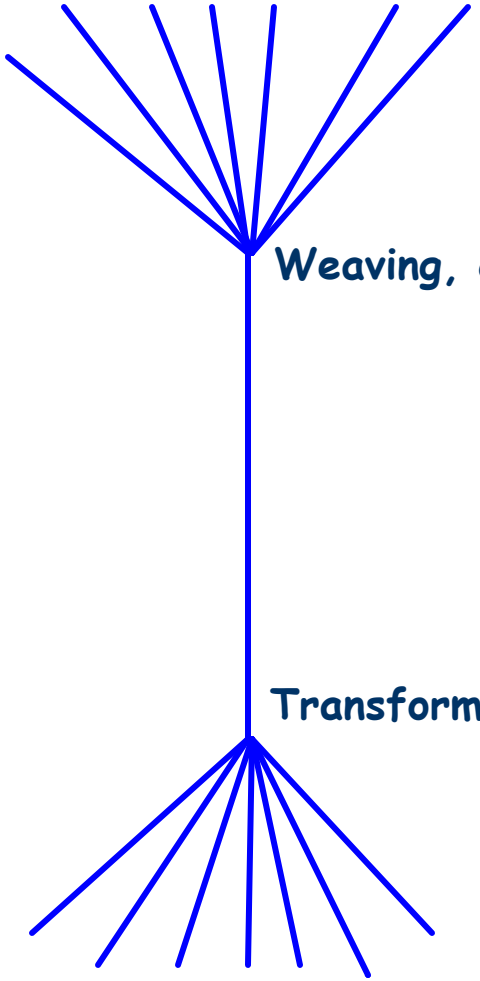
Weaving, composition

Composition complexity may become a major issue

An intrinsic part of the application

Transformation, generation

Transformations

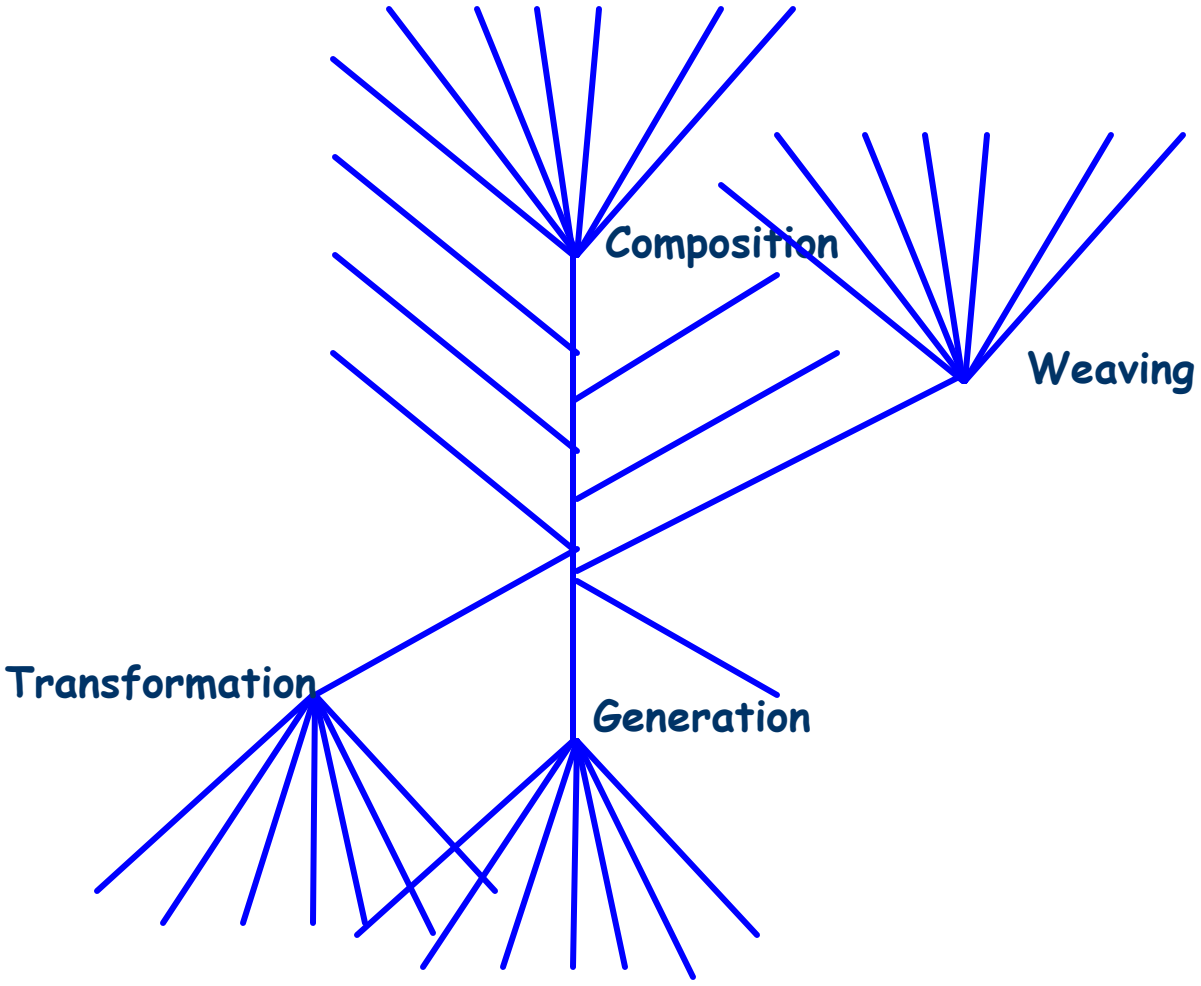


Composition complexity may become a major issue

An intrinsic part of the application

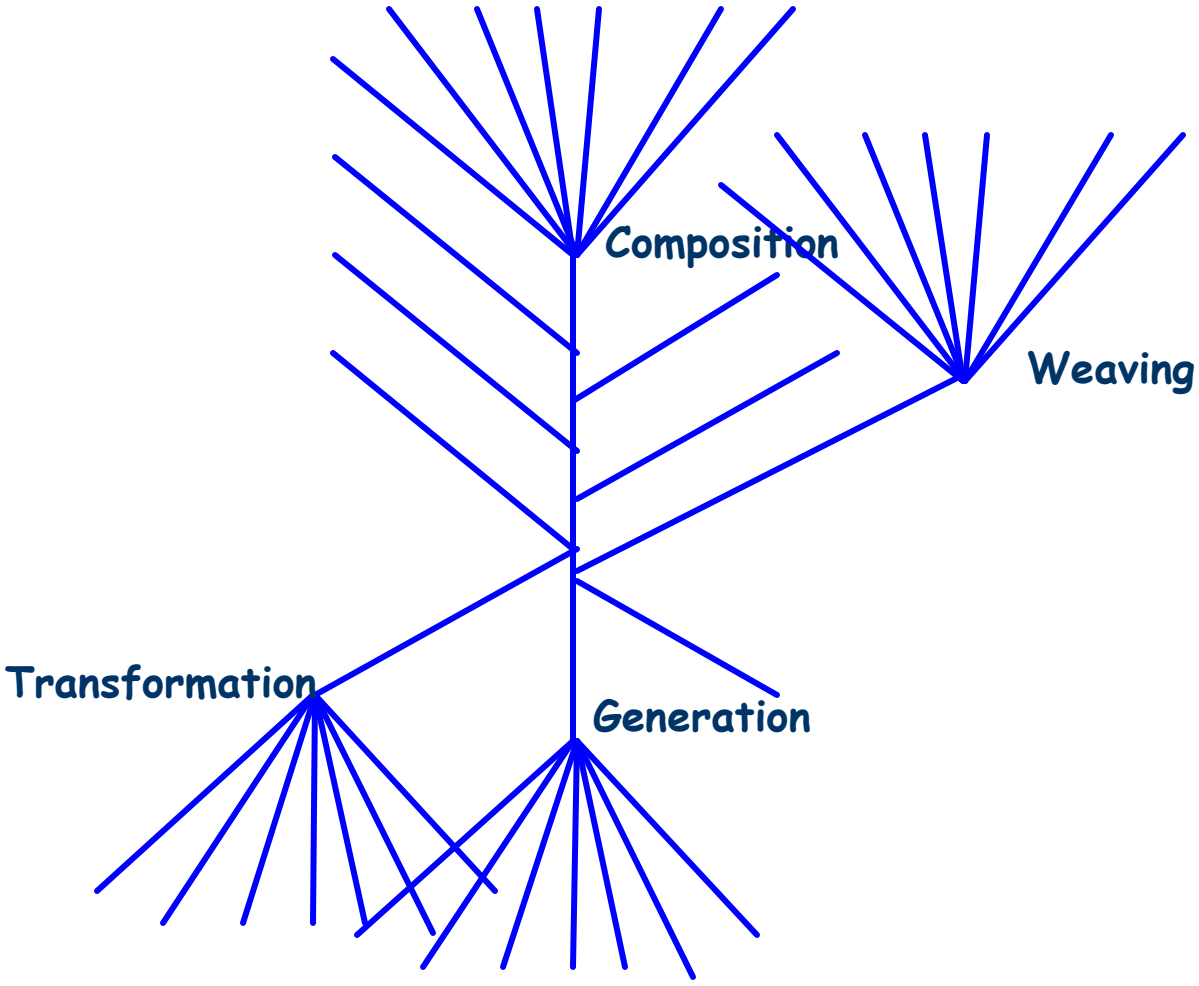
MDE : Is based on model tranformation, generation
Generative programming, DSL …

Architecture and methodology

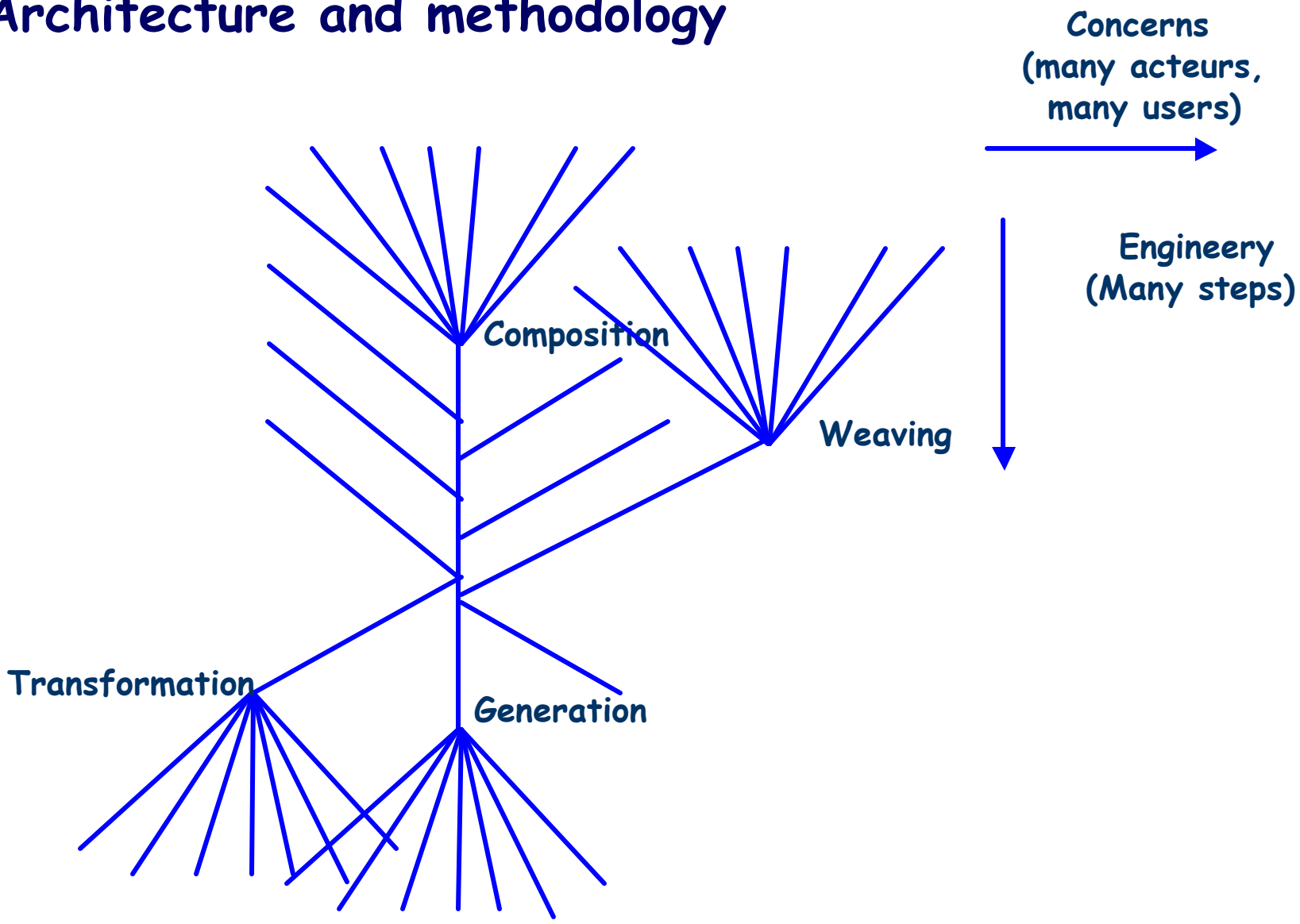


Architecture and methodology

Concerns
(many acteurs,
many users)



Architecture and methodology



Architecture and methodology

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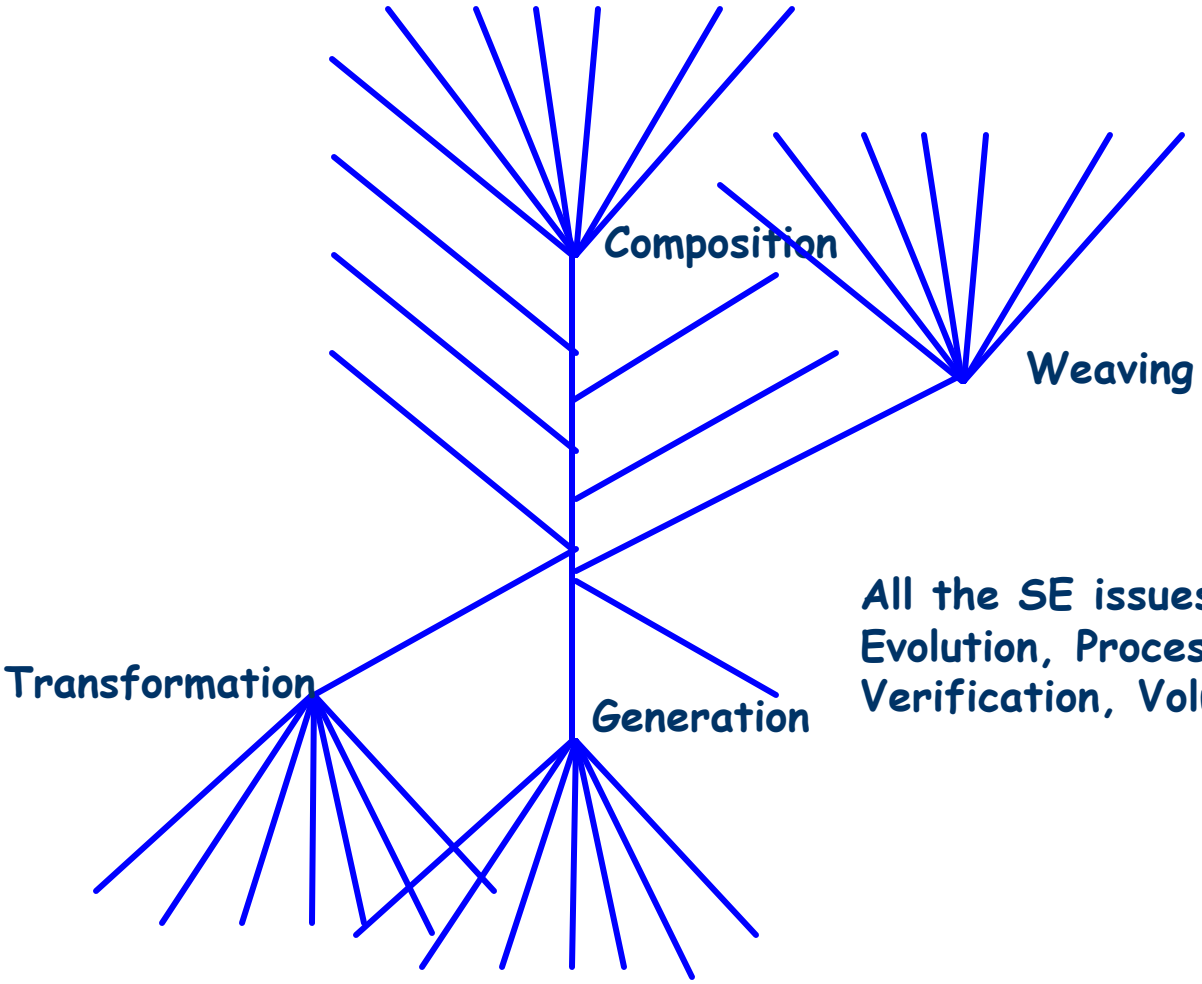
Engineery
(Many steps)



All the SE issues are found again:
Evolution, Process, Versioning, Validation, Verification, Volume, Complexity, etc.

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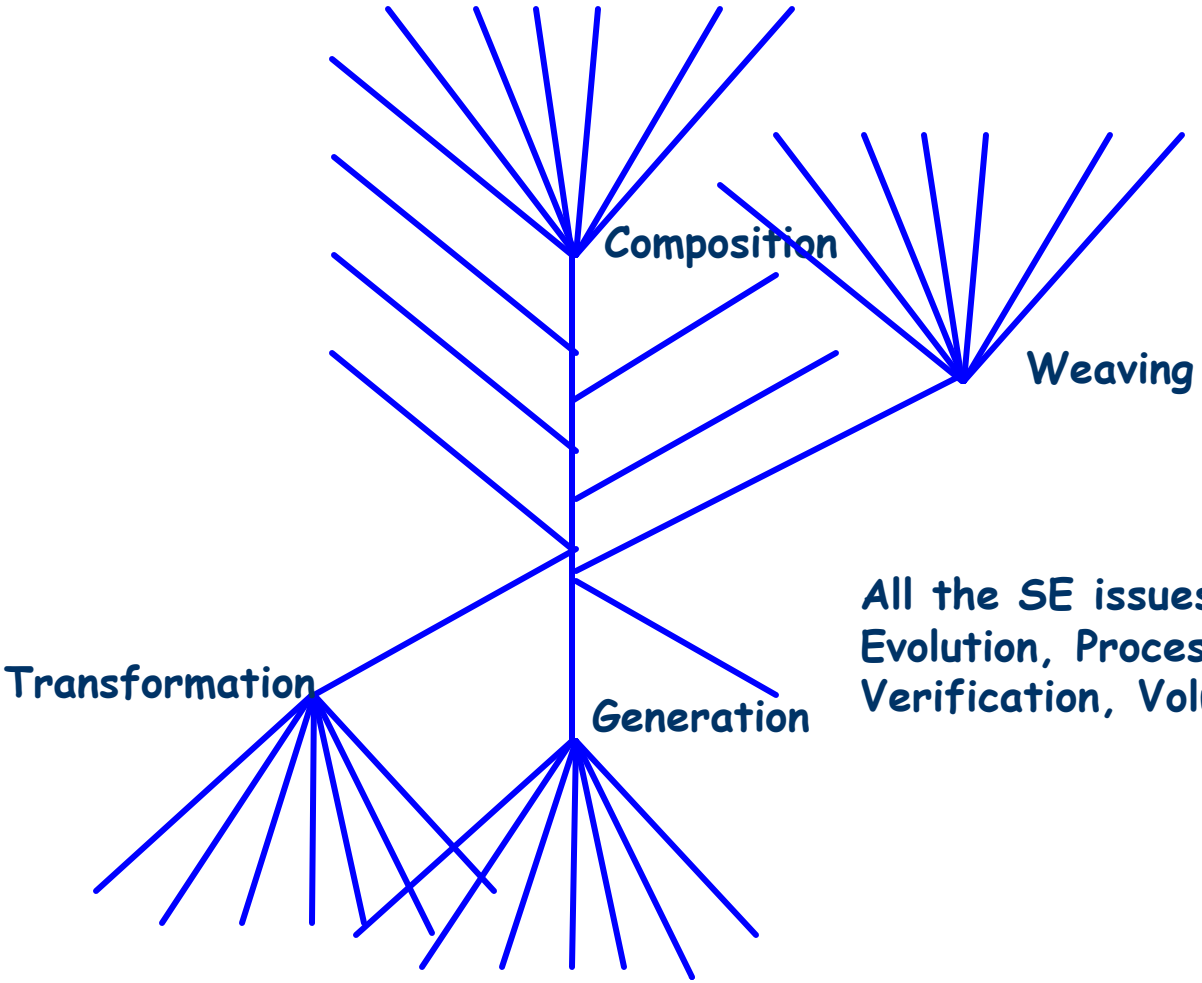
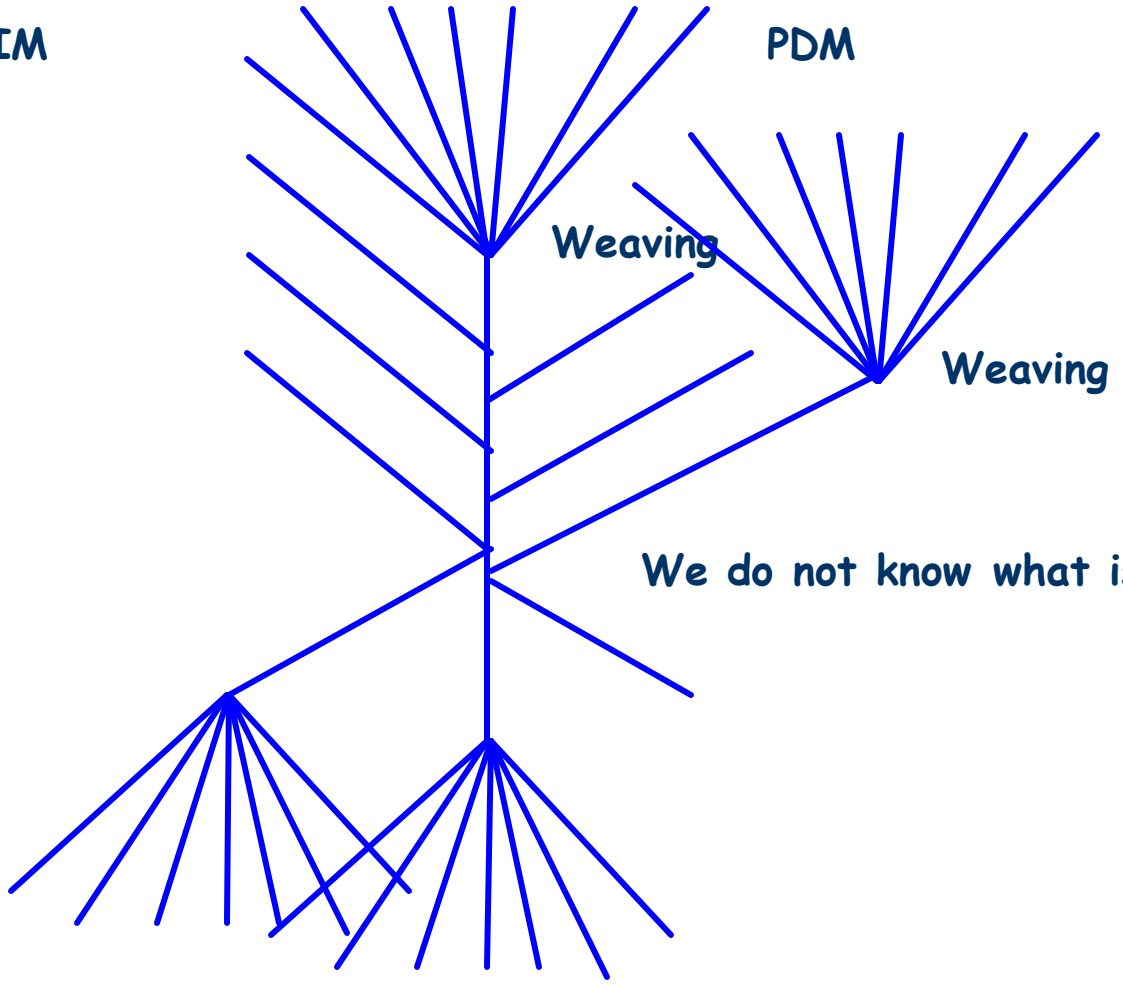


All the SE issues are found again:
Evolution, Process, Versioning, Validation,
Verification, Volume, Complexity, etc.

MDE : New methods, new tools and new platforms are required

Model Transformation, composition, correspondence. Model Engineerie. MDSE



We do not know what is a platform ….

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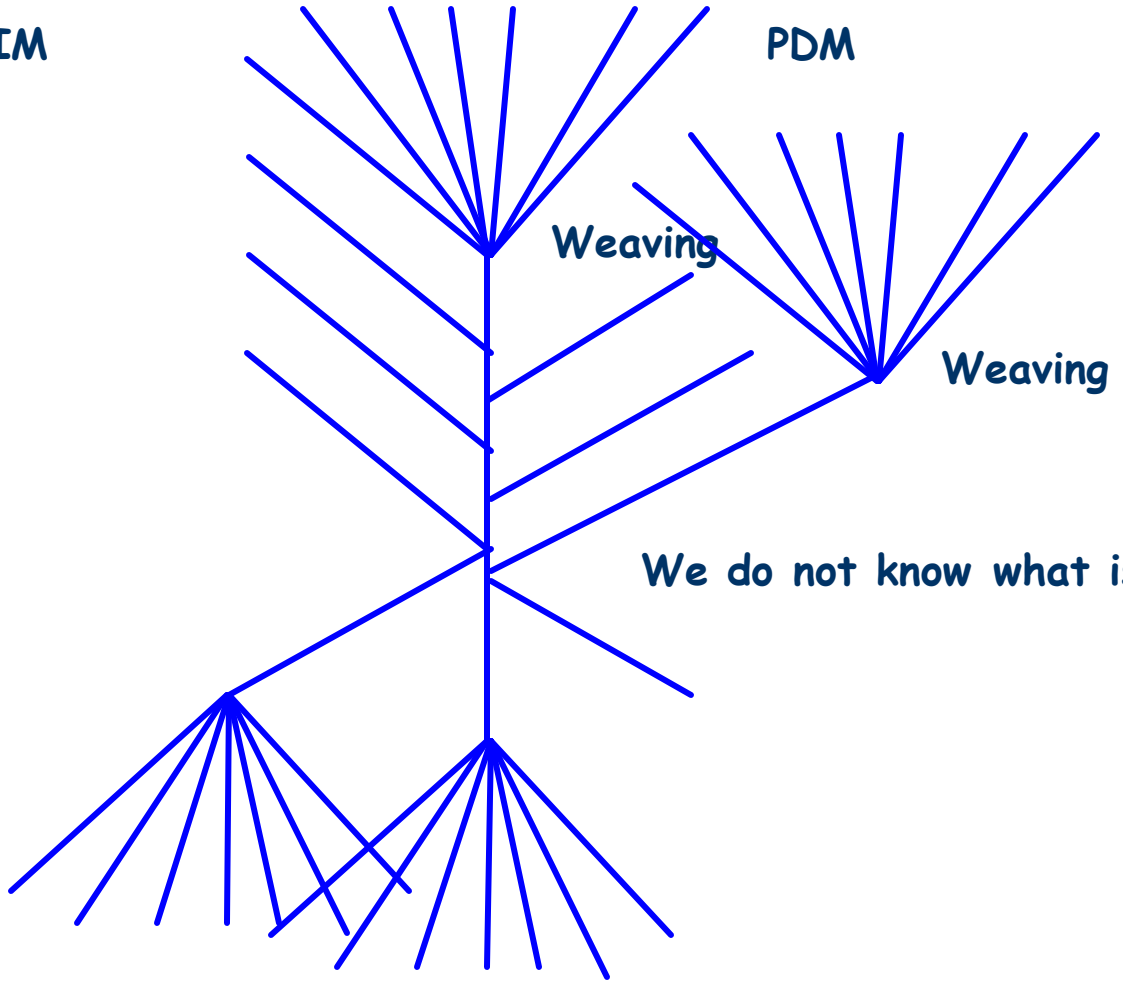
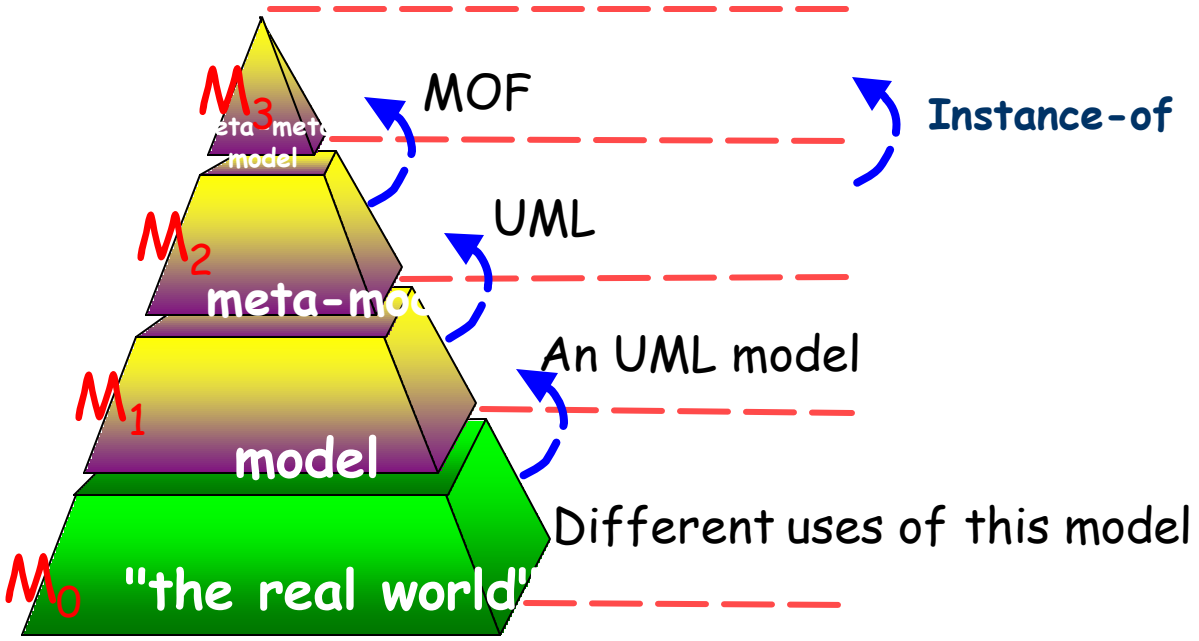


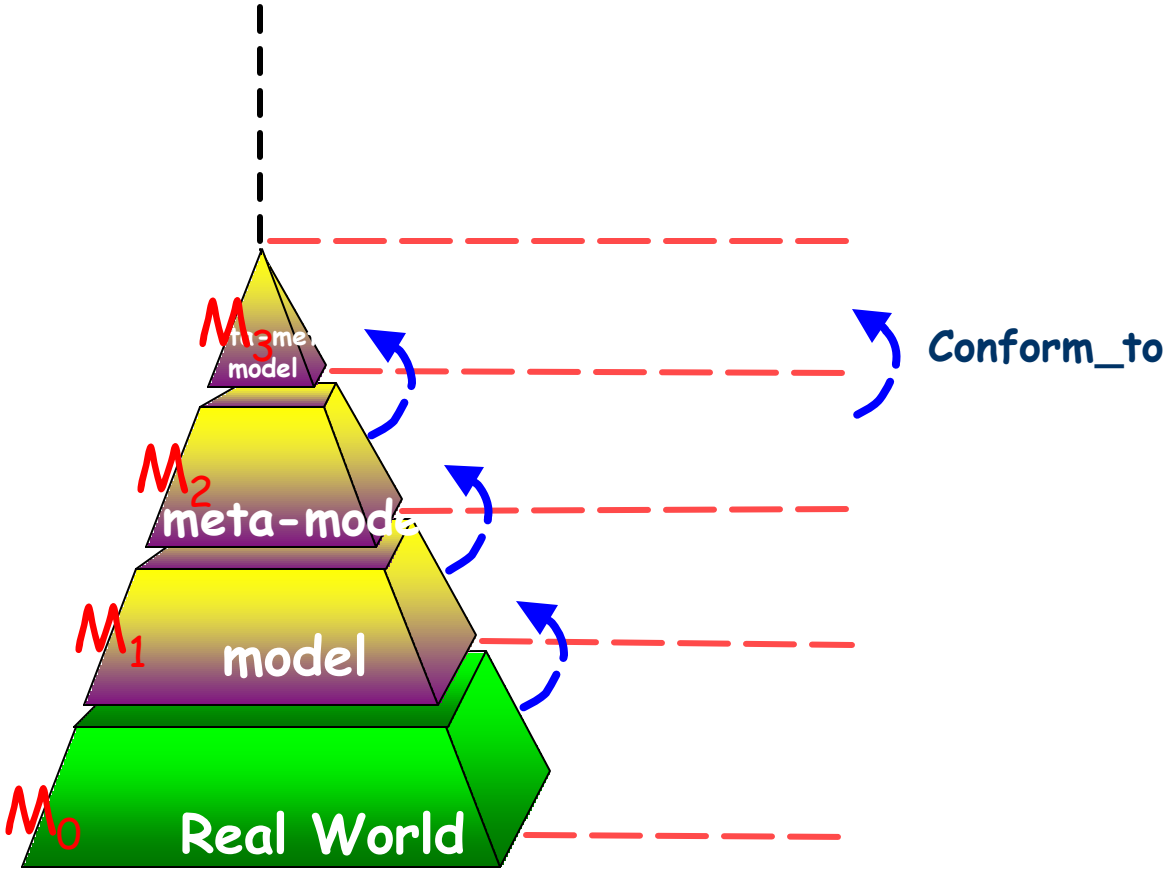
We do not know what is a platform ….

Exit : Y, PIM and PSM

The architecture revisited



The current vision : The fundamental relationships



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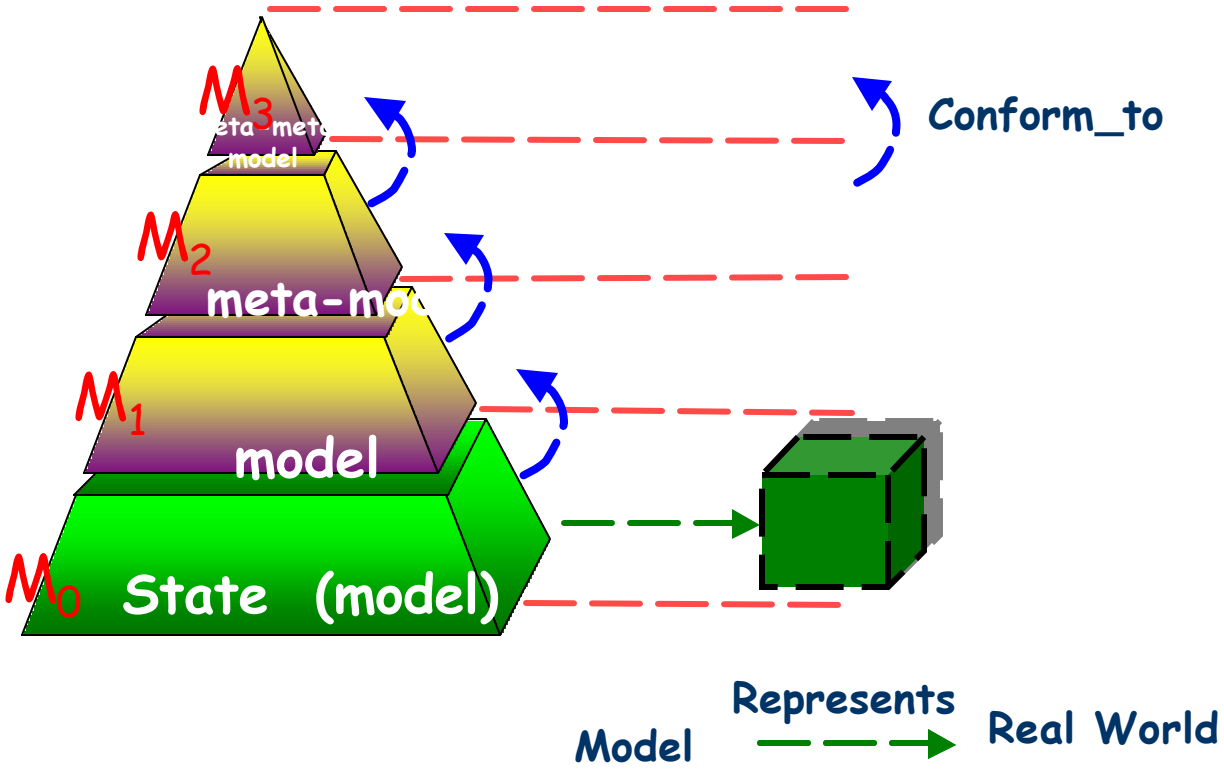

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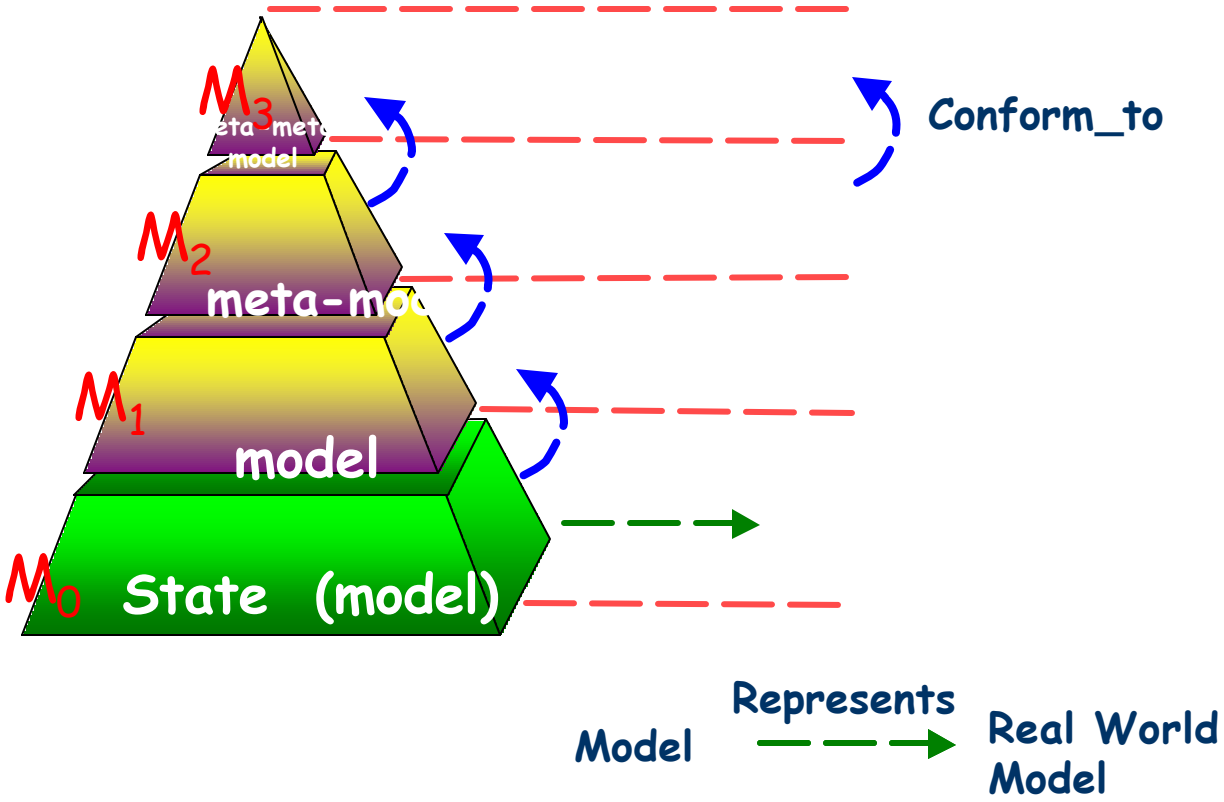

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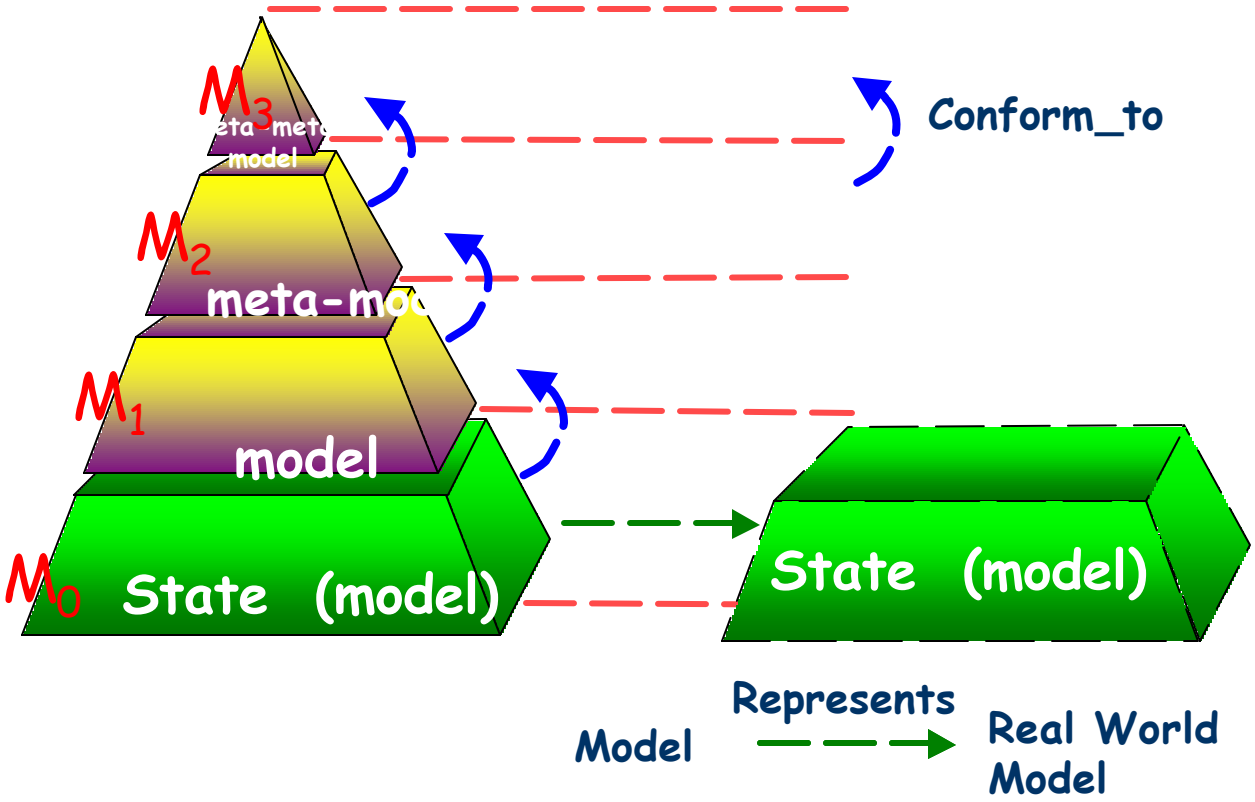

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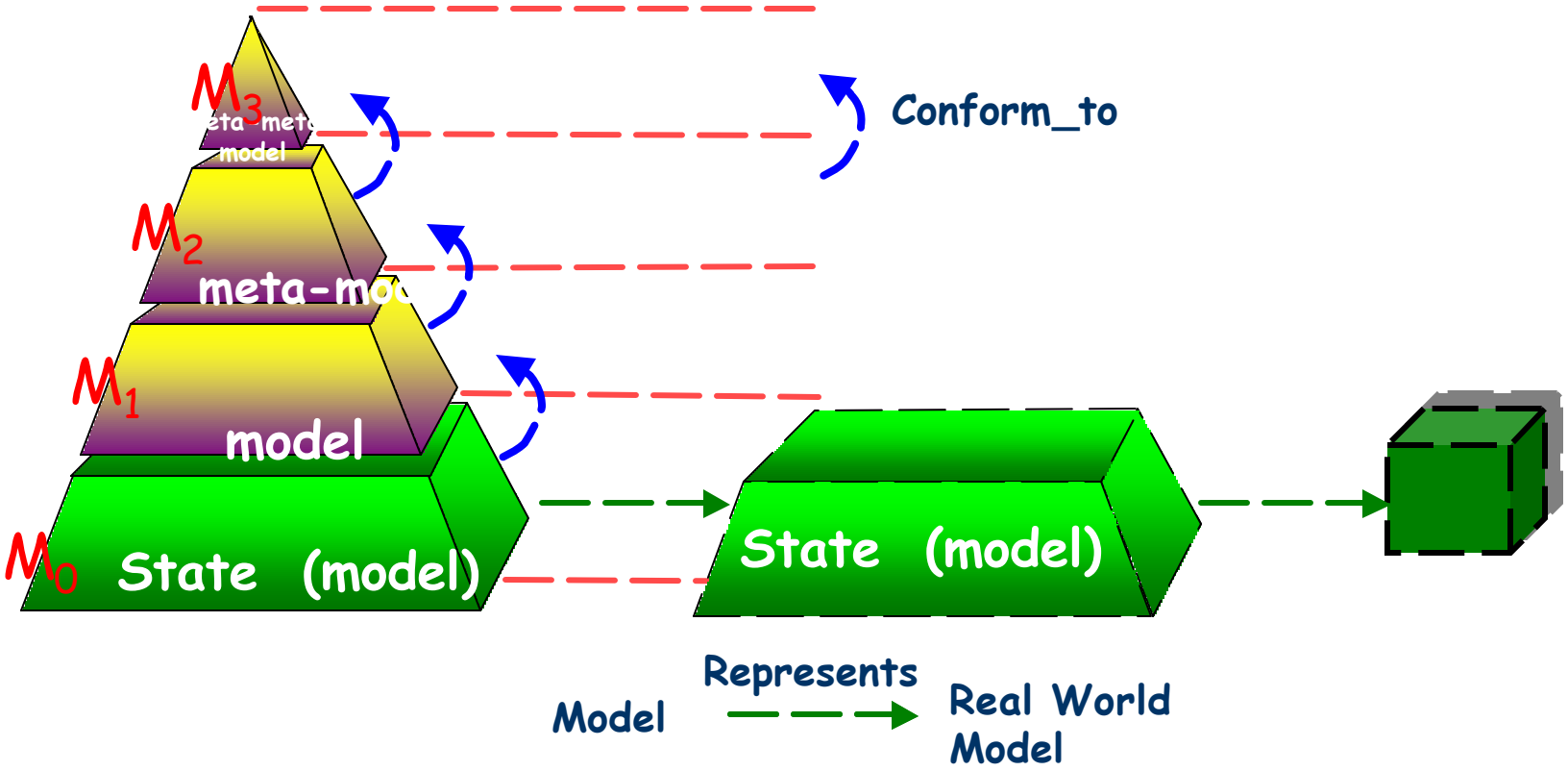

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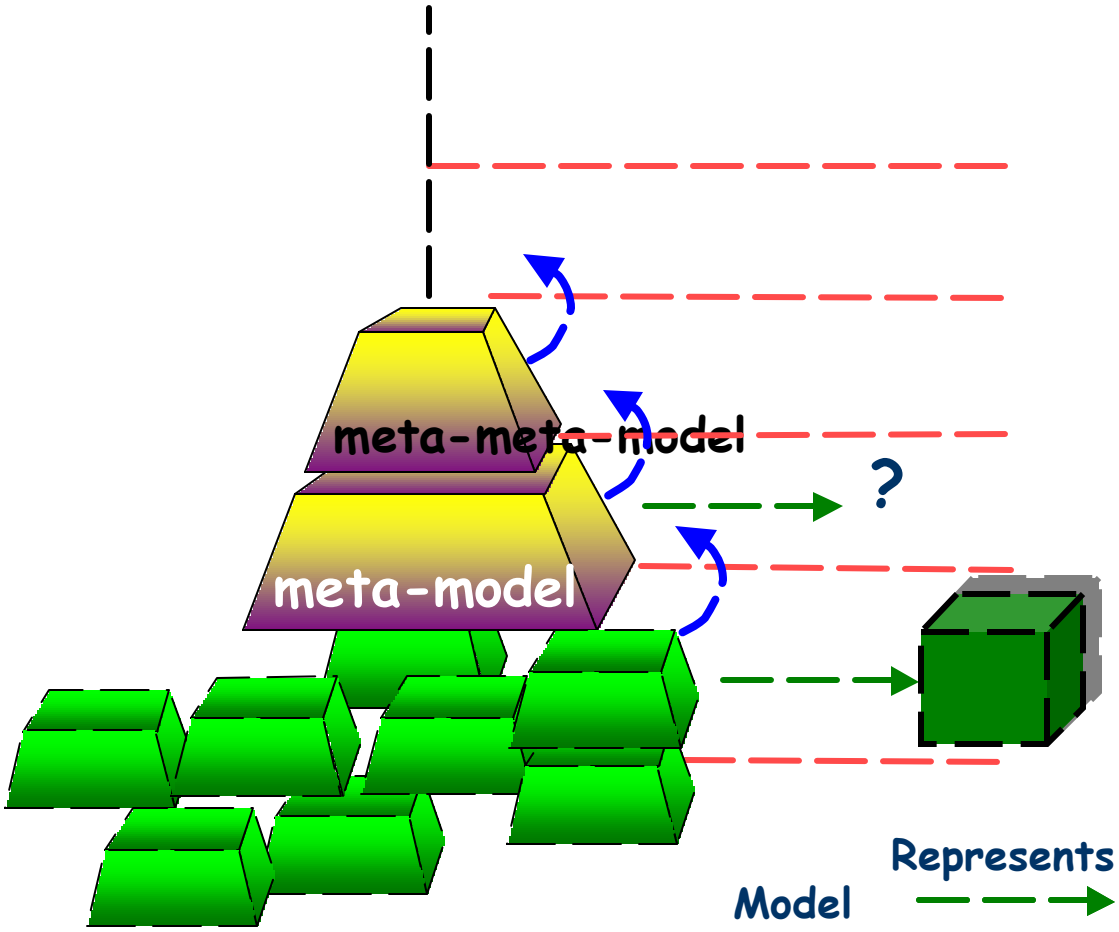
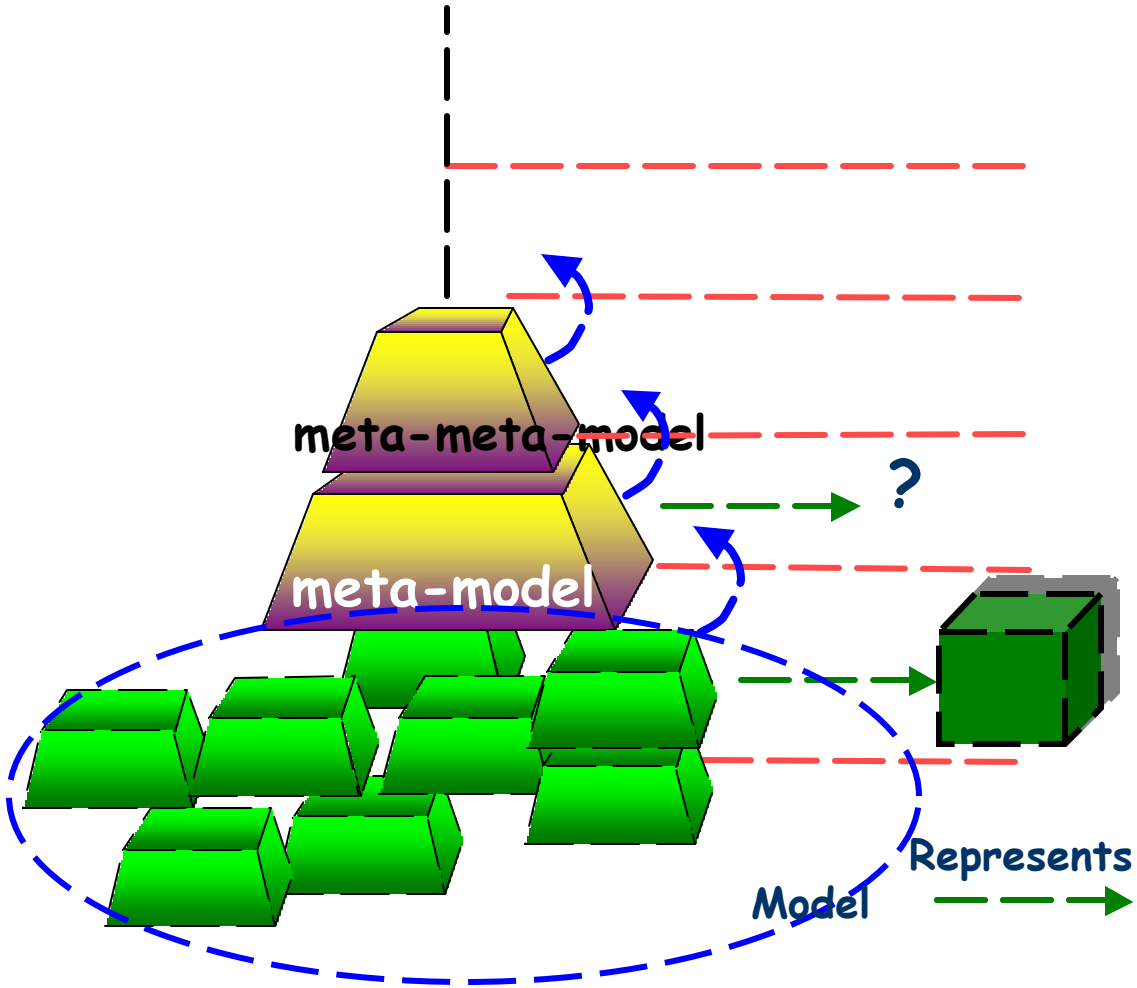


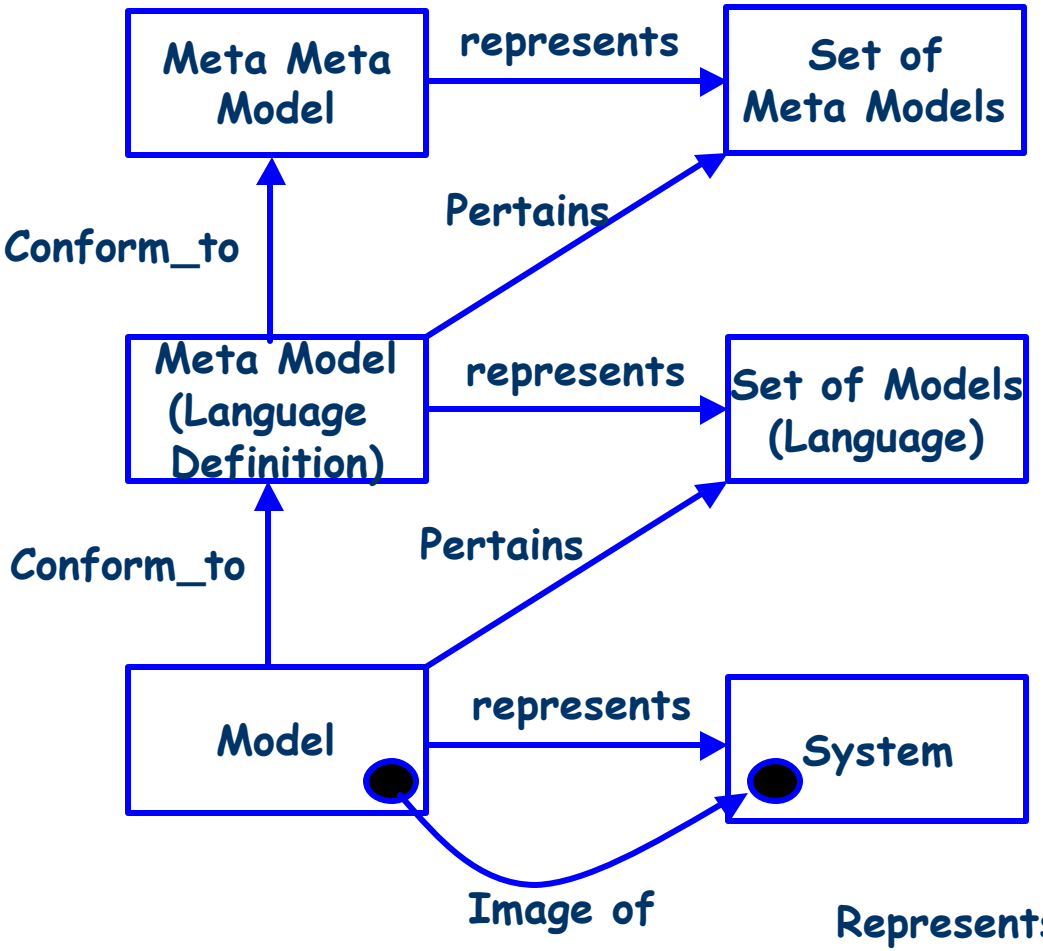
Model — Represents → Real World Model

Model — Conform_to → Meta Model

The current vision : The fundamental relationships



Fundamental relationships

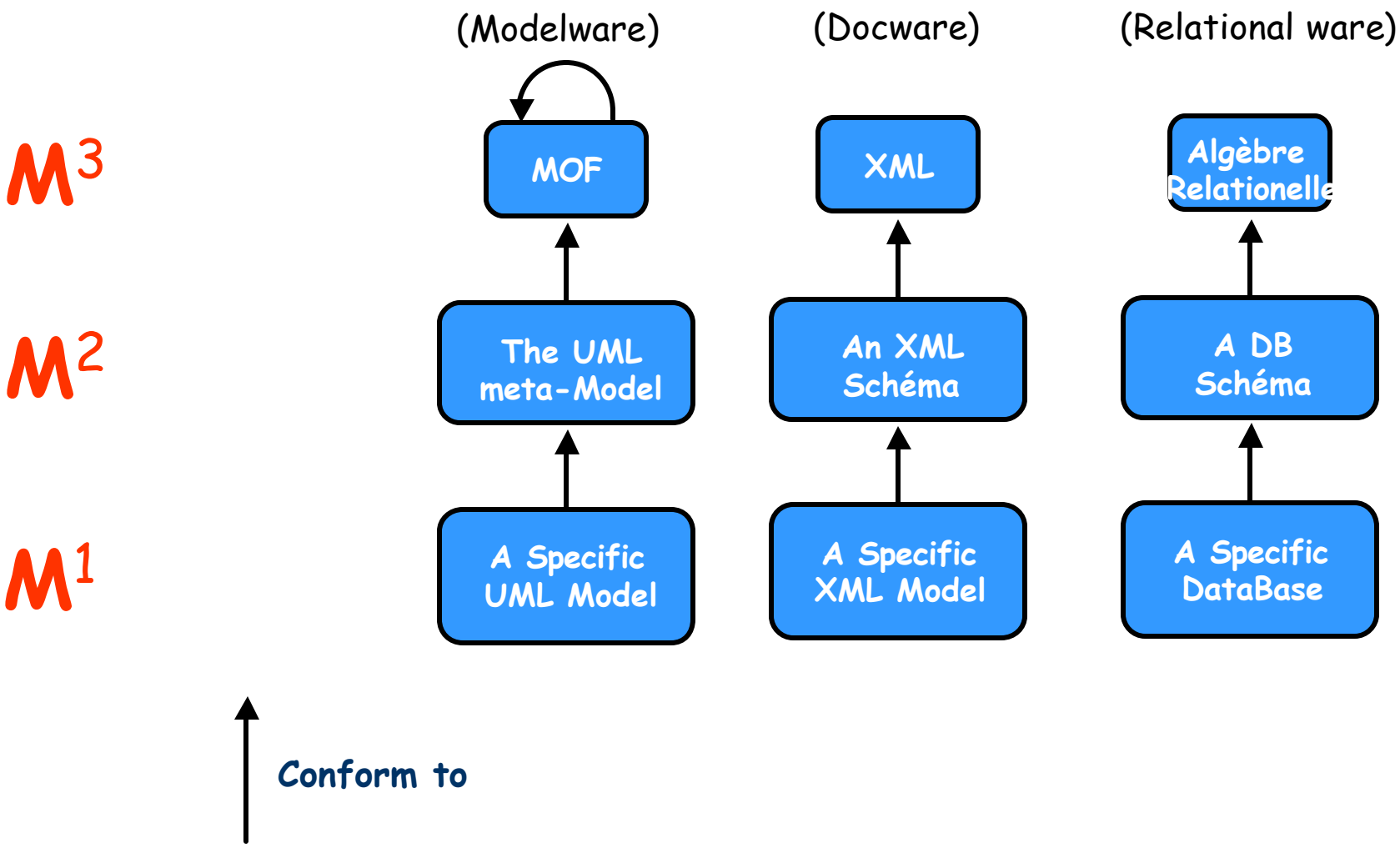


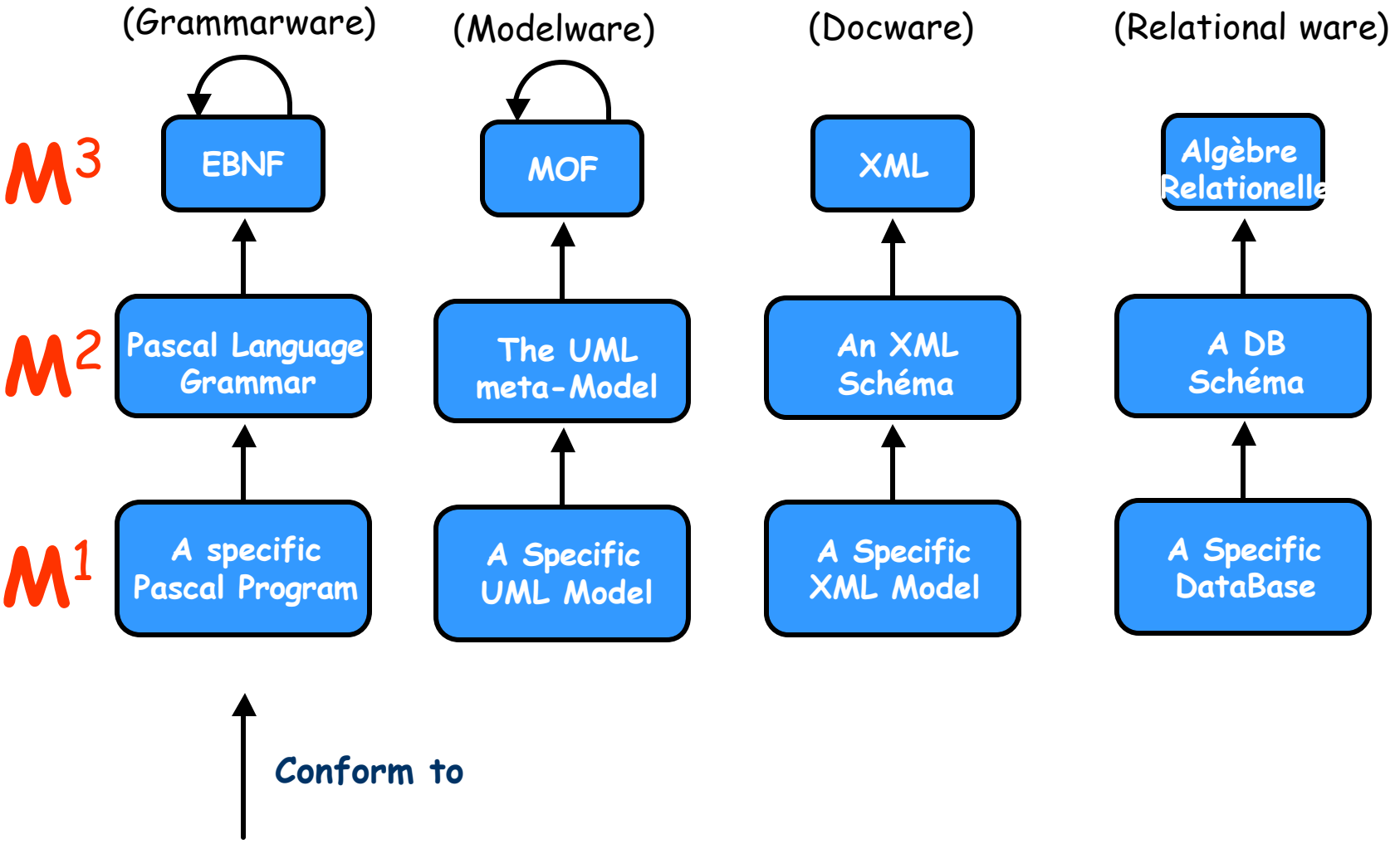
We can learn a lot from :
- Programming languages,
- Formal methods,
- Ontologies,
- Generative Programming,
- Domain Specific Languages,
- Validation techniques,
- Etc ….

Represents == describe or specify
Image_of == Interpretation.

Conformity

- A meta model is the model of a set of models.
  - A meta model is a Language Specification.
    - A meta model is a DSL (Domain Specific Language) and vice versa.
    - UML, SPEM, QVT, etc. are DSLs
  - Specification en term of classes (Modelware)
    - An instance is conform to its class (conformity = instance_of)
  - Specification in term of a classification (Ontologies)
    - An element pertains to its ontological class (conformity = fits the definition)
  - Specification in term of a grammar (GrammarWare)…
    - A program is conform if it exists a sequence of derivation, …
- A meta model is NOT a model of a model
  - But a model if the set of valid models.


(Modelware)
(Docware)
(Relational ware)
M3
M2
M1
MOF
XML
Algèbre Relationelle
The UML meta-Model
An XML Schéma
A DB Schéma
A Specific UML Model
A Specific XML Model
A Specific DataBase
Conform to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M3
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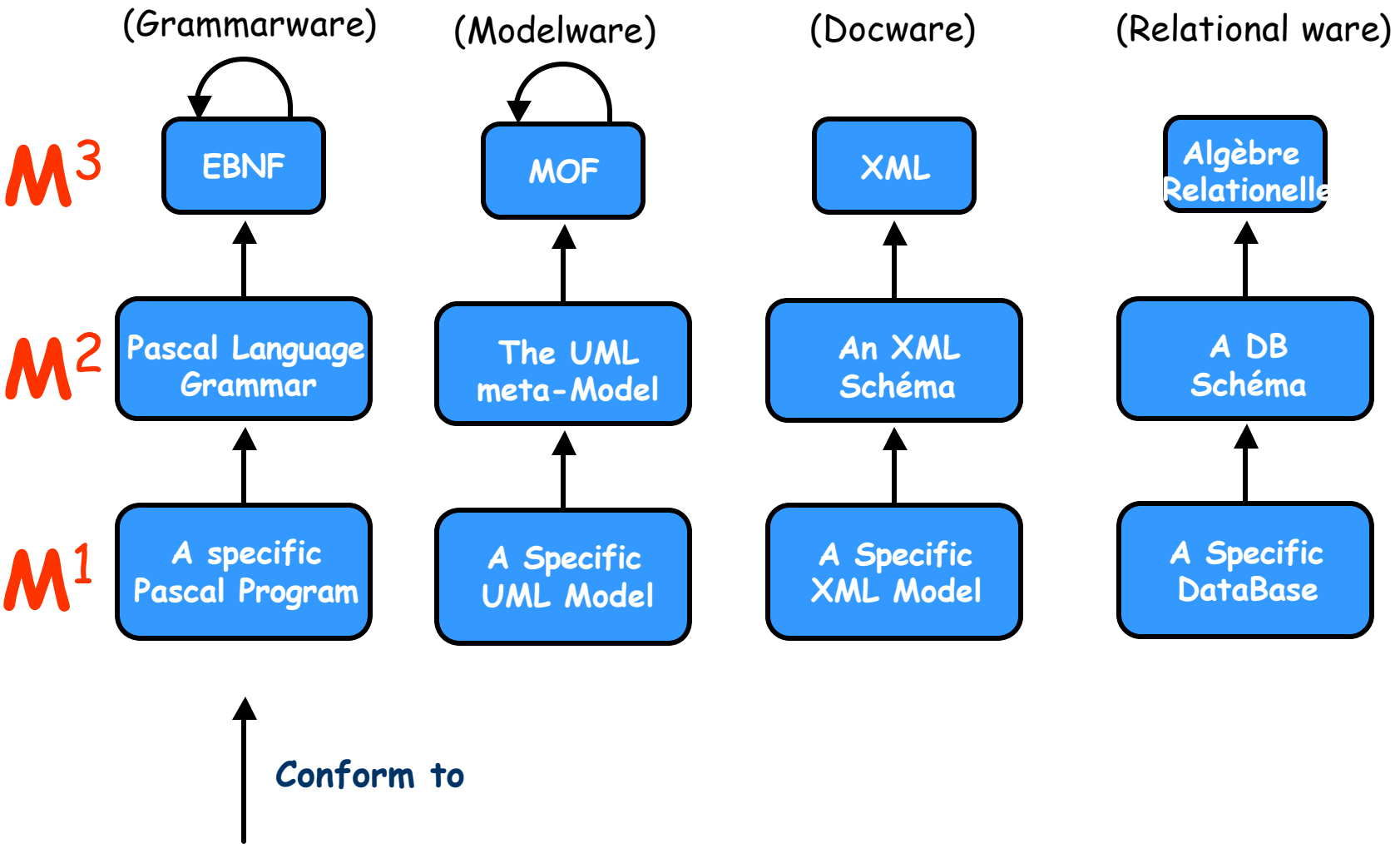
Pascal Language Grammar
The UML meta-Model
An XML Schéma
A DB Schéma
A specific Pascal Program
A Specific UML Model
A Specific XML Model
A Specific DataBase
Conform to

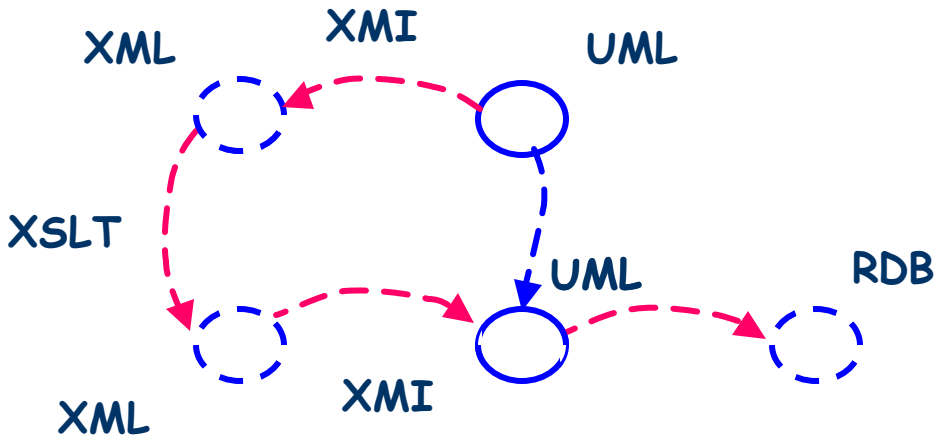
A recurrent pattern : The technological domains



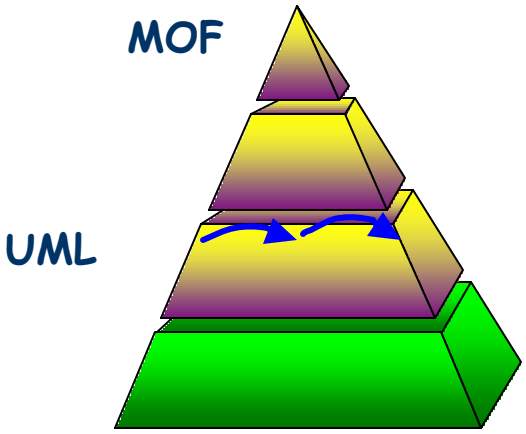
- There exist many technological domains :
  - XML, Grammarware, Ontologies, Data Bases …
  - A technological domain is defined by a family of MM models.
    - MOF, EMF, …
    - Relational algebras
    - The languages for grammar representation (BNF, EBNF, …)
- Each domains has its strong and weak points.
  - There is definitively not a superior technology
  - The different spaces must cooperate
  - Bridges between spaces must be built

Correspondences and transformations

- Transformations Inter technological domains



Software Engineering Process



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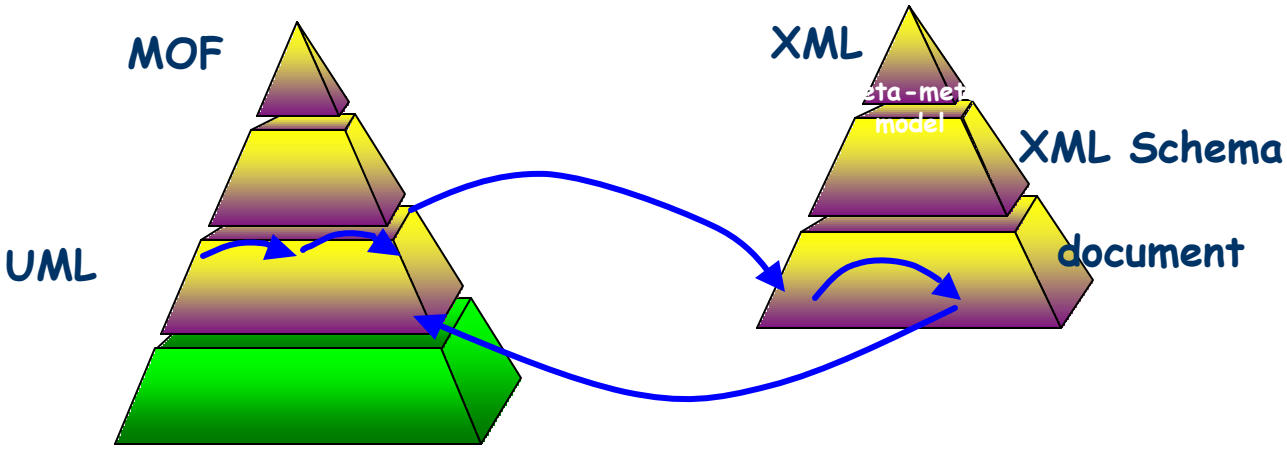

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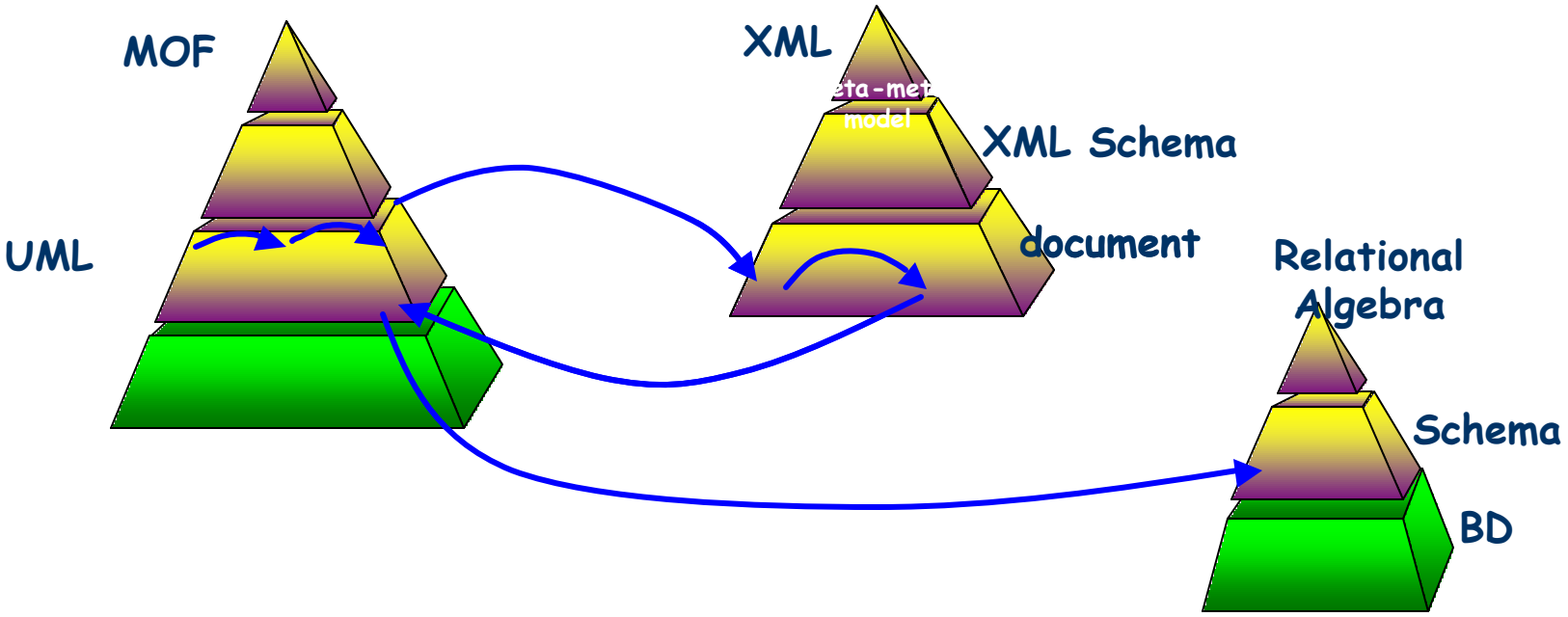

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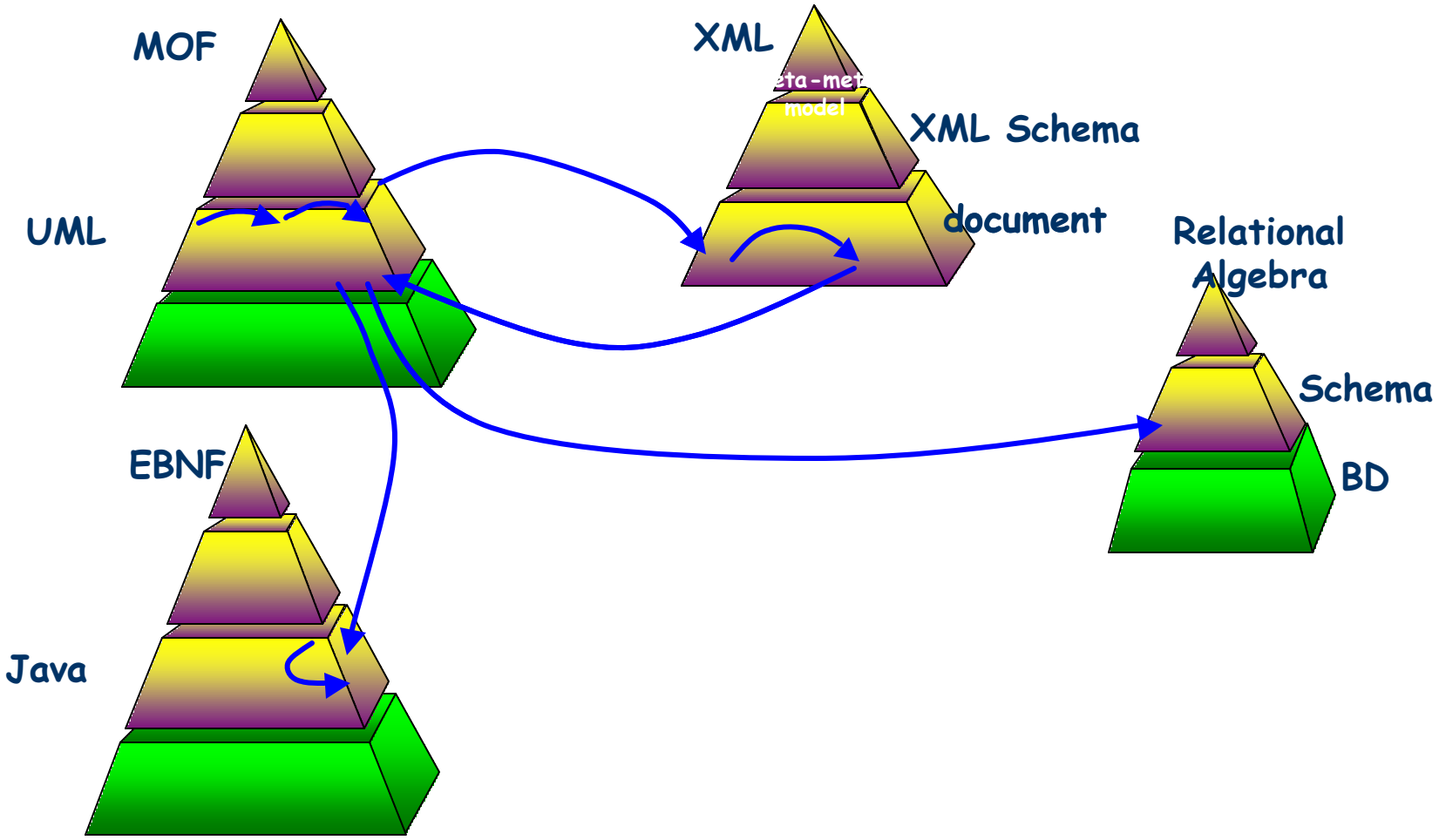

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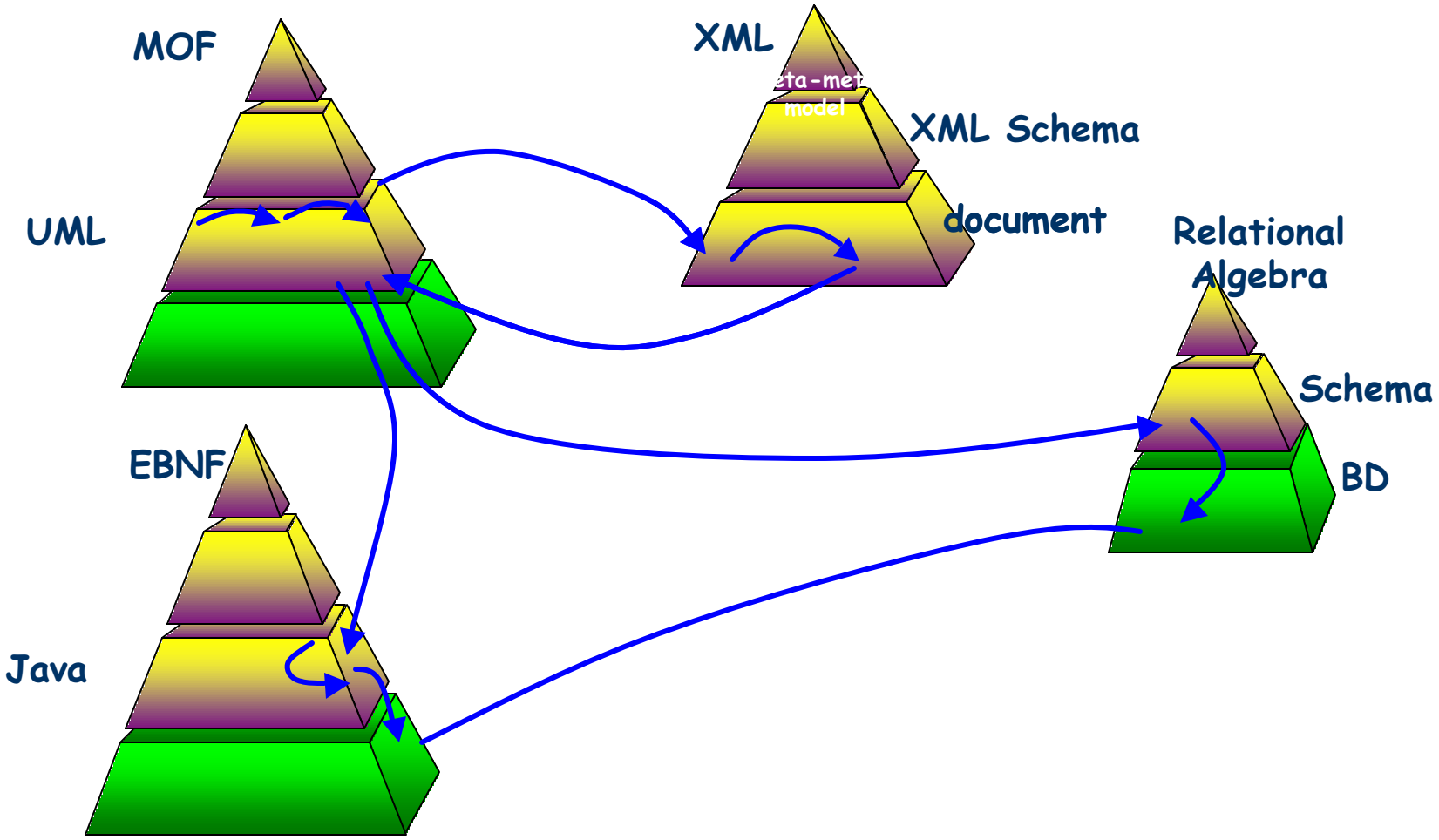
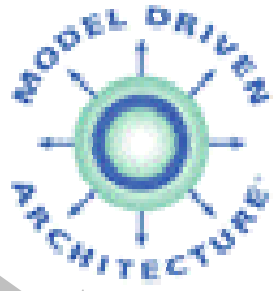


OBJECT MANAGEMENT GROUP

From Objects ...
... to Models

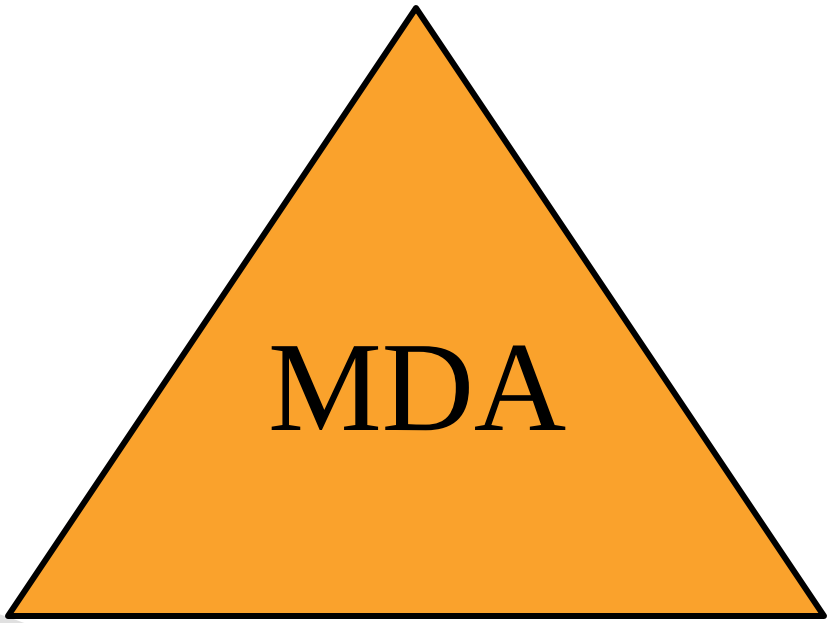
1990



2000

OMG: standardisation

1990 : Corba, the unique and universal middleware

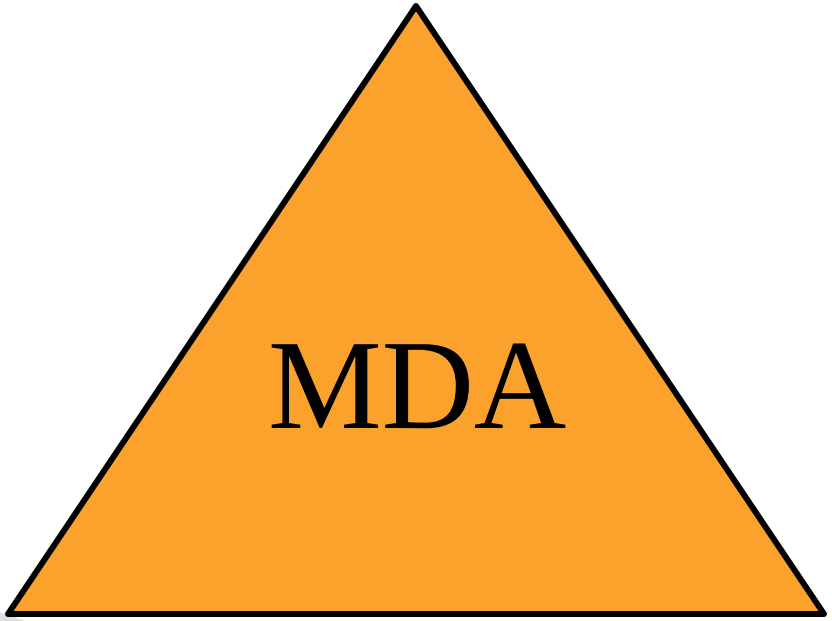


OBJECT MANAGEMENT GROUP

OMG: standardisation

~~1990 : Corba, the unique and universal middleware~~

2000 : UML, the unique and universal modeling language



OBJECT MANAGEMENT GROUP

IBM : a Major contributor

UML, MOF, XMI, CWM, QVT

A BPT COLUMN

MDA Journal

May 2004

Grady Booch
Alan Brown
Sridhar Iyengar
James Rumbaugh
Bran Selic

IBM Rational Software

"MDA as the potential to greatly reduce development time and greatly increase the suitability of application. But does so not by magic, but by providing mechanisms by which developers can capture their knowledge of the domain and implementation technology more directly in a standardized form and by using this knowledge to produce automated tools that eliminate much of the low level work of development.

May 2004

IBM

"An MDA Manifesto"

A BPT COLUMN

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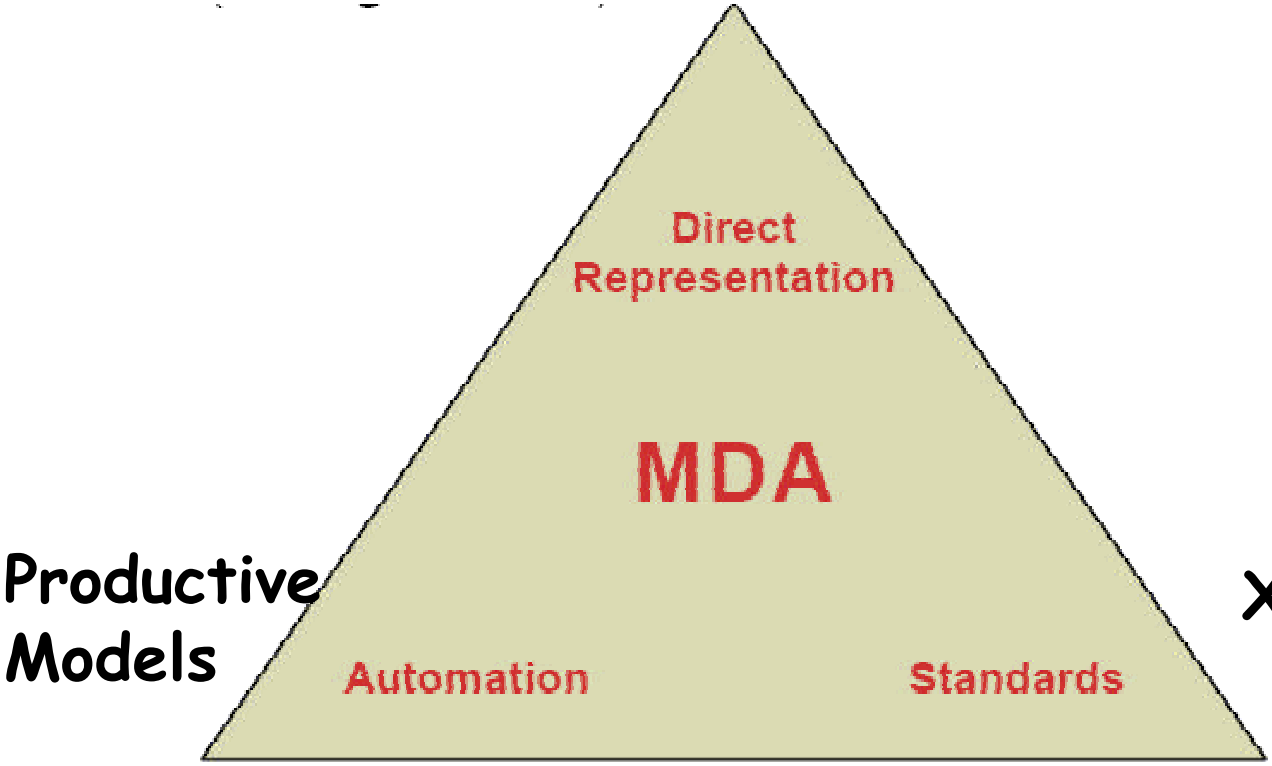
Domain Specific Language



Productive Models

Generative Programming

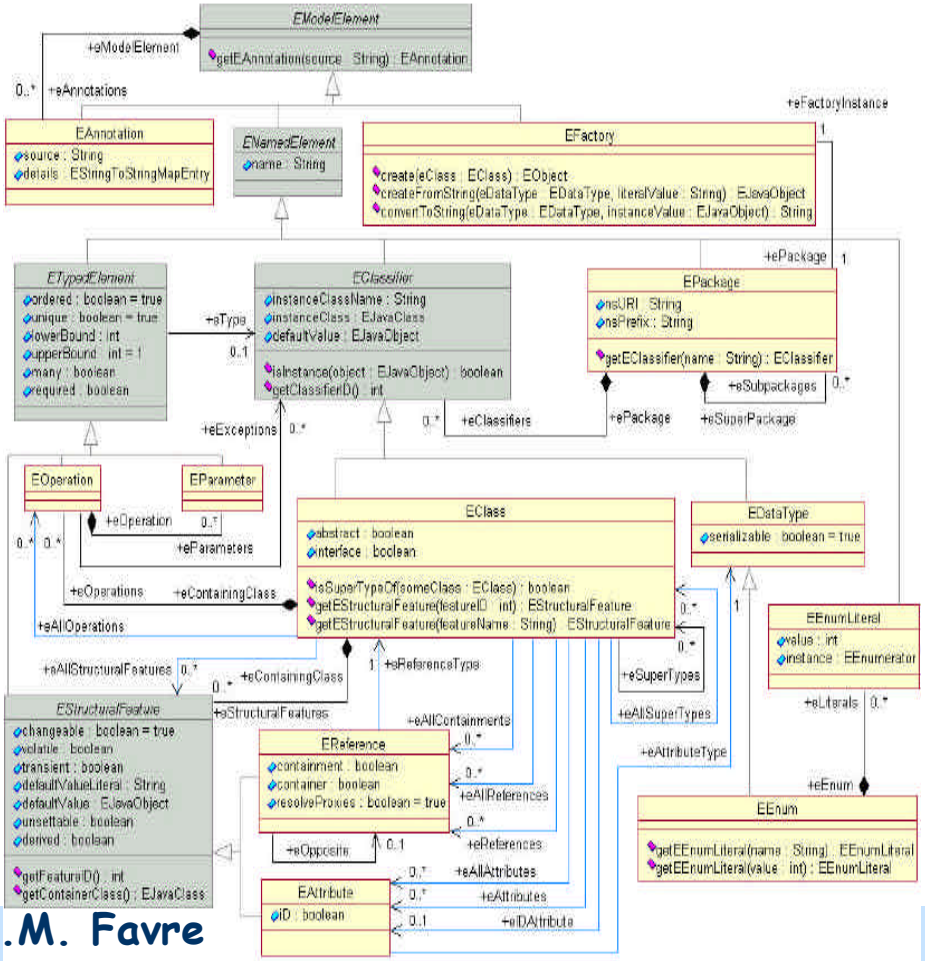
XML

MOF

UML ...

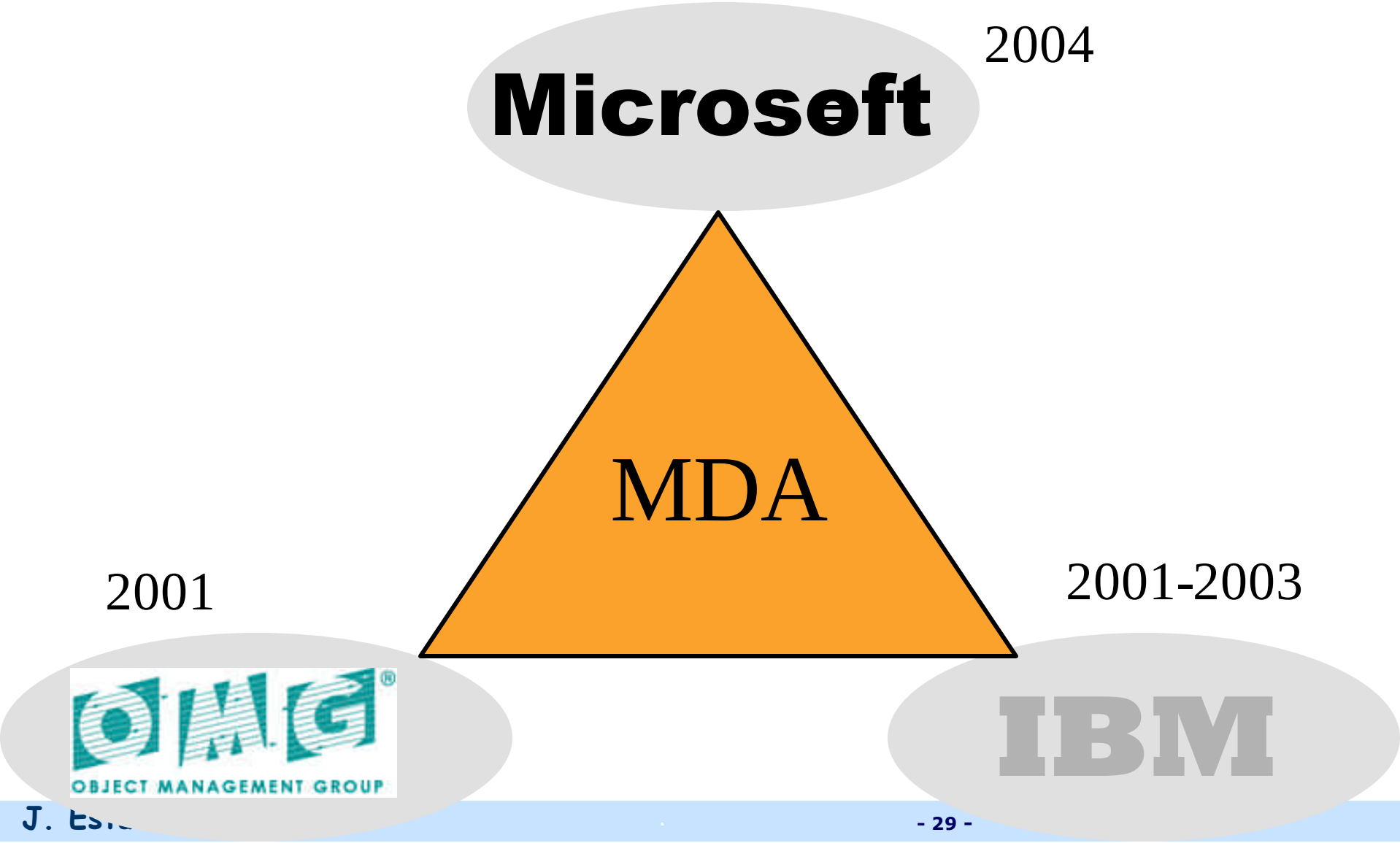
EMF

IBM



Eclipse Modelling Framework

Une convergence forte



Microsoft

You know UML made the meta-models a little complex, so **I don't think UML alone is the answer.** Web services forces you to think modeling. And that's part of the good thing about it. And the promise here is that you write a lot less code, that you have a model of the business process. And you just look at that visually and say here is how I want to customize it.

So even a business could express in a formal, modeled way, not just scribbling on paper, how the business process is changing over time or how it's different from other companies. **So instead of having lots of code behind that, you just have visual, essentially model, customization.**

MDE is not ...

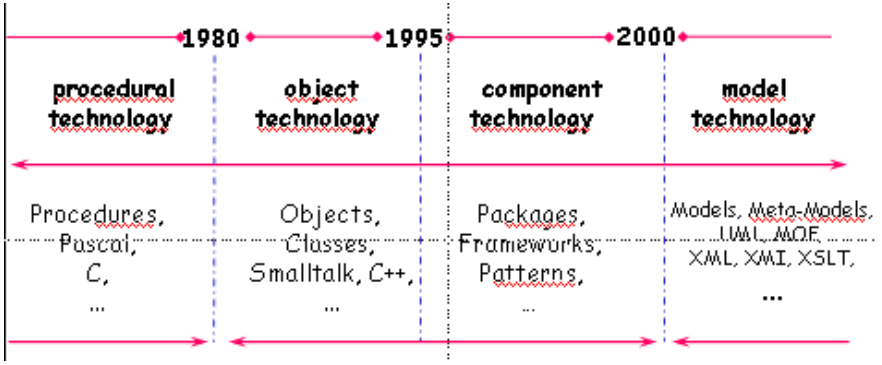
- MDE <> MDA
  - MDA = an industrial standard
  - MDE = a federative approach
  - MDE => Multiples technological domains
  - Toward robust MDE fundaments
- MDE <> UML
  - MDE et UML2.0 : Contradictory approaches
  - UML = define a new UML profile
  - MDA = define a new metamodel
- MDE <> OO
  - Everything is a model <> Everything is an object
  - A model is not an instance (OO) of a metamodel
  - OO : instance_of, inherits; MDE : represents, conform_to
  - MDE => Multiple technological domains

MDE is neither ...

- MDE <> Modelisation method (e.g. Meurise, Sadt, ...)
  - Modelisation : analysis and design
  - MDE : implementation, deployment, execution, evolution, ...
  - Contemplative Models (modelisation) vs. Productive Models (MDE)
  - Modelisation: models as 1st order elements
  - MDE : metamodels and transformations as 1st order elements
- MDE <> AOP, MDE = AOM
  - Aspect Oriented Programming : Too late in the life cycle
  - Aspect Oriented Modeling : natural solution
  - Model Weaving
- MDE <> "traditional" Compilation
  - Extensible Languages, Modular Languages, Languages weaving
  - User defined transformations.
  - Transformation evolution, etc.

Conclusion

- MDE do not propose anything radically different
- MDE seeks to integrate the good ideas developed elsewhere
  - Separation and composition of concerns
  - Generalized Transformation and composition Techniques
- Many fundamental open research issues
- MDE requires a long term and collaborative effort from various scientific communities.
- Consequences on Software Engineering and the Software industry will be deep and long lasting.




MDE
mde.imag.fr