



Interaction Flow Modeling Language

Model-Driven Development of Software Front Ends

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with input from **Marco Brambilla**

Politecnico di Milano and WebRatio



@marcobrambi





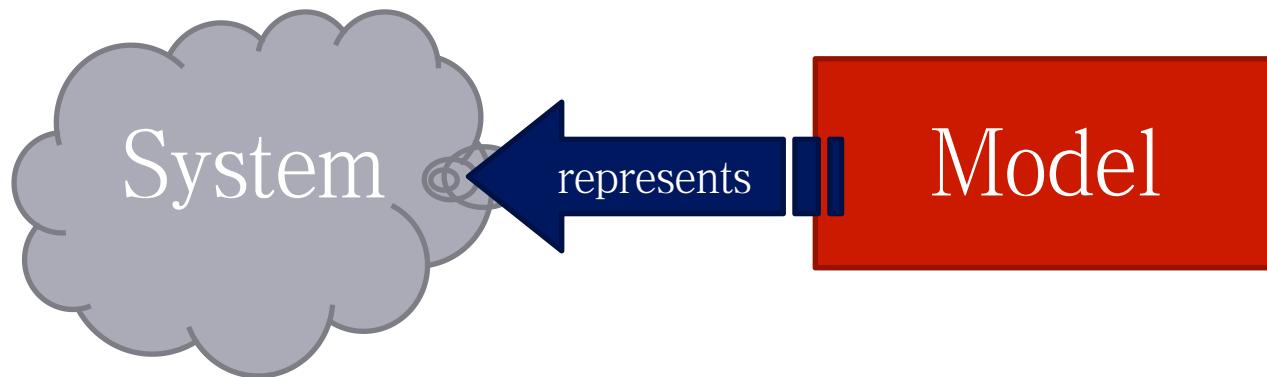
The modeling approach





Models

What is a model?



Mapping Feature A model is based on an original (=system)

Reduction Feature A model only reflects a (relevant) selection of the original's properties

Pragmatic Feature A model needs to be usable in place of an original with respect to some purpose

Purposes:

- descriptive purposes
- prescriptive purposes



The UI Modeling Problem





UI Modeling Problem

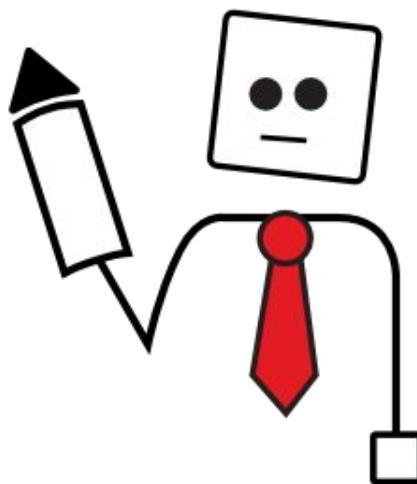
User interface and interaction development
is a painful phase of software process

... for everybody!



The UI Design Problem

Costly and
Inefficient process



Complexity of
user interfaces (UIs)



Ineffective
tools



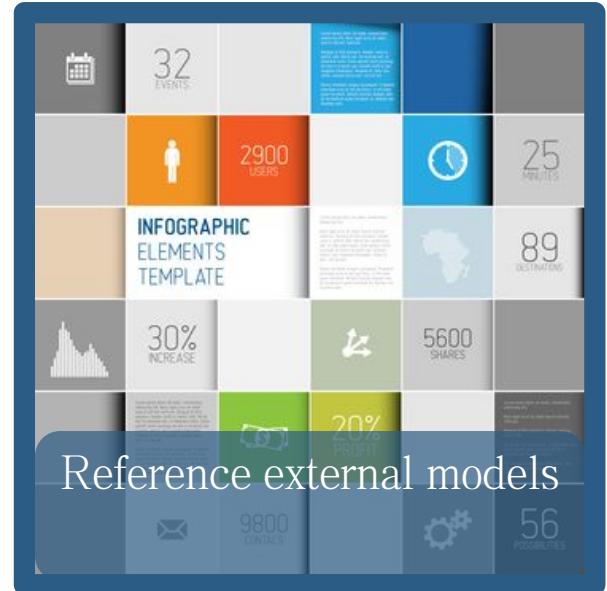
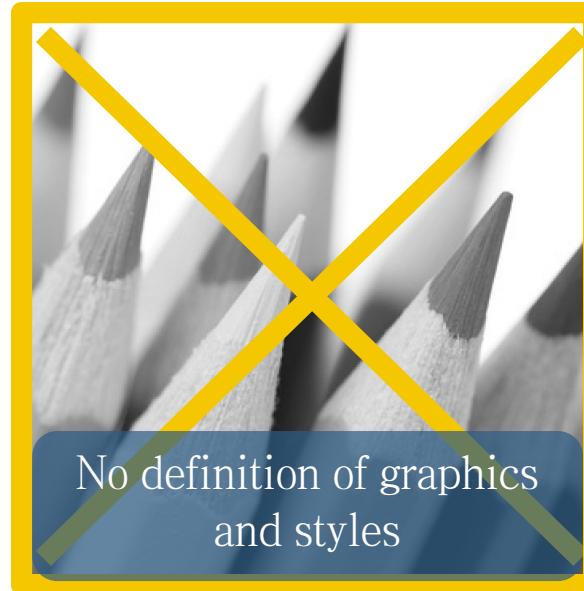
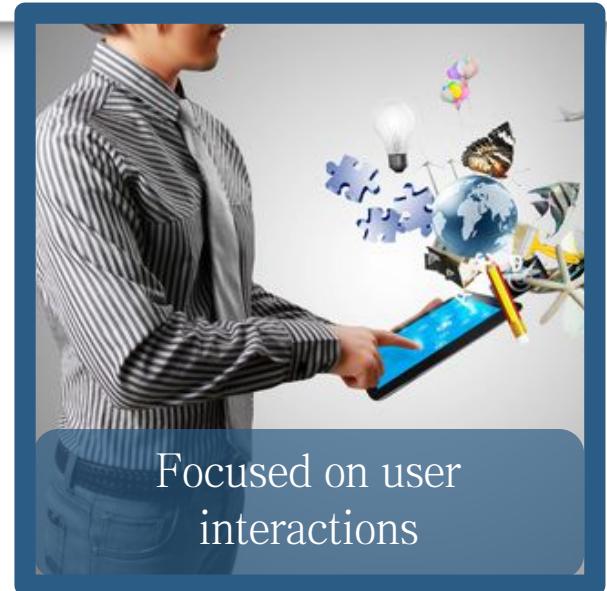
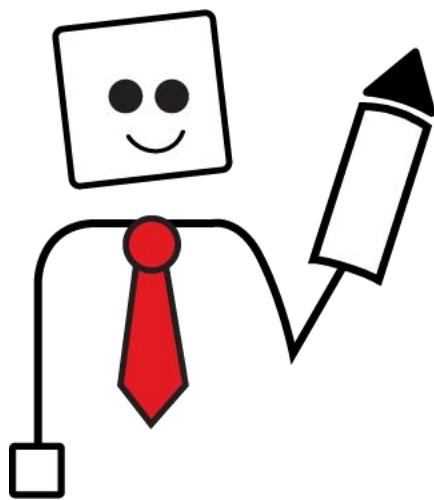
Manual
development



No MDE
technology



The UI Design solution: IFML





Standardization gap

- User interaction has been overlooked in software engineering standards
- Hence **the Interaction Flow Modeling Language (IFML)**



- In less than 2 years (a record in OMG!), we obtained approval of the IFML standard



The Interaction Flow Modeling Language



WEB  RATIO


WE SET THE STANDARD®



IFML Objectives



Content

Navigation Path

Event

Binding to
Business Logic

Binding to
Persistence Layer



IFML Objectives: Content

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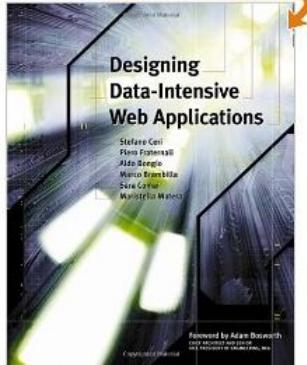
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IFML Objectives: Events

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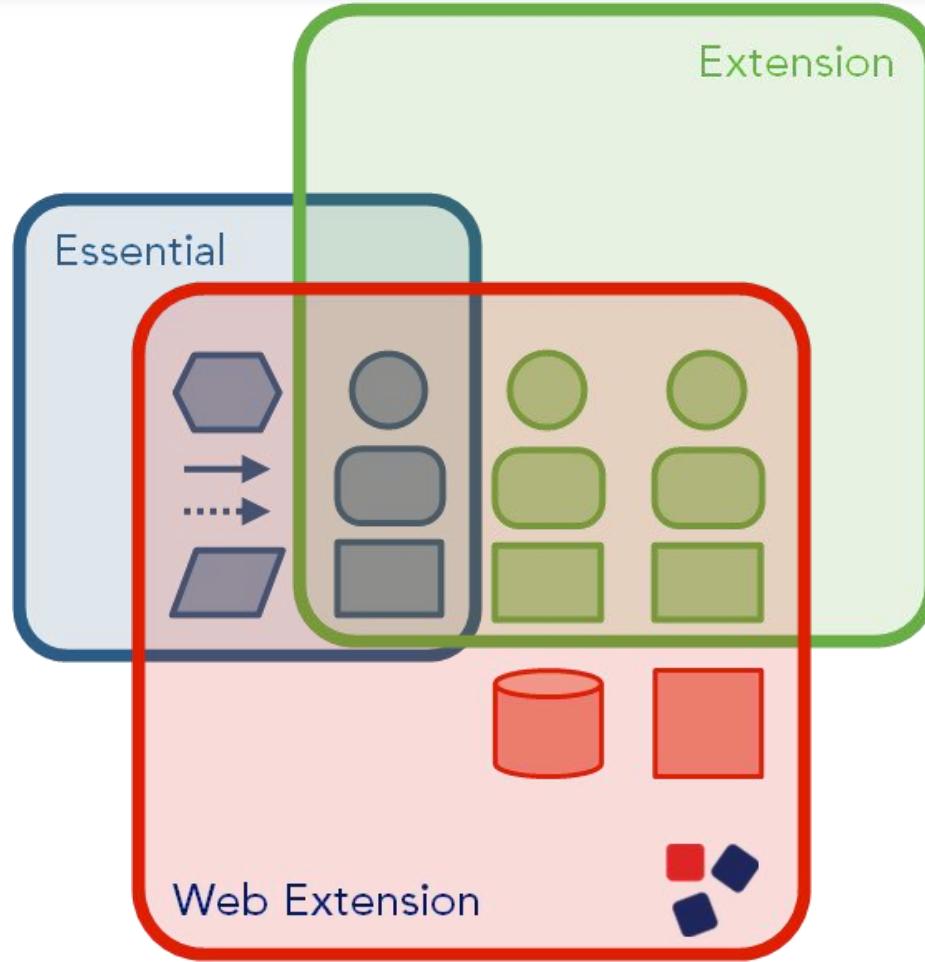
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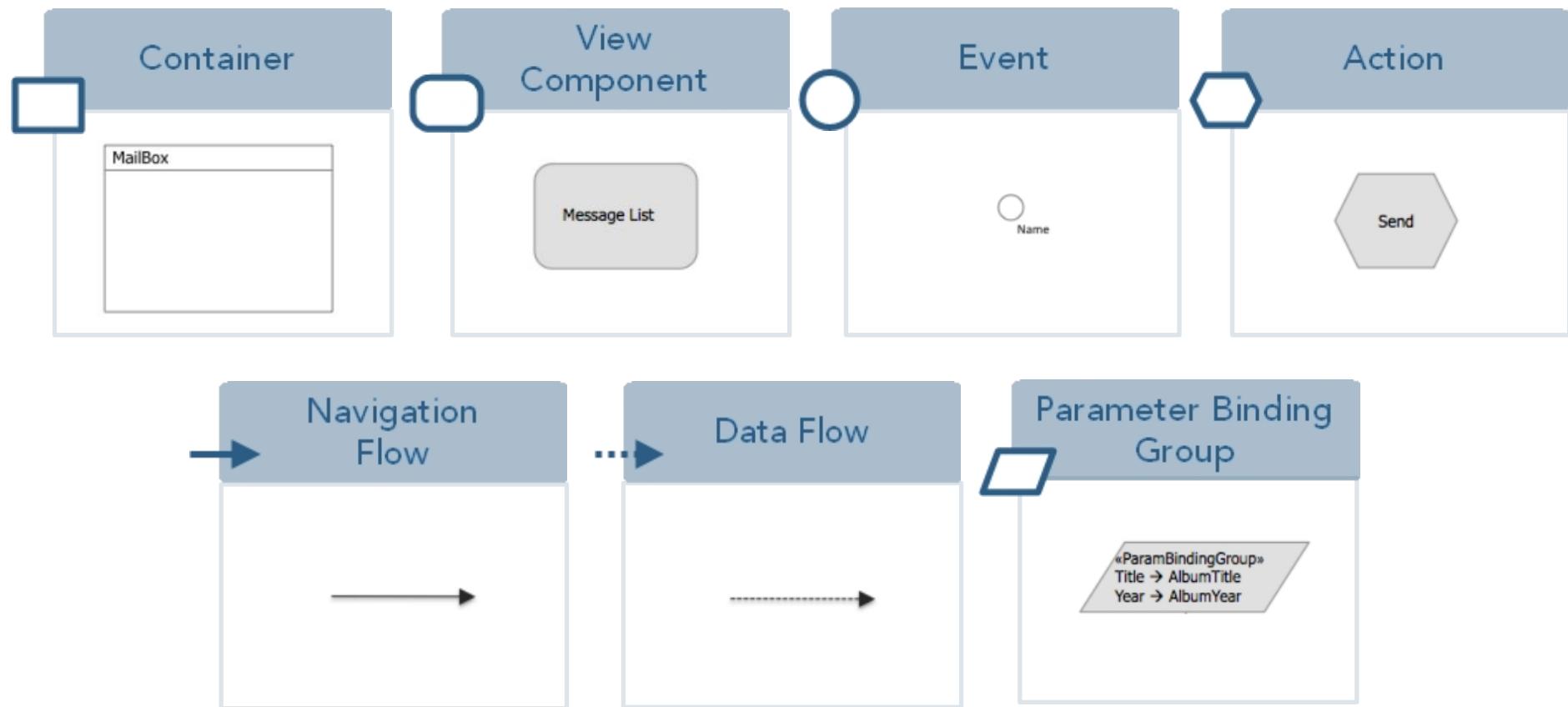


IFML Overview





IFML Essentials



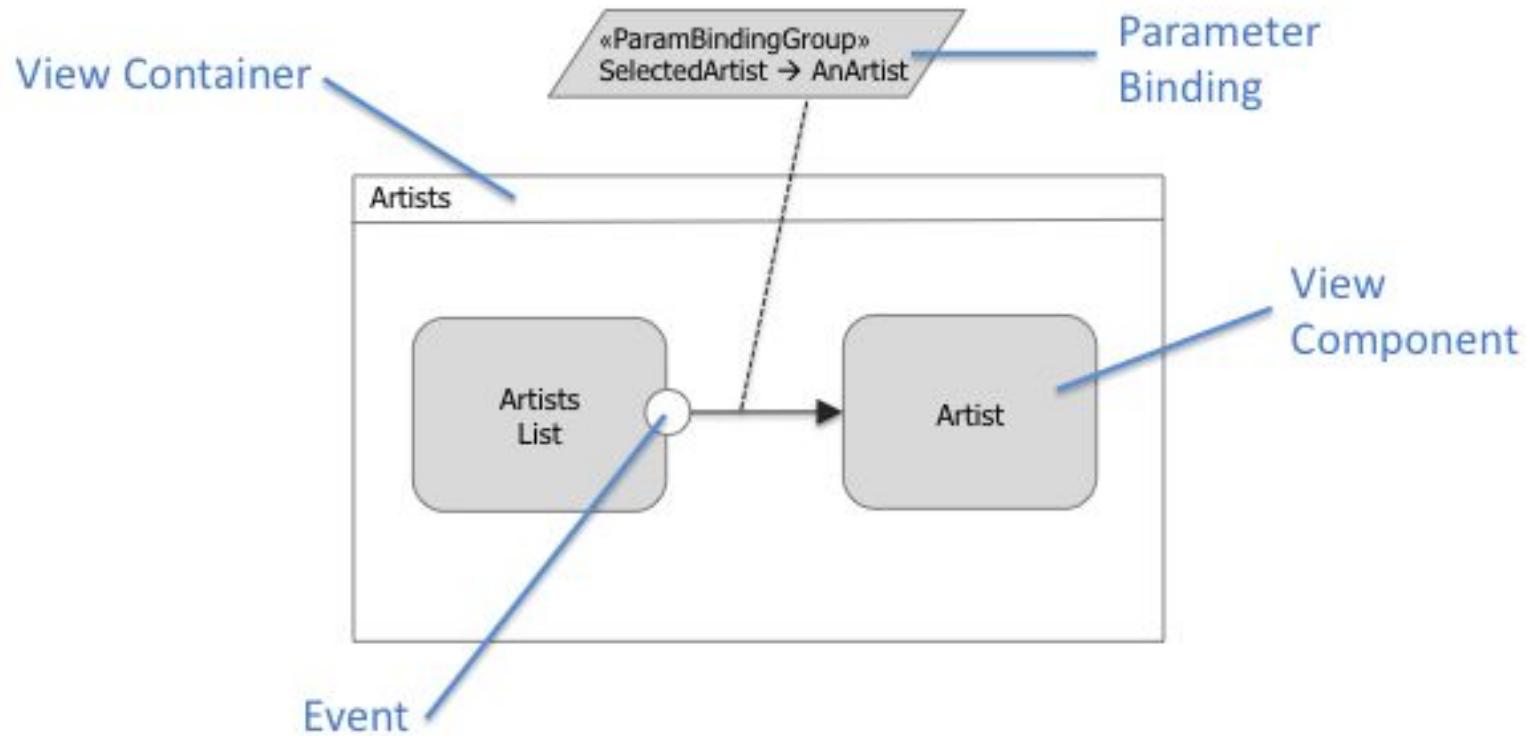


Covered aspects

- **Multiple views** for the same application
- **Mobile and multi-device** applications
- Visualization and input of data, and production of **events**
- **Components** independent of concrete widgets and presentation
- **Interaction flow**, initiated by the user or by external events
- **User context**: the user status in the current instant of the interaction (position, history, machine, platform,...)
- **Modularization** of the model (design-time containers for reuse purpose)
- User input **validation**, according to OCL or other existing constraint languages



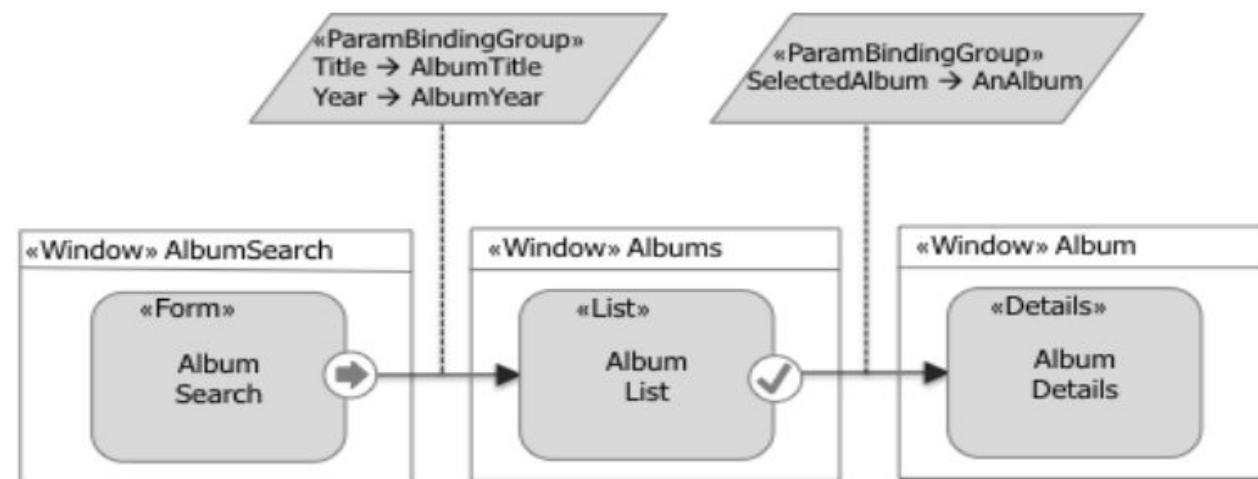
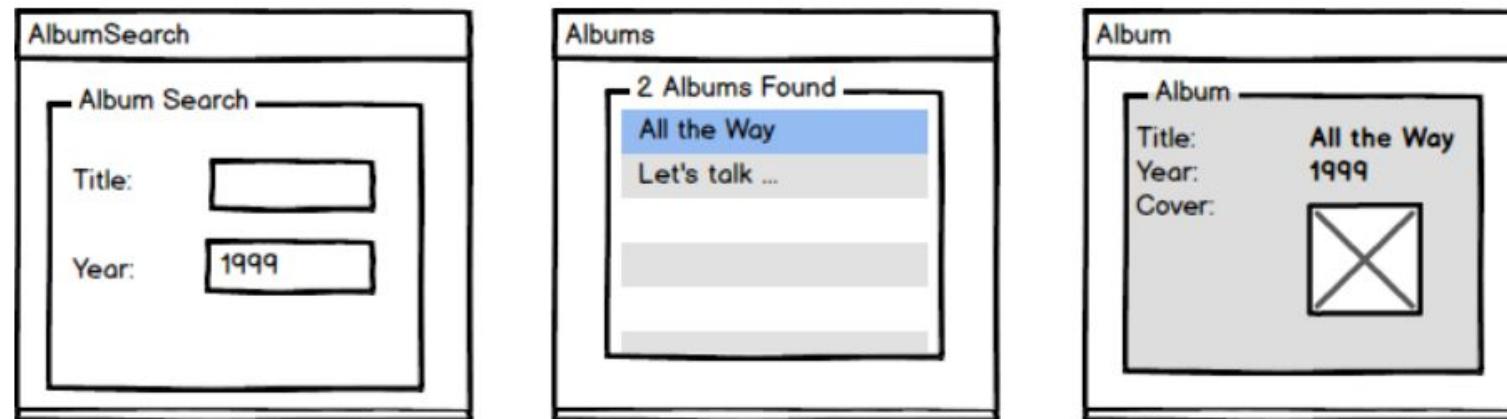
IFML by example



Basic navigation flow between ViewComponents

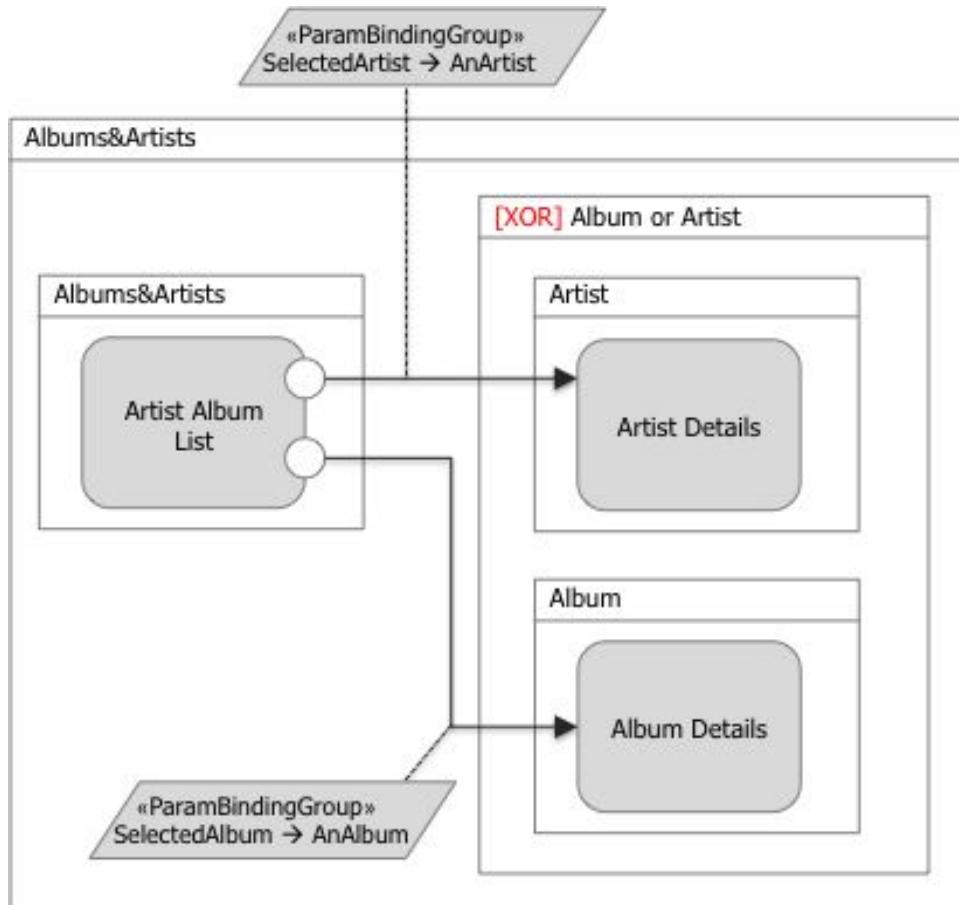


IFML by example





IFML by example

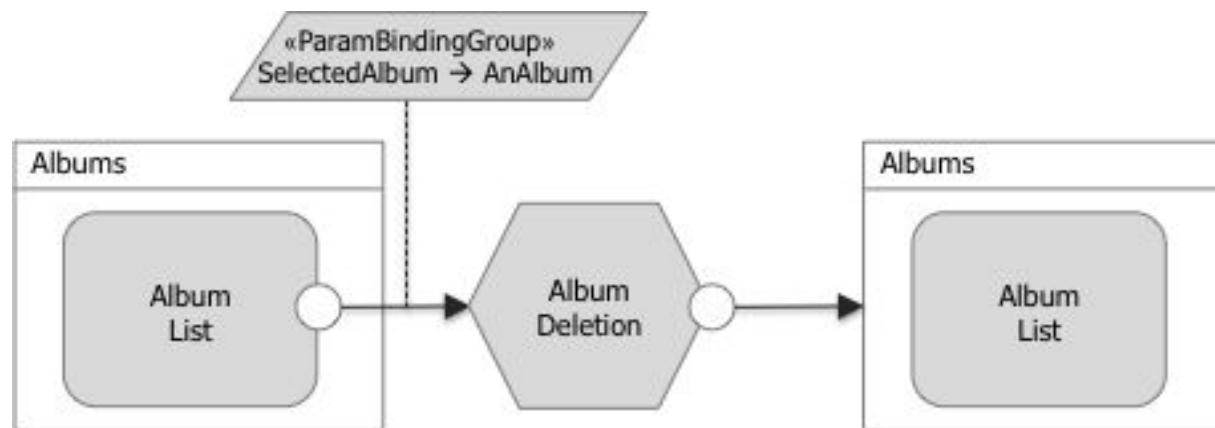


Nesting of ViewContainers

Tagged ViewContainers (XOR, L, D, Modal, Modeless)



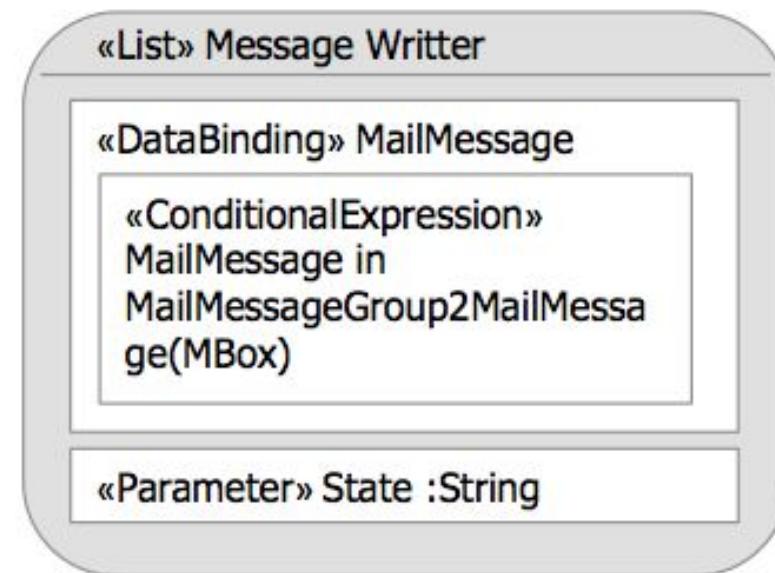
IFML by example



Actions



IFML – adding details to ViewComponents



ViewComponentParts:

- Data binding
- Parameters

Types of ViewComponents (<<List>>)



Data binding

- Joint use of IFML and other modeling languages:
 - DataBinding to classes and attributes of UML Class Diagrams
 - Upcoming: also with other content models, such as: Entity-Relationship, Ontologies, ...



Dynamic Behaviour

- Joint use of IFML and other modeling languages
- Connection of Actions to back-end business logic as
 - UML methods of classes
 - whole UML dynamic diagrams
 - activity diagram, sequence diagram, state chart diagram, ...

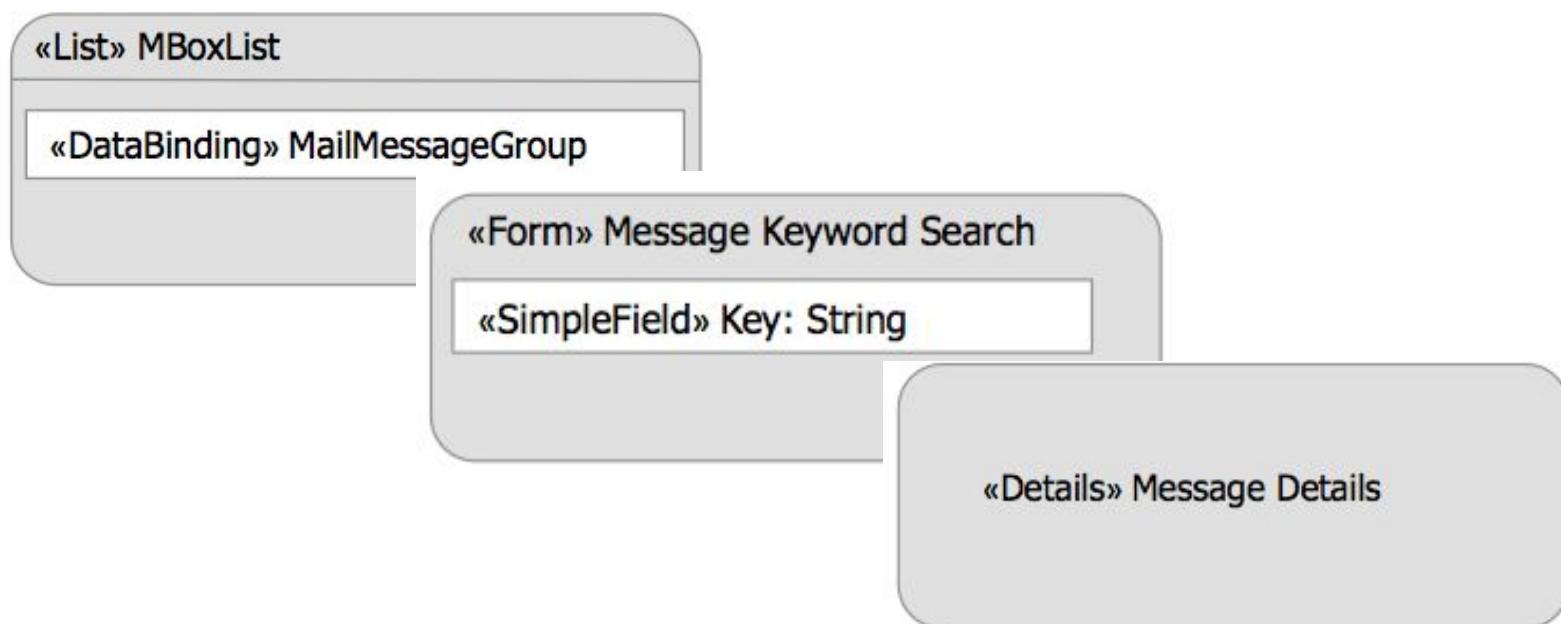


IFML – subtyping components and events

Selection event



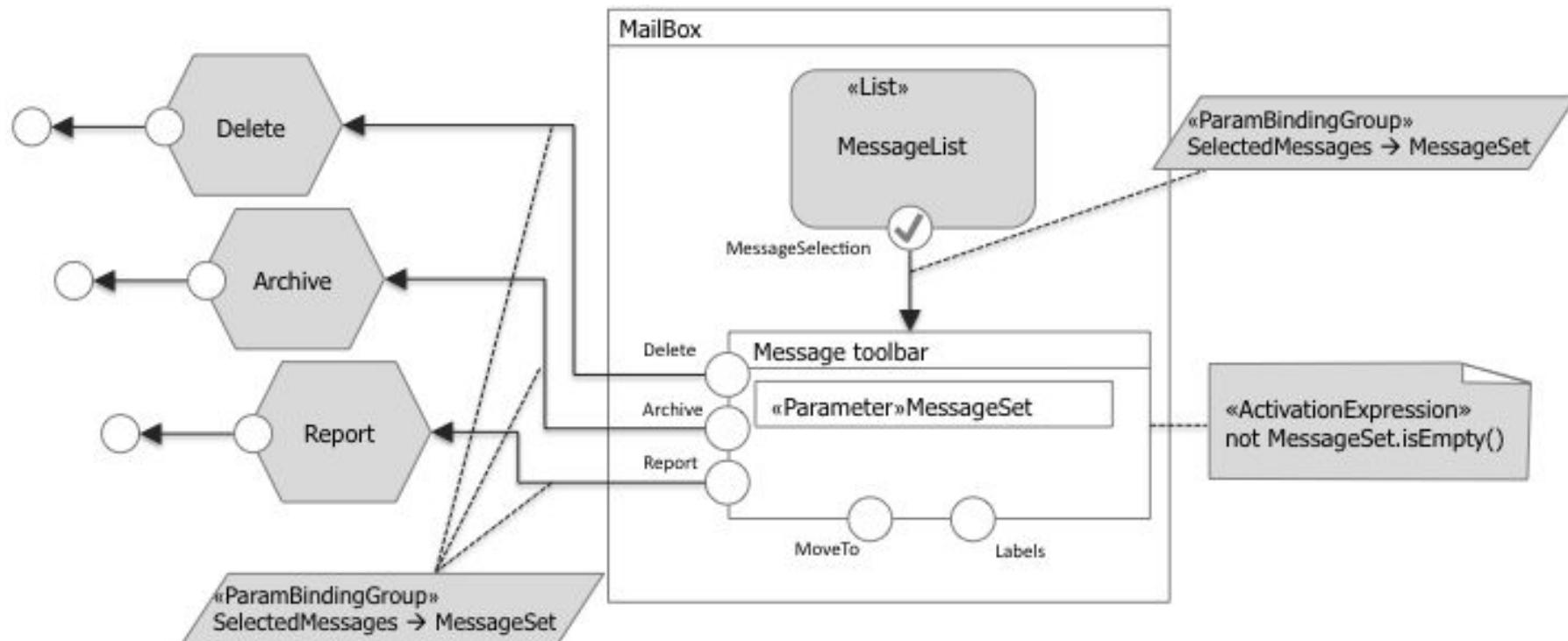
Submit event



.. And as many others as you want!



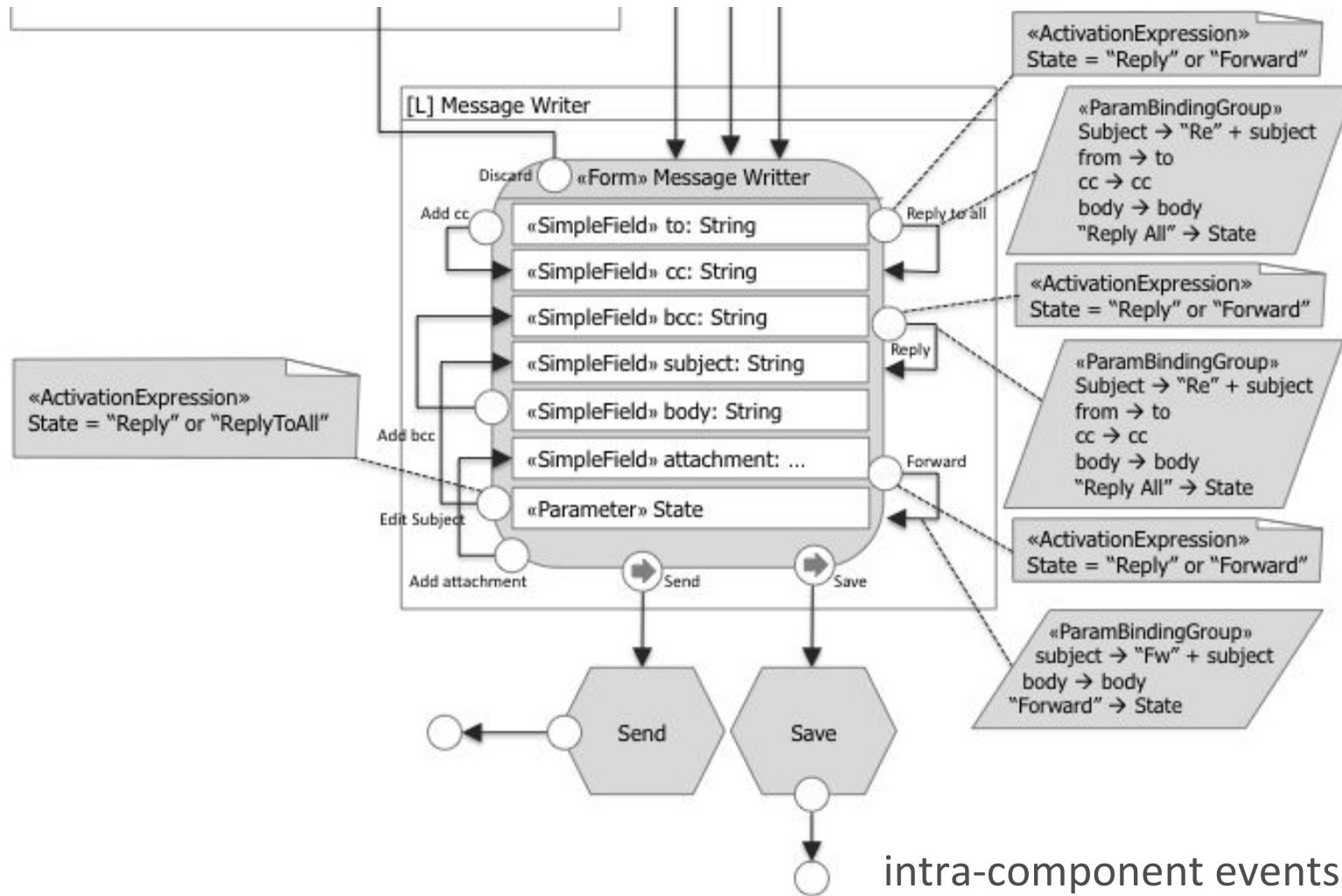
IFML by example



ActivationExpression, SubmitEvent, Event generation



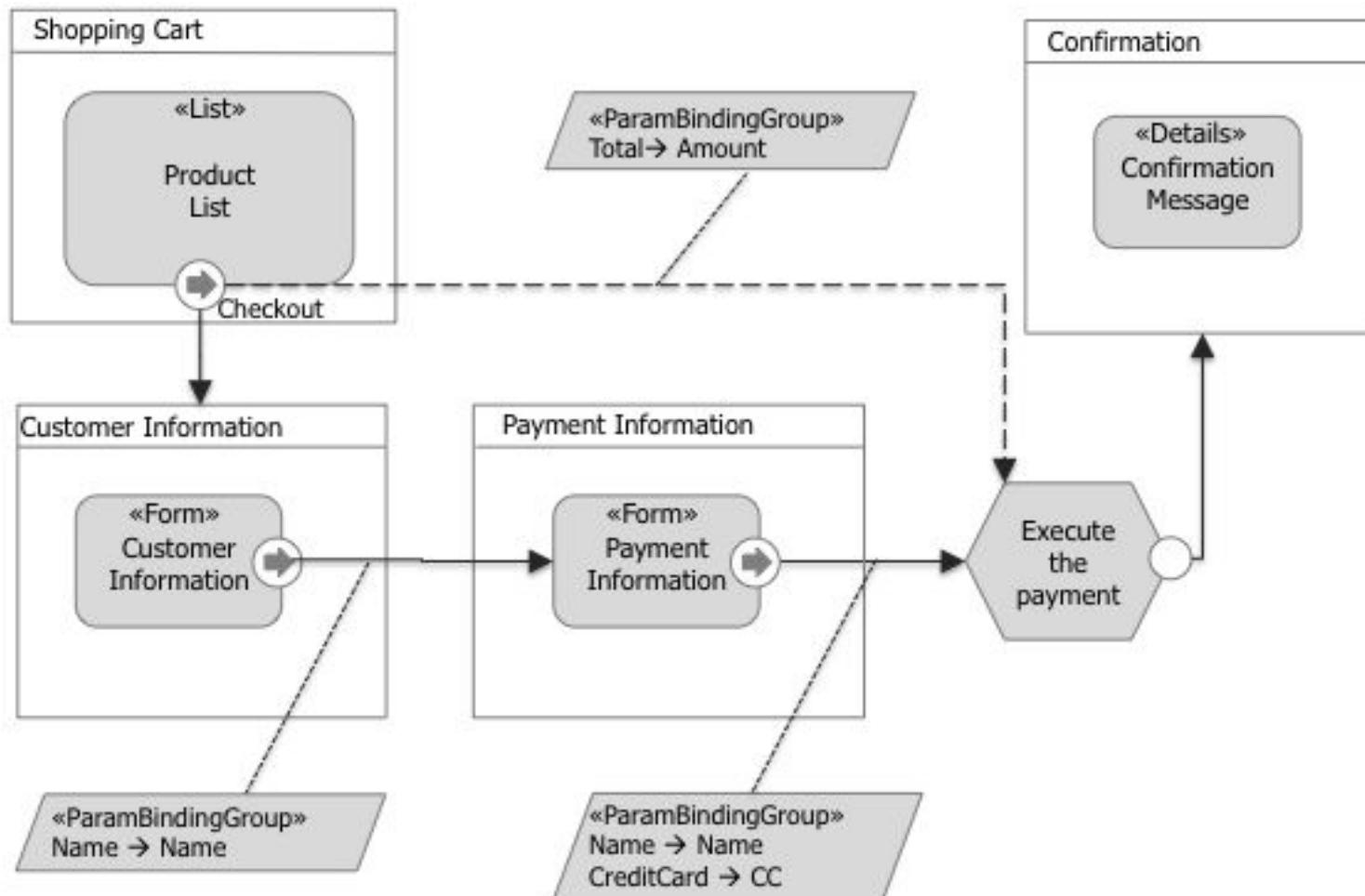
IFML concrete syntax by example



intra-component events and flows



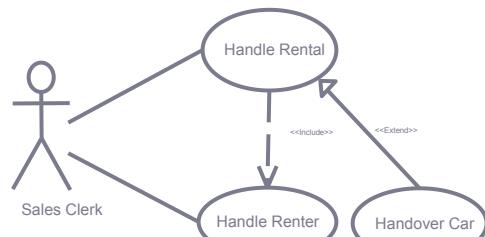
IFML example – online payment



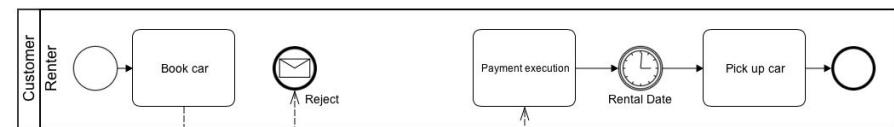


Multiple aspects modeling – 1 (business and requirements)

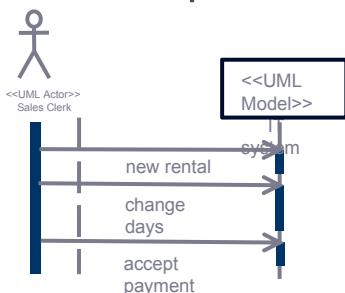
UML Use Case



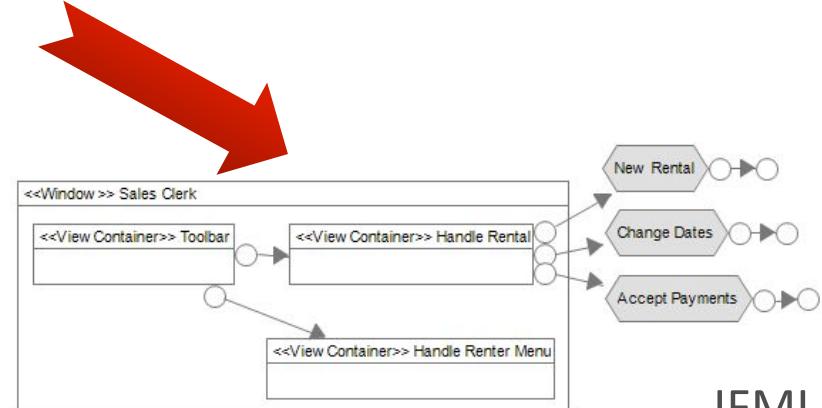
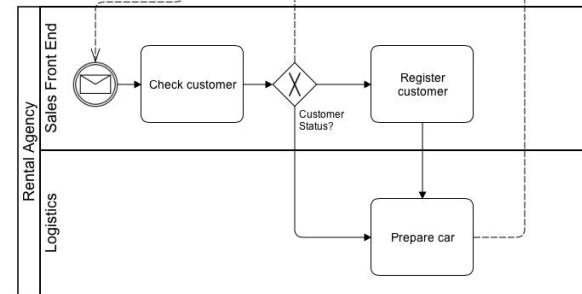
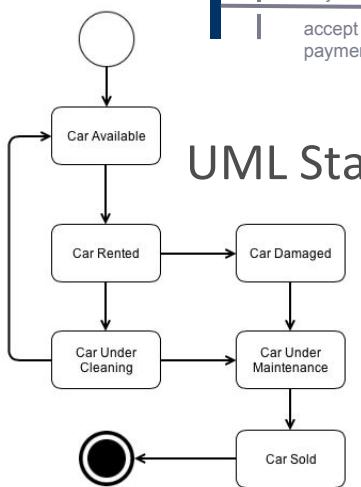
BPMN process



UML Sequence



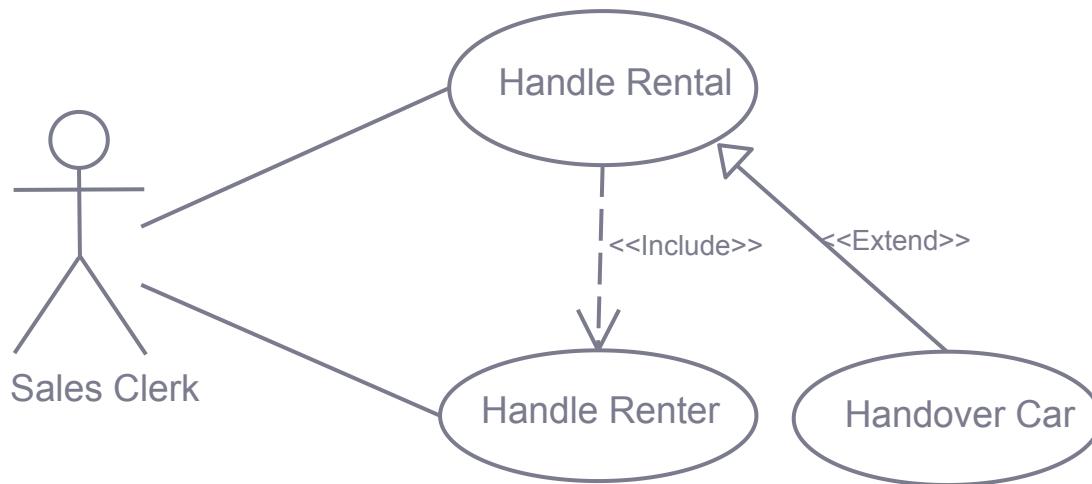
UML Statechart



IFML



Integration with UML Use Cases

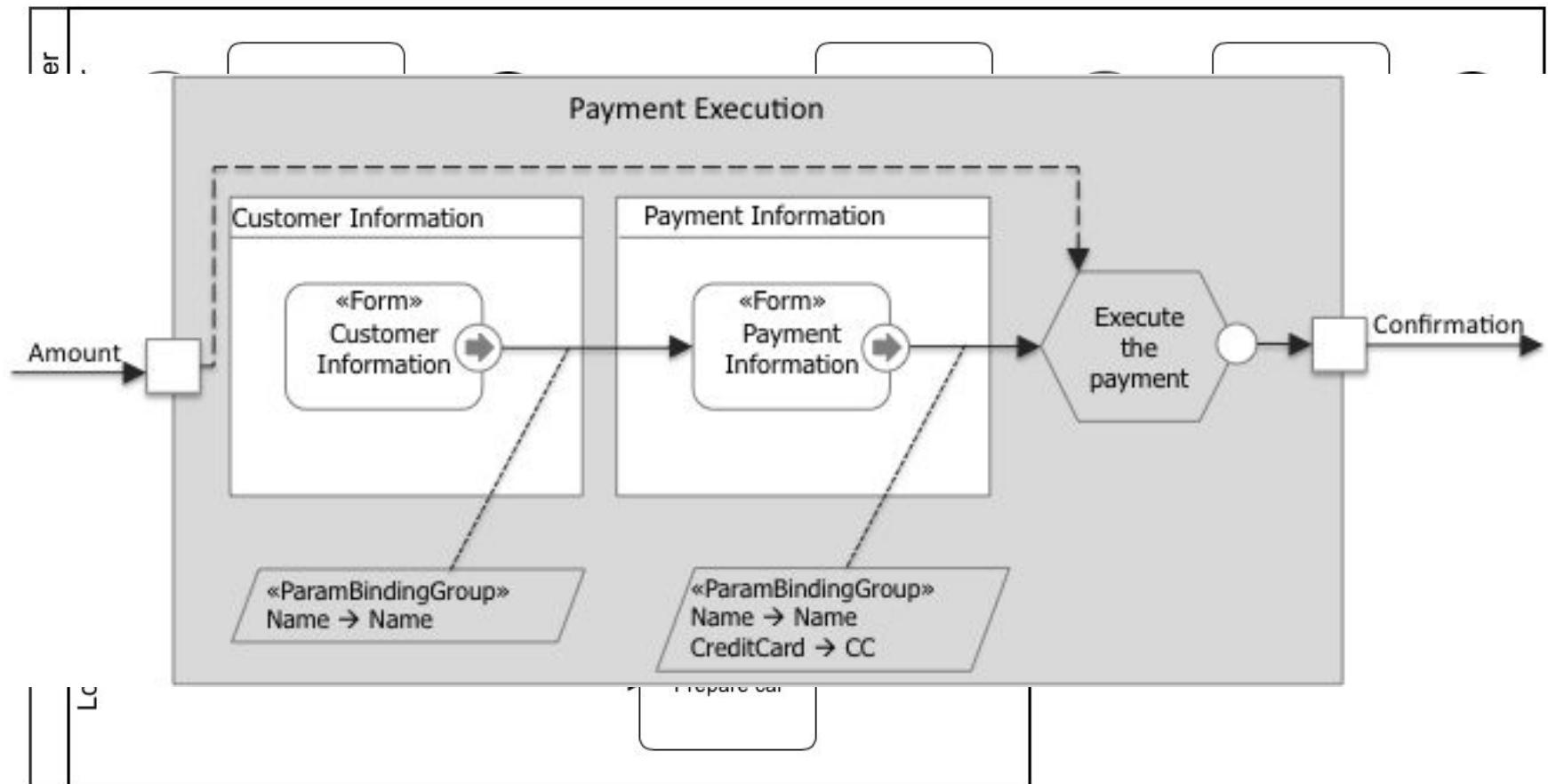


Each use case can be described by

- A business process
- A plain UI description in IFML
- Some UML dynamic diagrams (e.g., activity, sequence, ...)

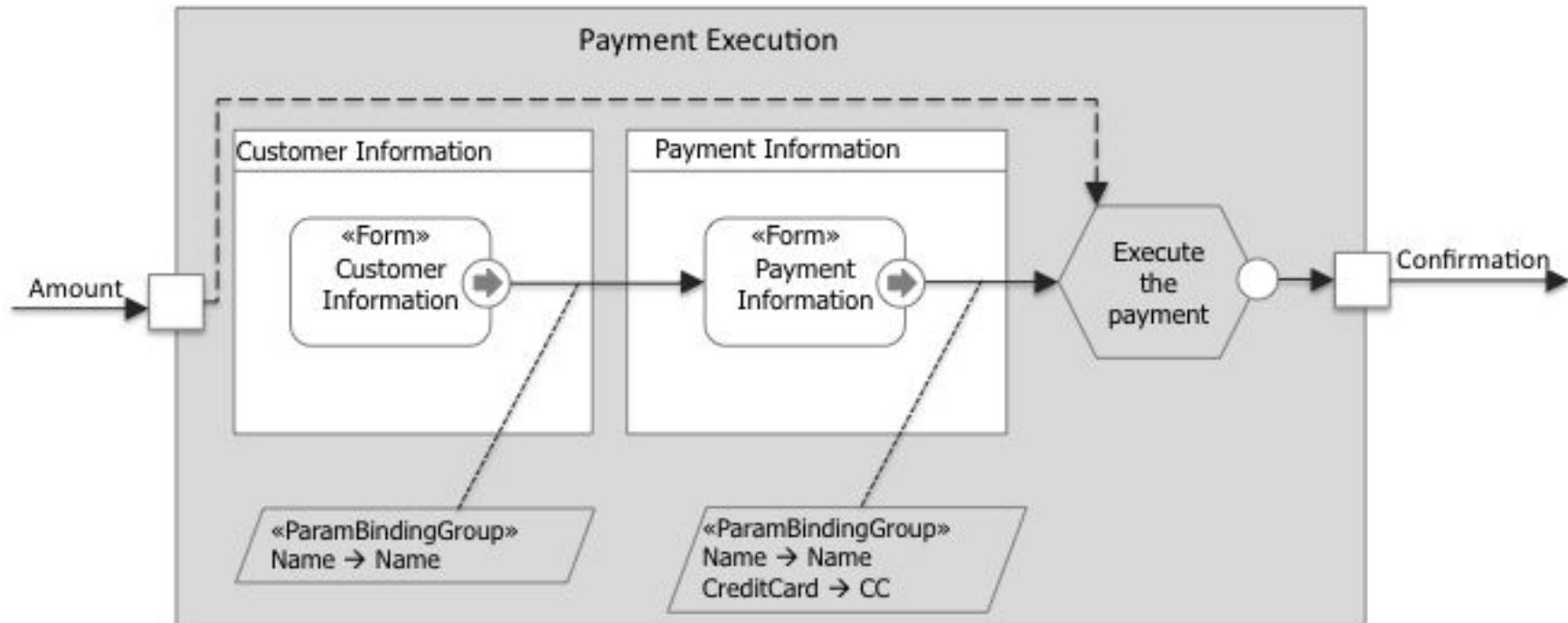


Integration with BPMN





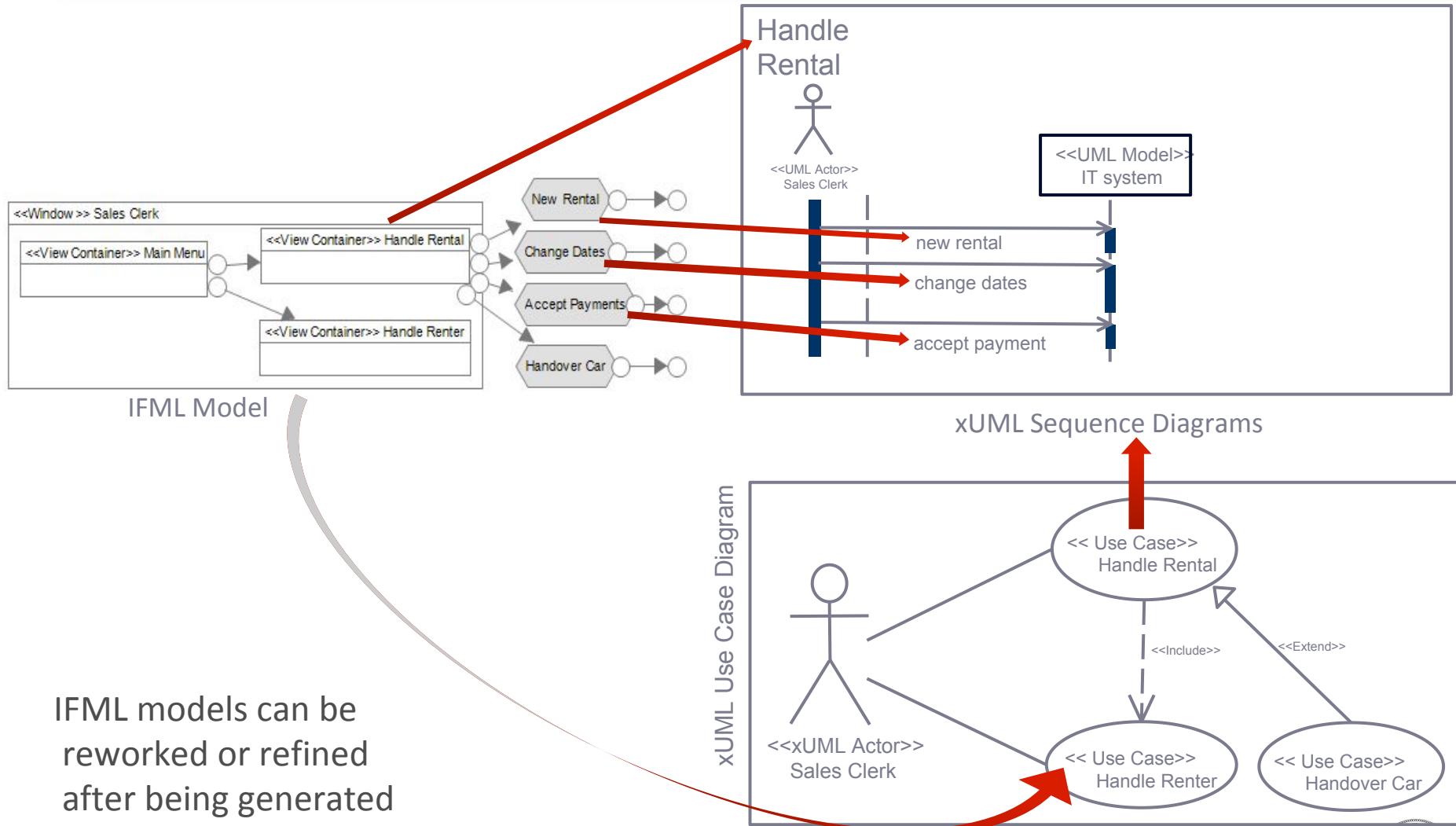
IFML concrete syntax by example



IFML Modules - definition



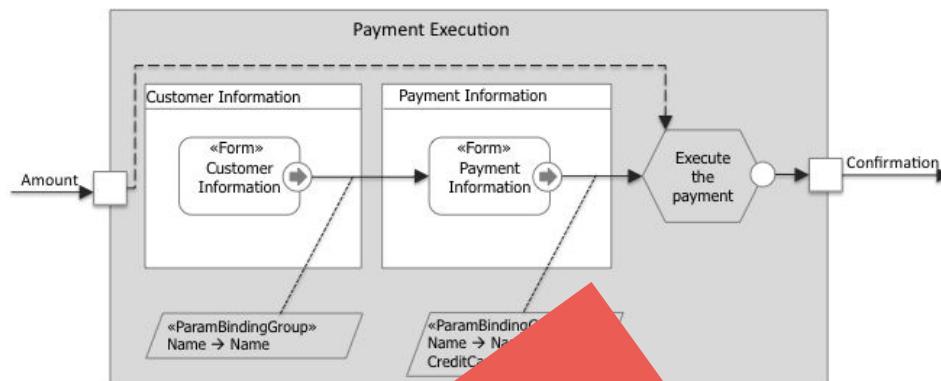
Example of UML - IFML mapping



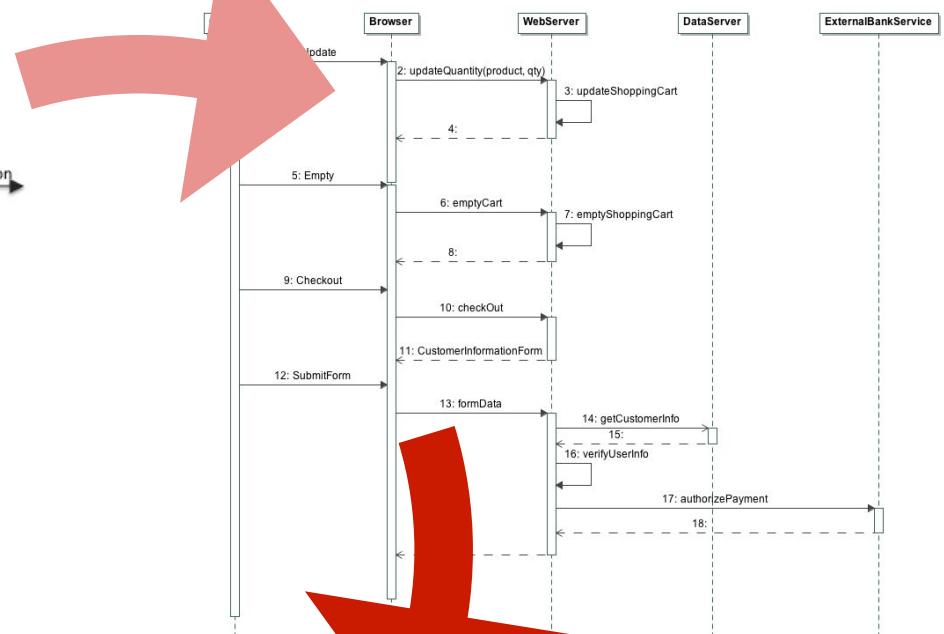


Multiple aspects modeling – 2 (implementation and architecture)

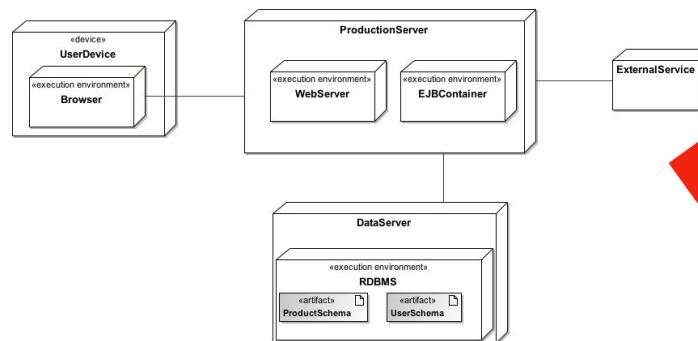
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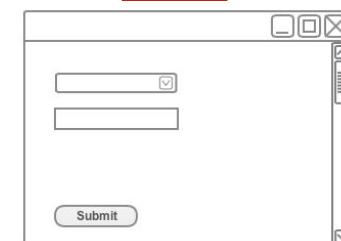
UML Sequence



UML Deployment



UI Mockup models

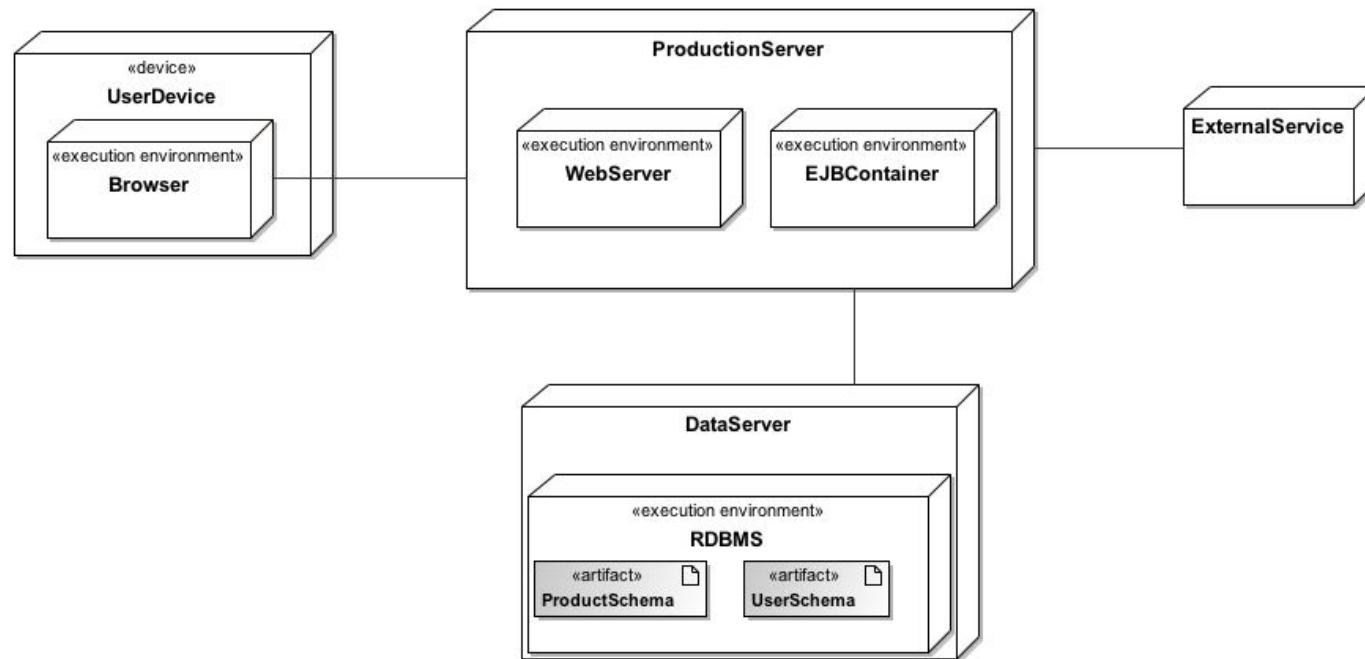




Integration with UML

Description of deployment architecture

- UI is just one facet of system design
- Often need to position it in a broader architectural vision

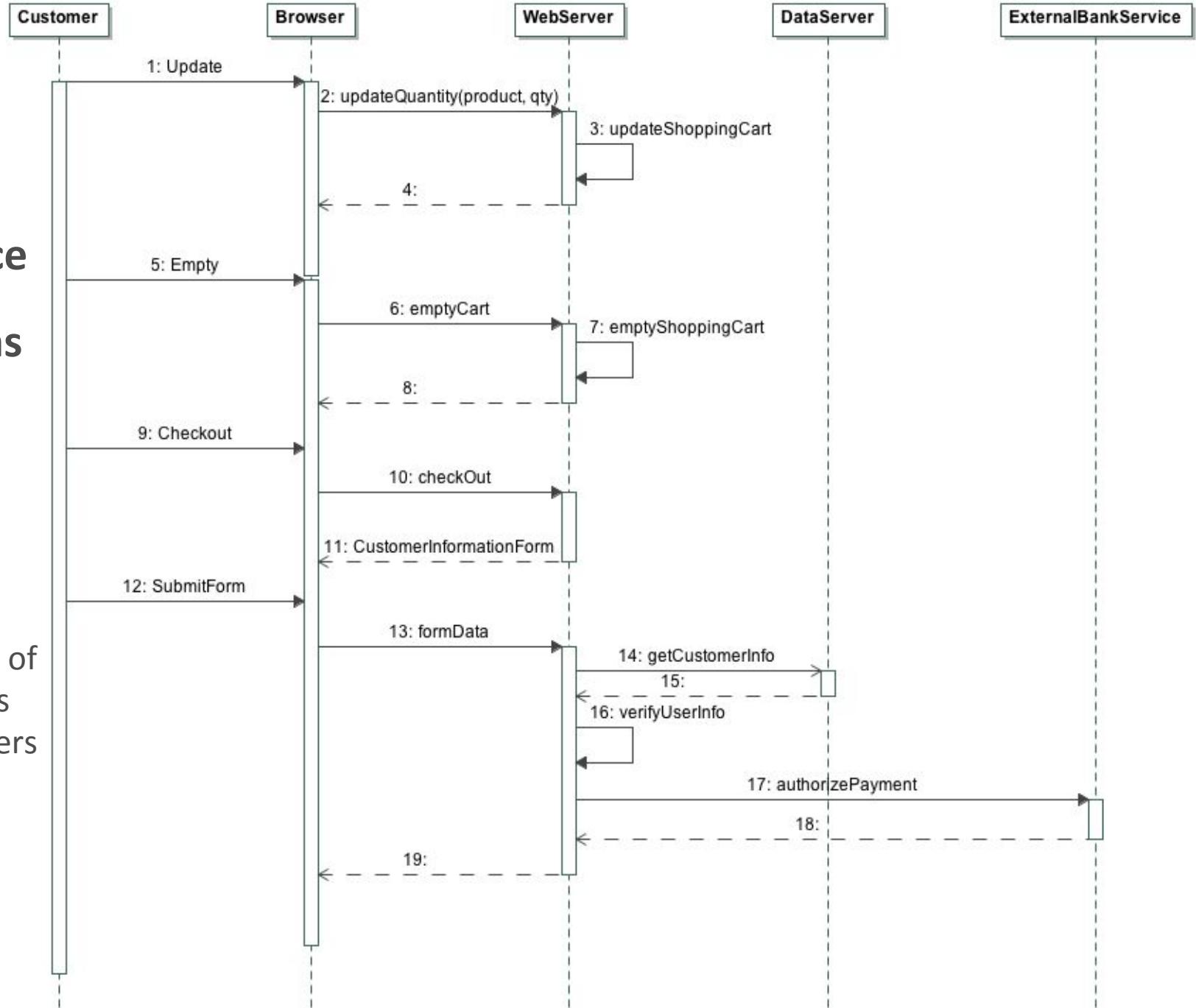


- UML deployment diagram

UML Sequence Diagrams

Tiers and calls

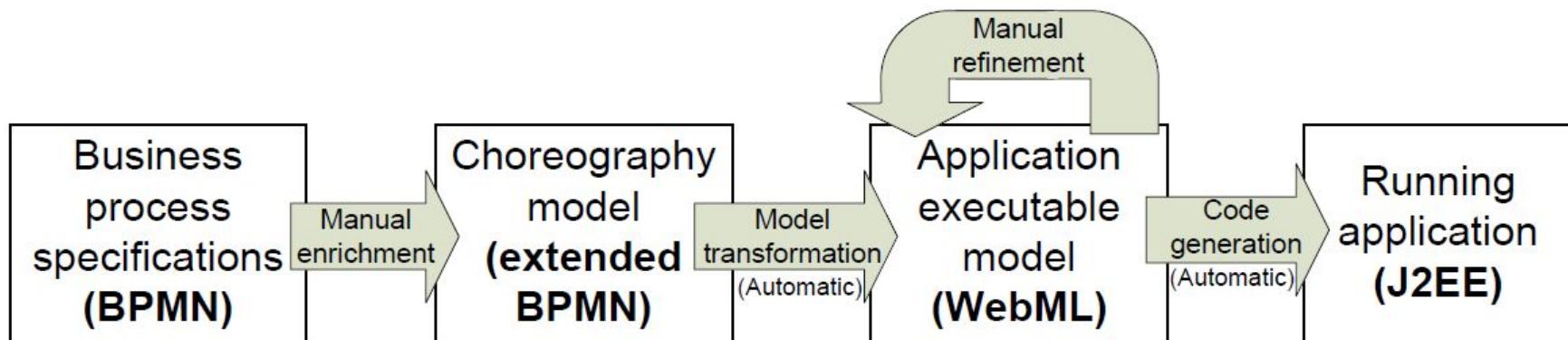
Explicit description of interactions between tiers





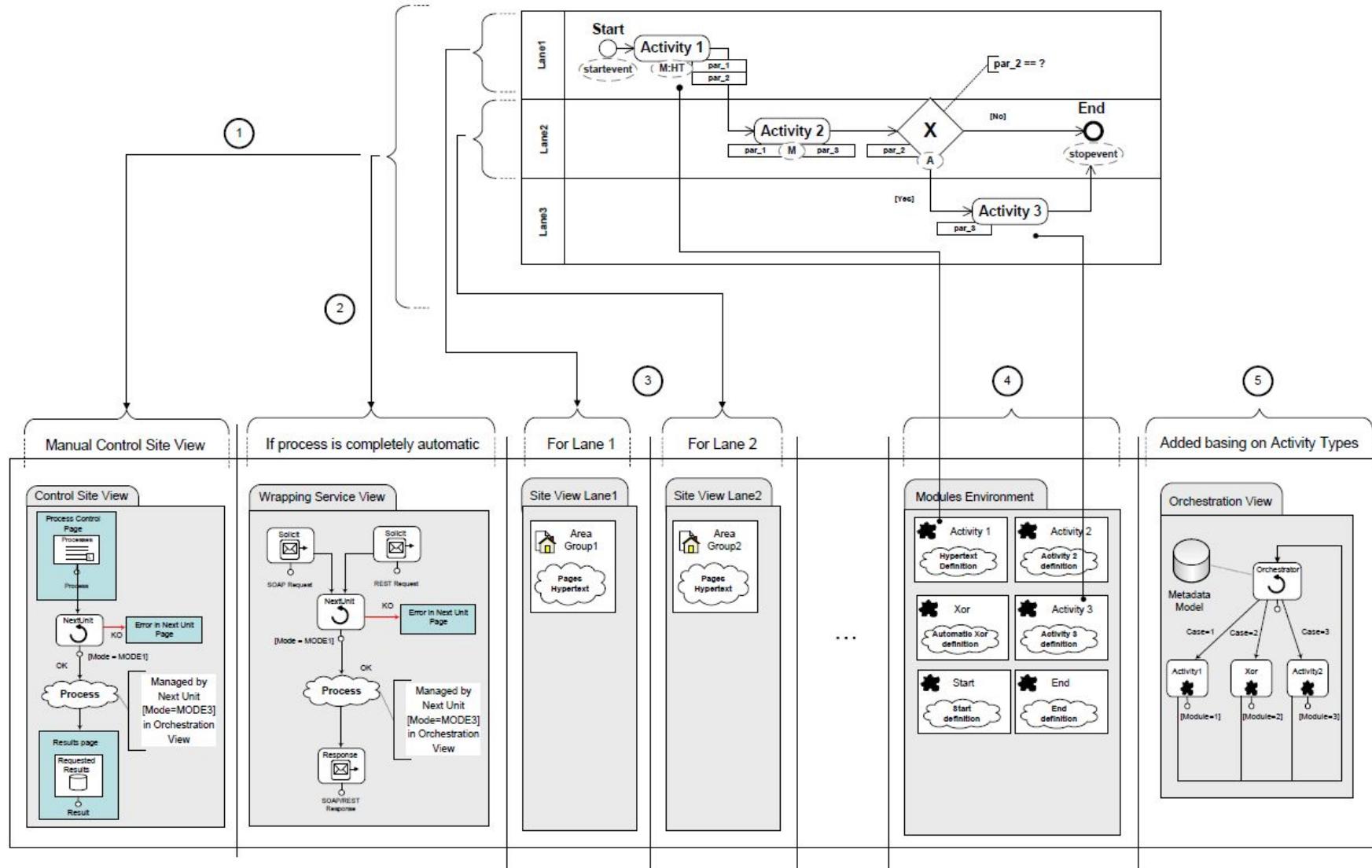
Model-driven Development Process

- Manual specification of BPMN process model
- Automatic transformation of BPMN to WebML
- Possible manual refinement of WebML models
- Automatic running code generation on J2EE platform
- Virtuous development cycle





The generated model artifacts

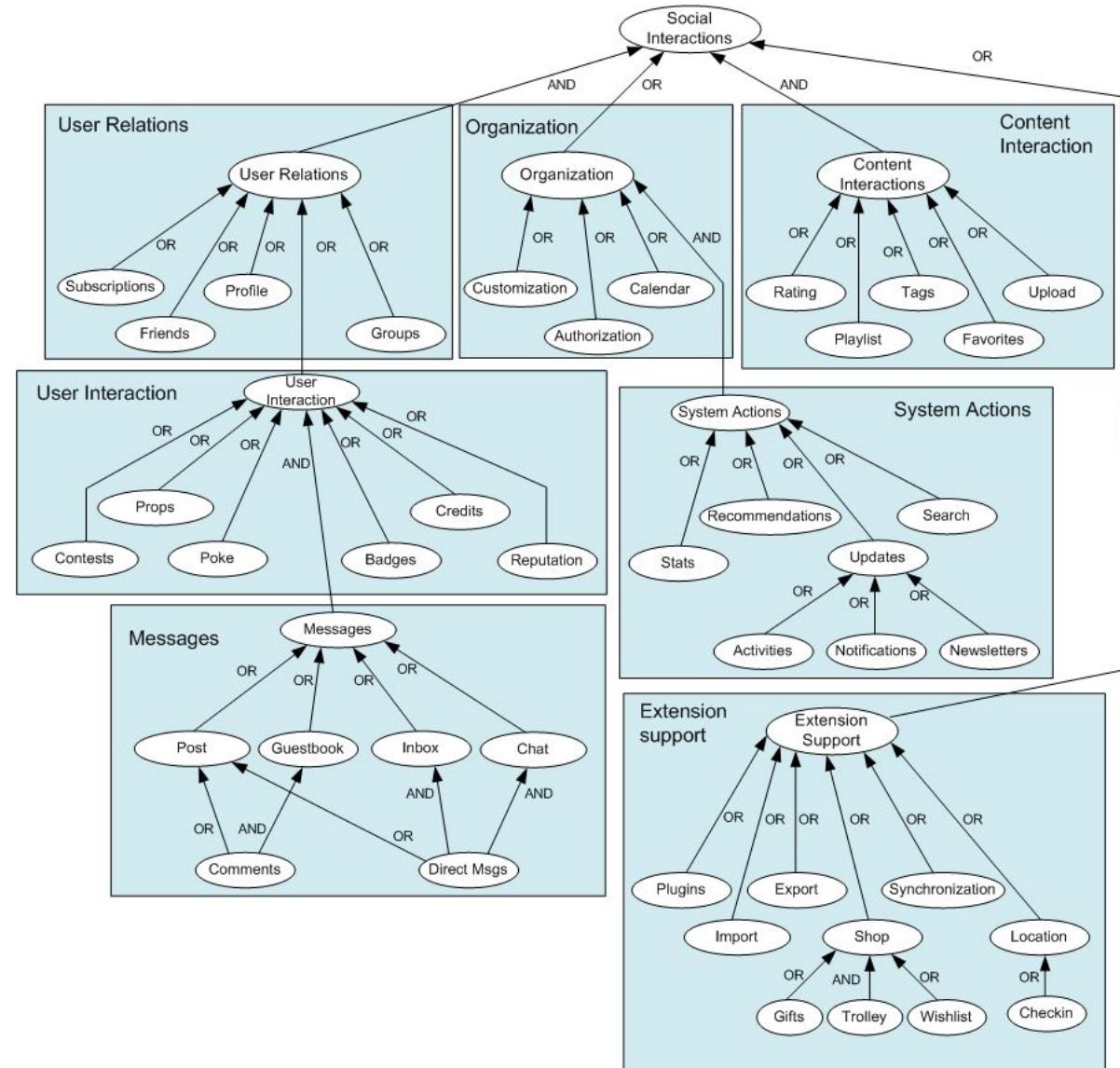




Needs addressed by social networks

Goal taxonomy

Interleaving with
enterprise values





Design patterns and goals

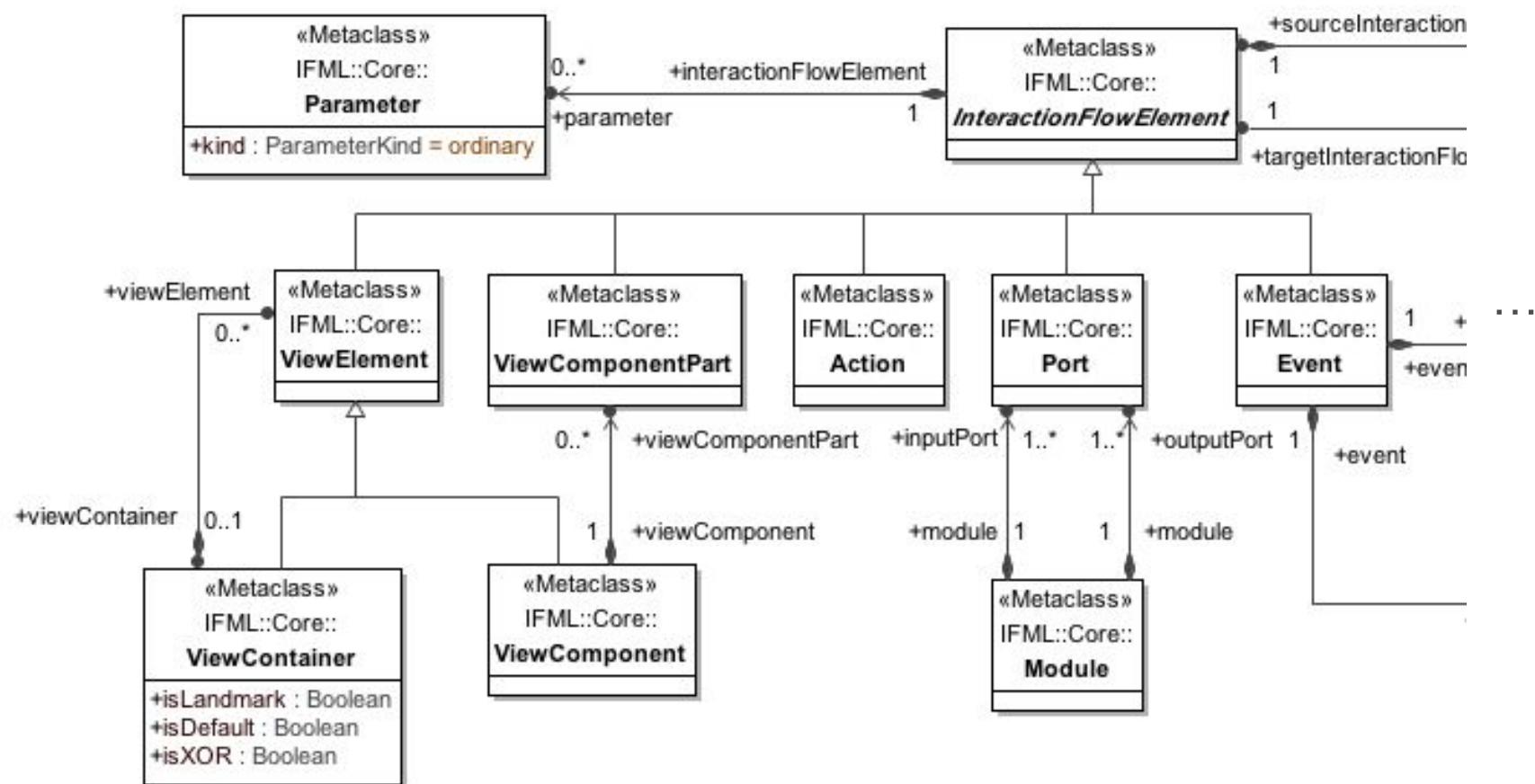
Socialization goals can be used as drivers for the selection of the social BPM design patterns that are more relevant to a process socialization effort

	Weak Ties / Tacit Knowledge	Transparency	Participation	Activity distribution	Decision distribution	Social f.back	Knowledge sharing
Dynamic enrollment			X				
Poll					X	X	
People / Skill search	X			X	X		
Social content publication		X					X
Social sourcing				X			
Progress notification		X					
Ranking and commenting	X				X	X	X



How does it work? IFML metamodel (1)

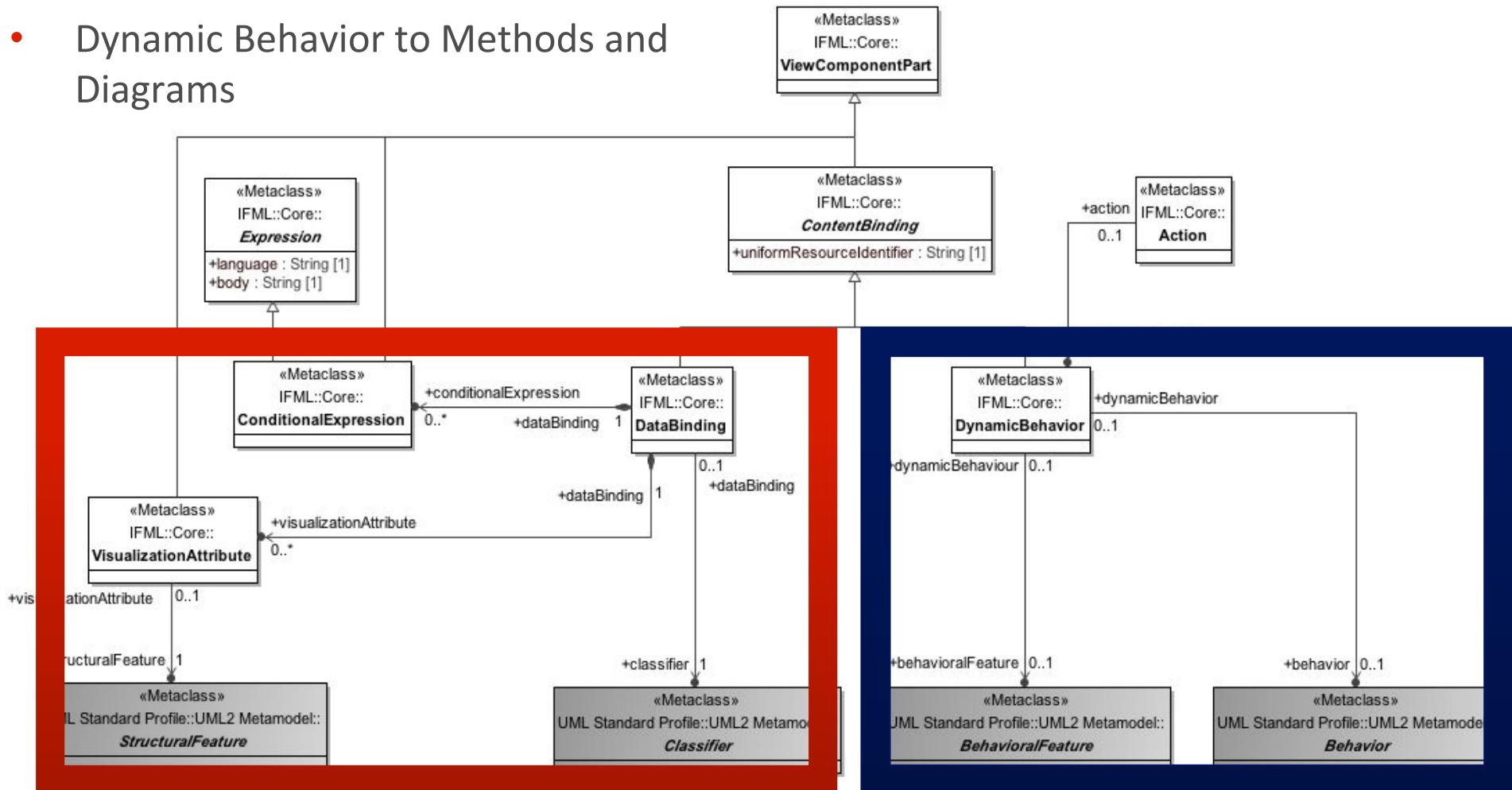
IFML is defined through a metamodel





IFML metamodel (2): Content Binding

- Data binding to Classes and Attributes
- Dynamic Behavior to Methods and Diagrams





Practical results of having a standard

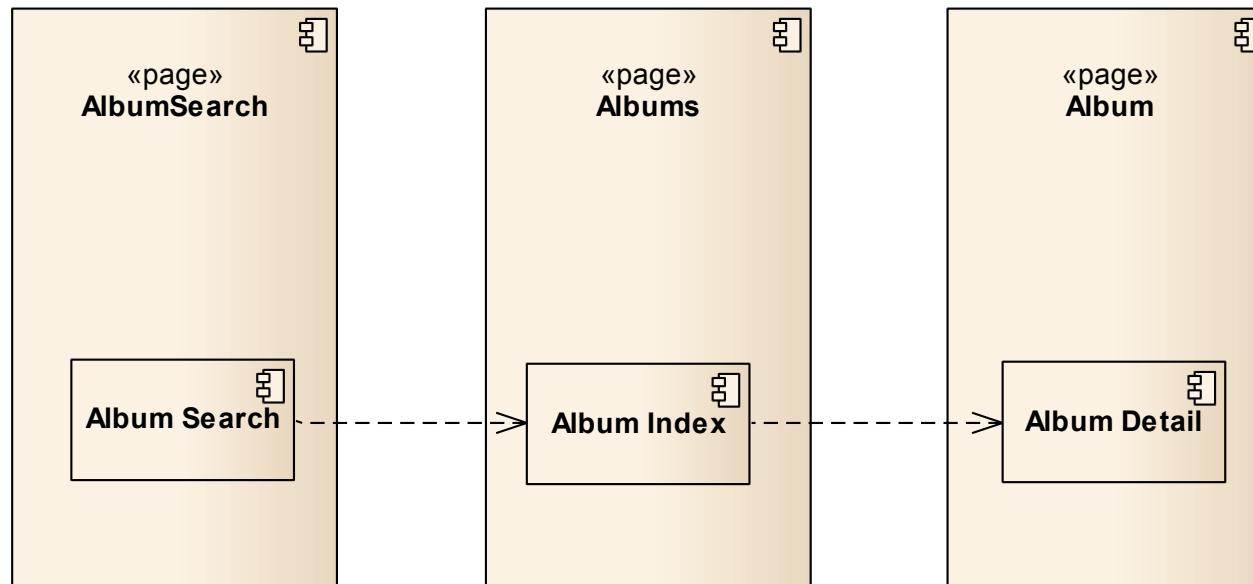
- An official **metamodel of the language** which describes the semantics of and relations between the modeling constructs
- A **graphical concrete syntax for the interaction flow notation** which provides an intuitive representation of the user interface composition, interaction and control logic for the front-end designer
- A **UML Profile** consistent to the metamodel
- An **interchange format** between tools using XMI

- All this, specified through standard notations themselves



Also: interchange with profile-based diagrams. The UML Profile for IFML

Static aspects



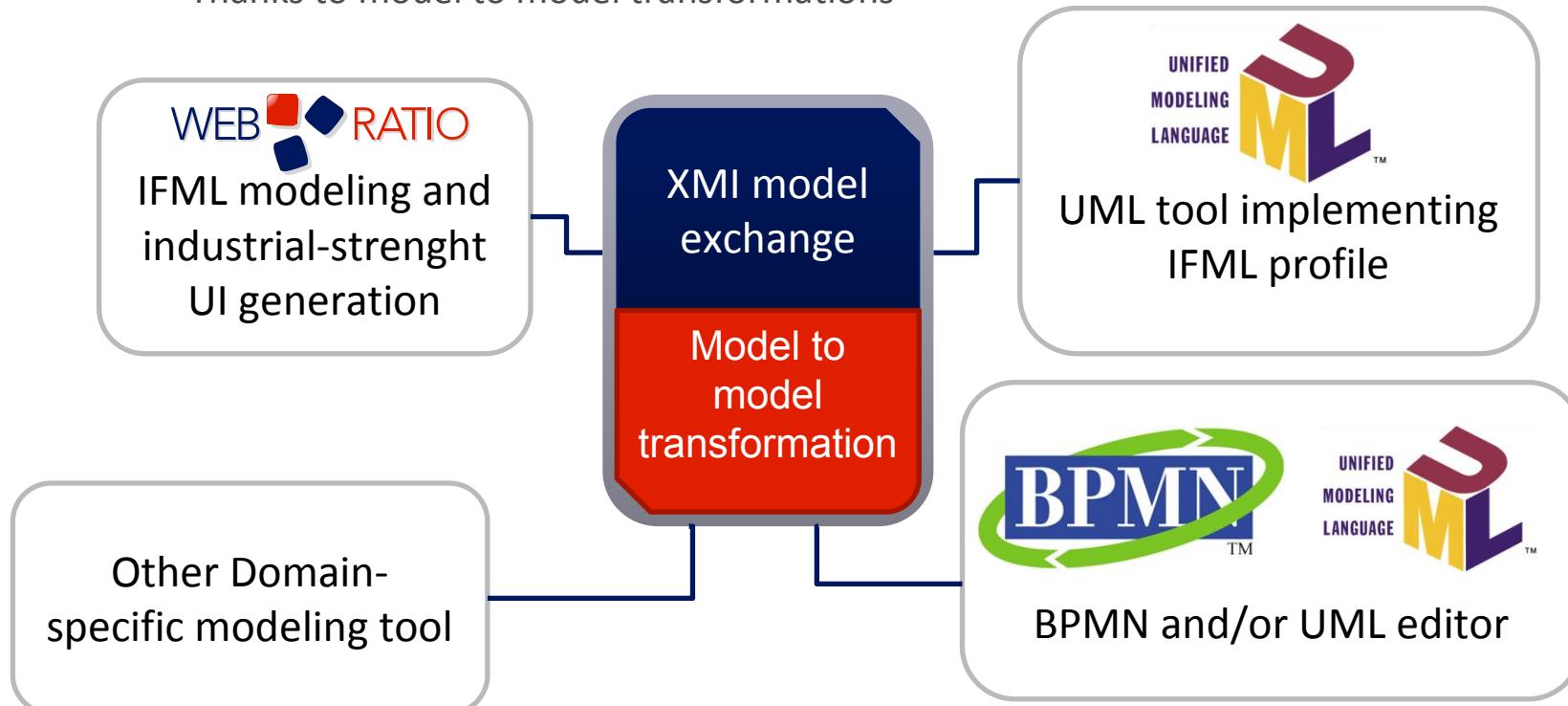
Dynamic aspects





Model integration and interchange

- Tight and seamless integration between different modeling tools
 - Thanks to XMI interchange format, UML profiles, vendor-specific notation implementations
 - Thanks to model to model transformations





The tool



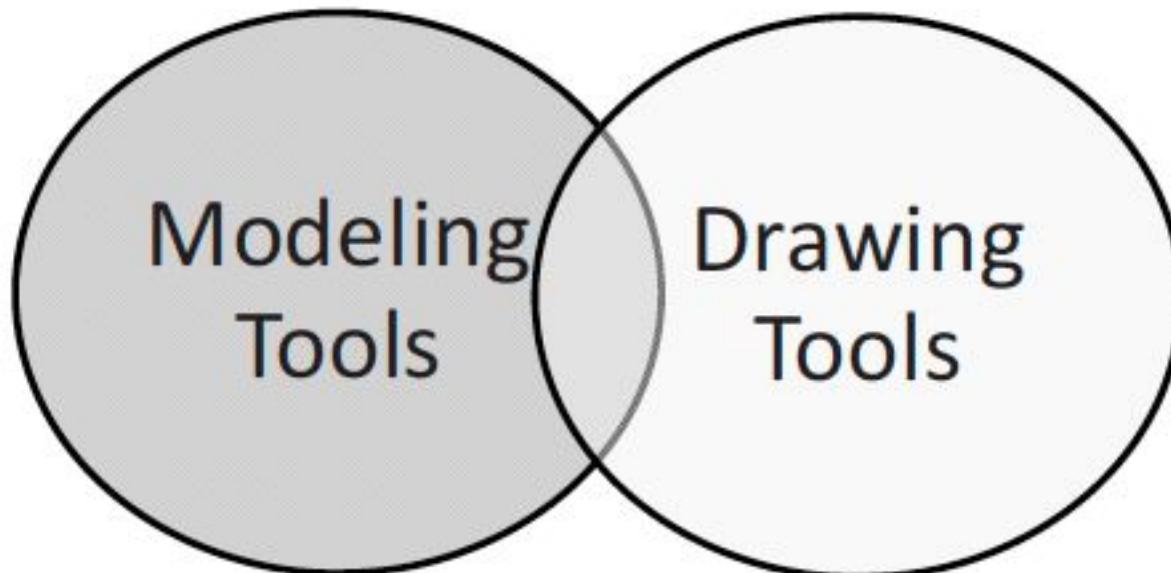
WEB RATIO

OMG®
WE SET THE STANDARD®



Tool support for MDE/MDD

Drawing vs. modeling





What is WebRatio

An Eclipse-based development environment allowing:

- Modeling: ER + IFML + BPMN
- **100% code generation** of standard JEE applications
 - Clear separation between design time and run time
 - No proprietary runtime
- Quick and agile development cycles
- Extending the generation rules
 - Defining new presentation styles
 - Defining new components
- Versioning, teamwork, full lifecycle mgt
- Truly multi-role model-driven development

Requirement Analysis

Results Verification

Solution Modeling

Prototype Generation



Some numbers

WebRatio is

- now at 7th release
- on the market since 2001

WebRatio customers

- 130+ companies and 500+ commercial users
- mainly Italy, USA, Europe and Latin America

WebRatio adoption

- 15,000+ users of the free edition
- Used in hundreds of universities all over the world

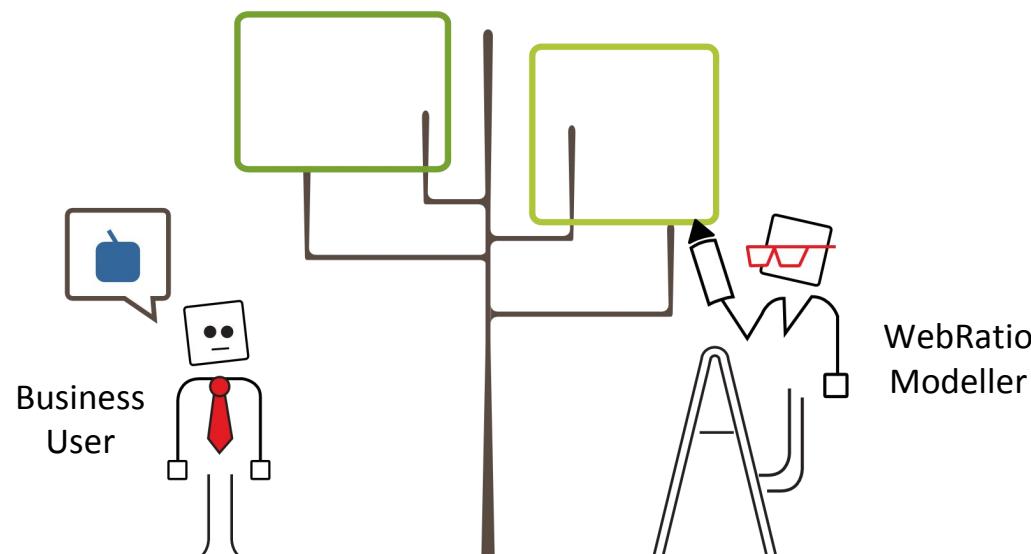
WebRatio partners

- 40+ software houses and system integrators
- 300+ universities worldwide, 13.000+ students



WebRatio – Step 1

You capture business requirements in abstract,
technology independent models

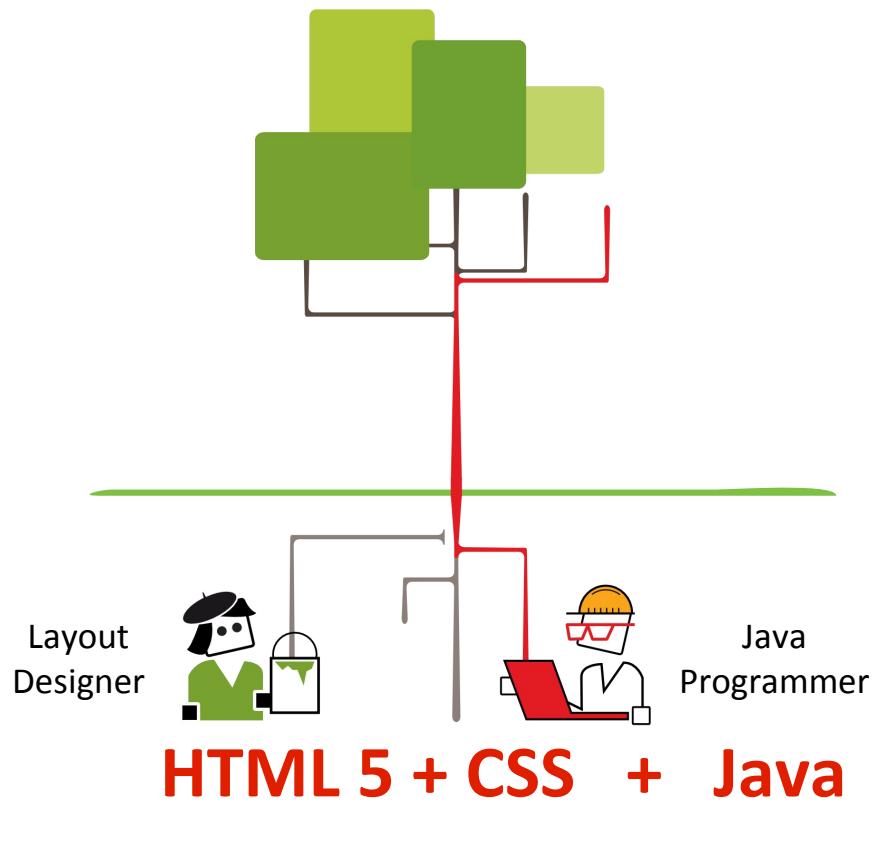


BPMN + IFML



WebRatio – Step 2

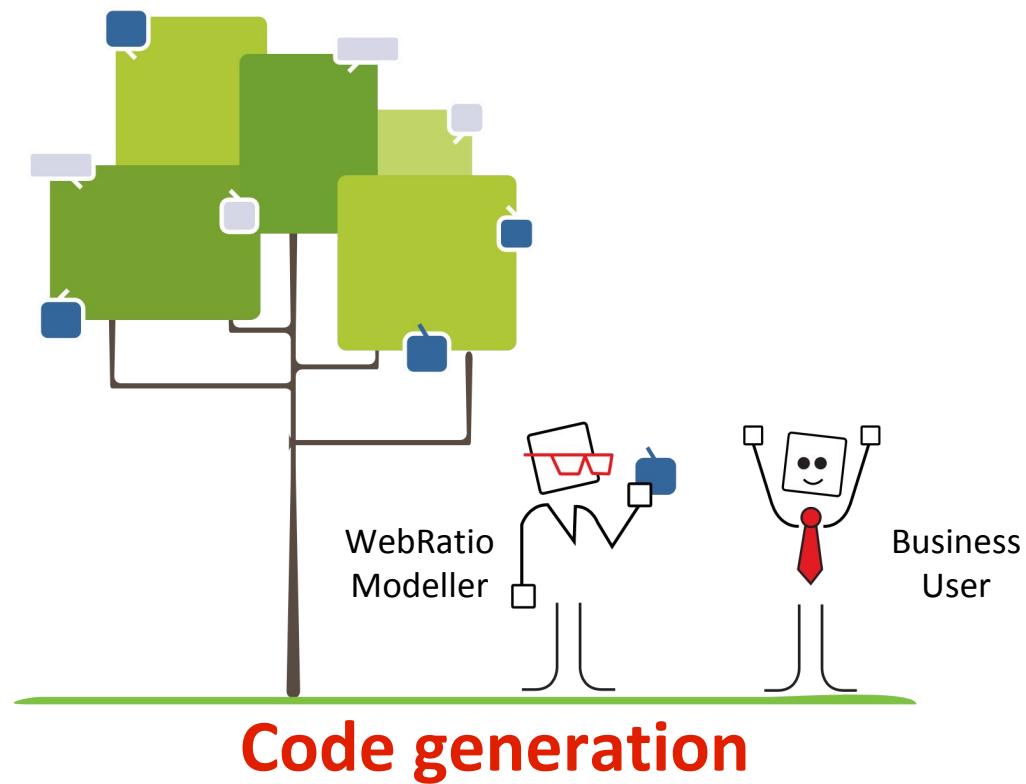
You customize the environment by defining your own generation rules





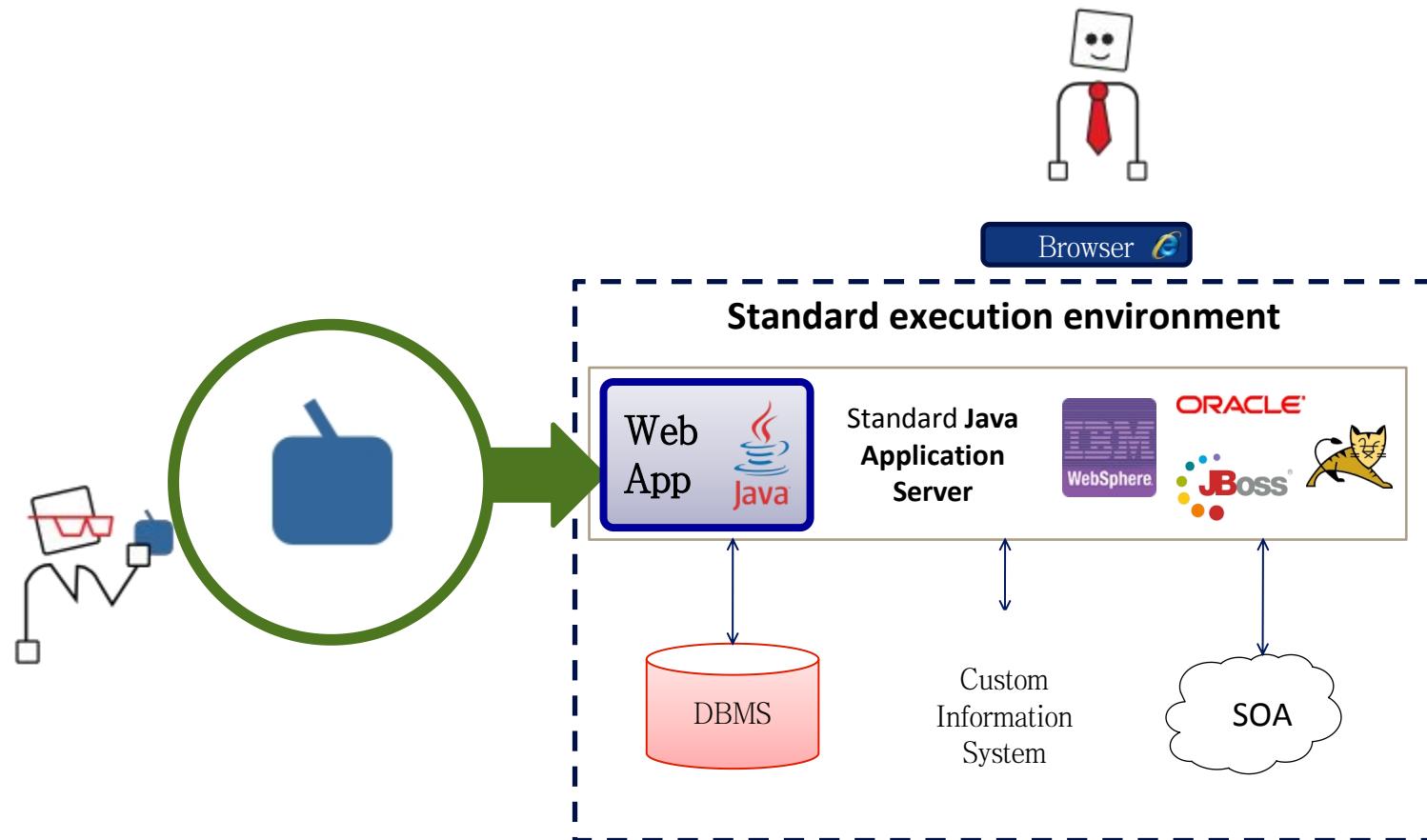
WebRatio – Step 3

You get a tailored, yet standard, Java Web application
with no proprietary runtime





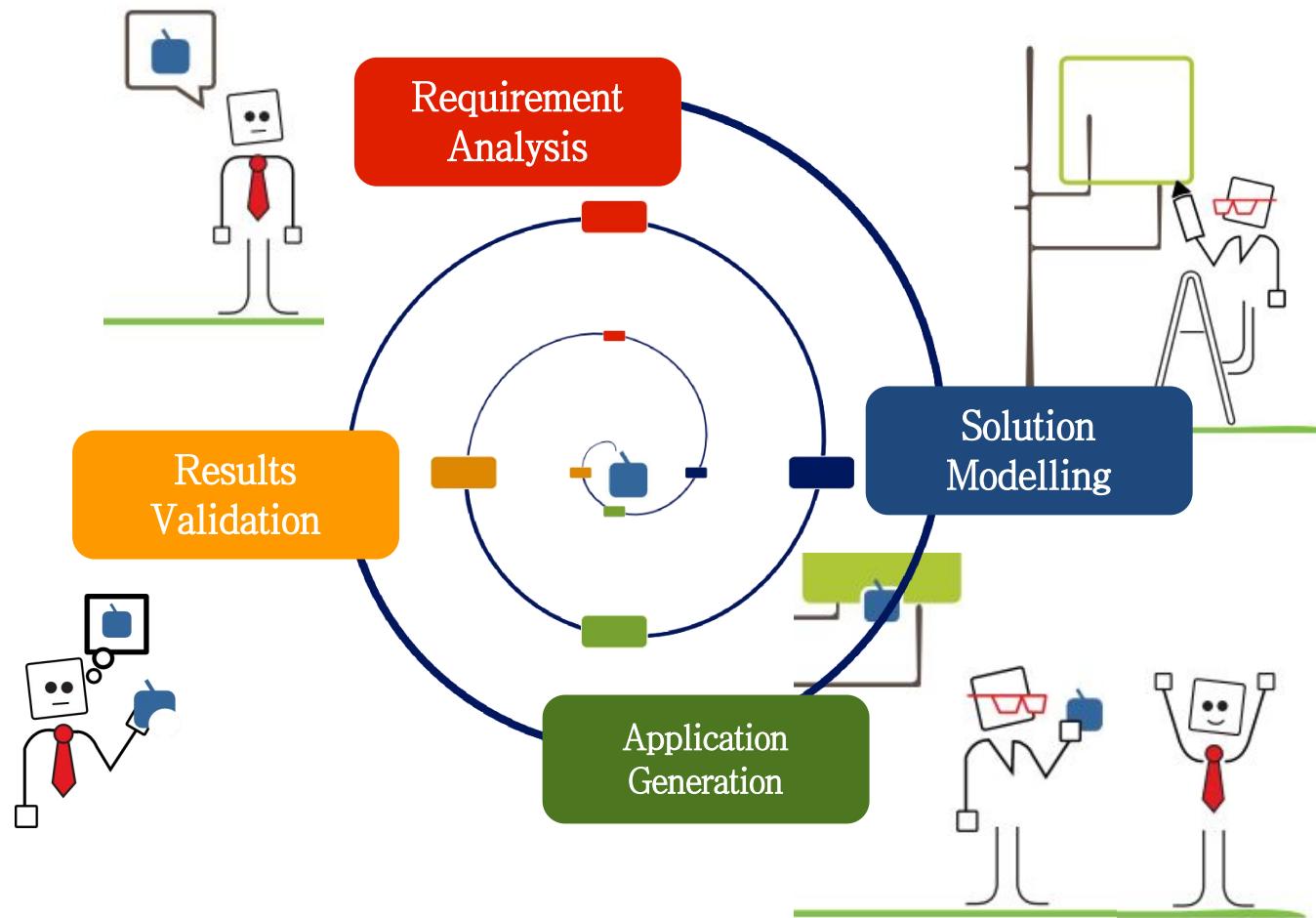
Get the application



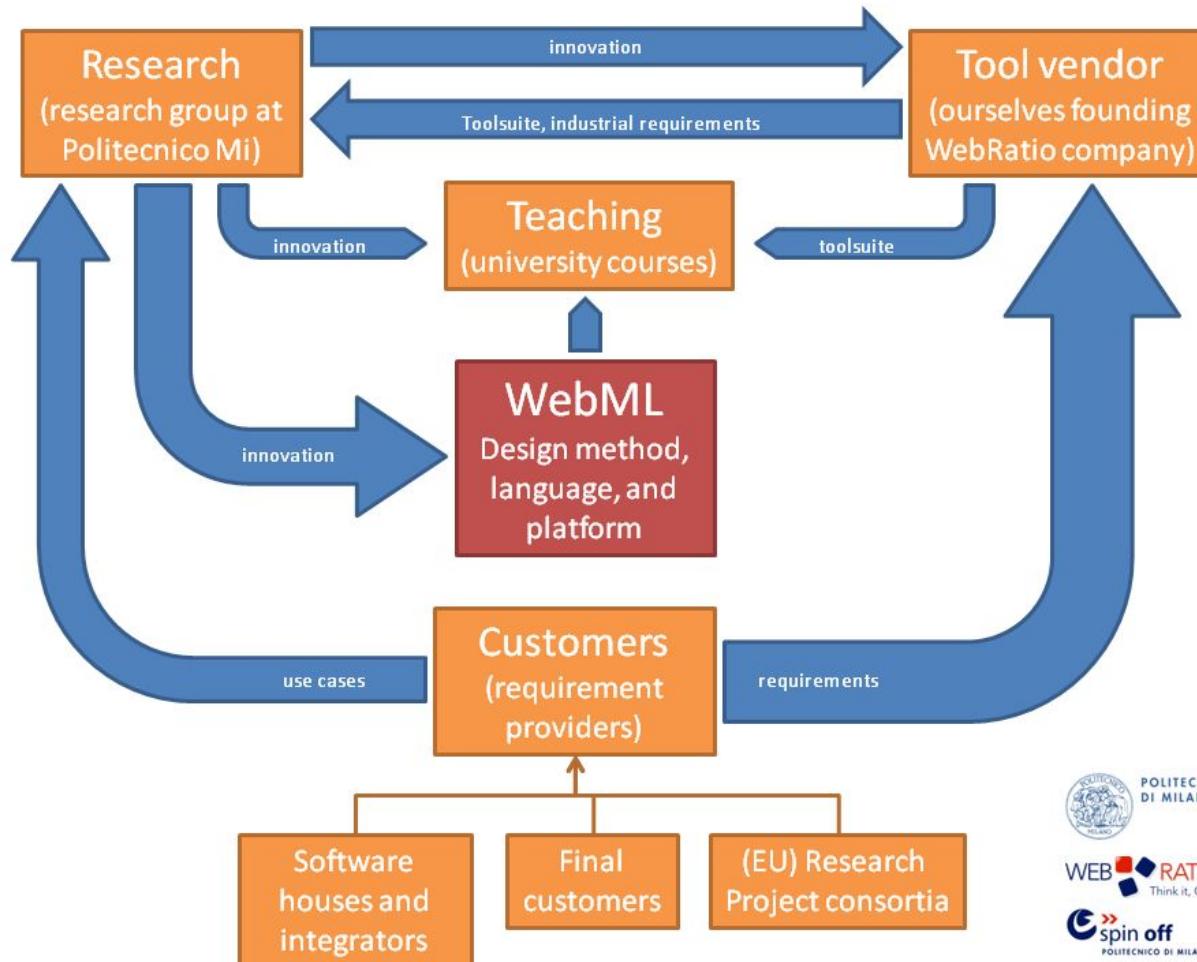


Agile, quick prototyping

Involve business users in the development process and converge quickly to the target



Our innovation environment



POLITECNICO
DI MILANO

WEB  RATIO®

Think it. Get it!

E spin off

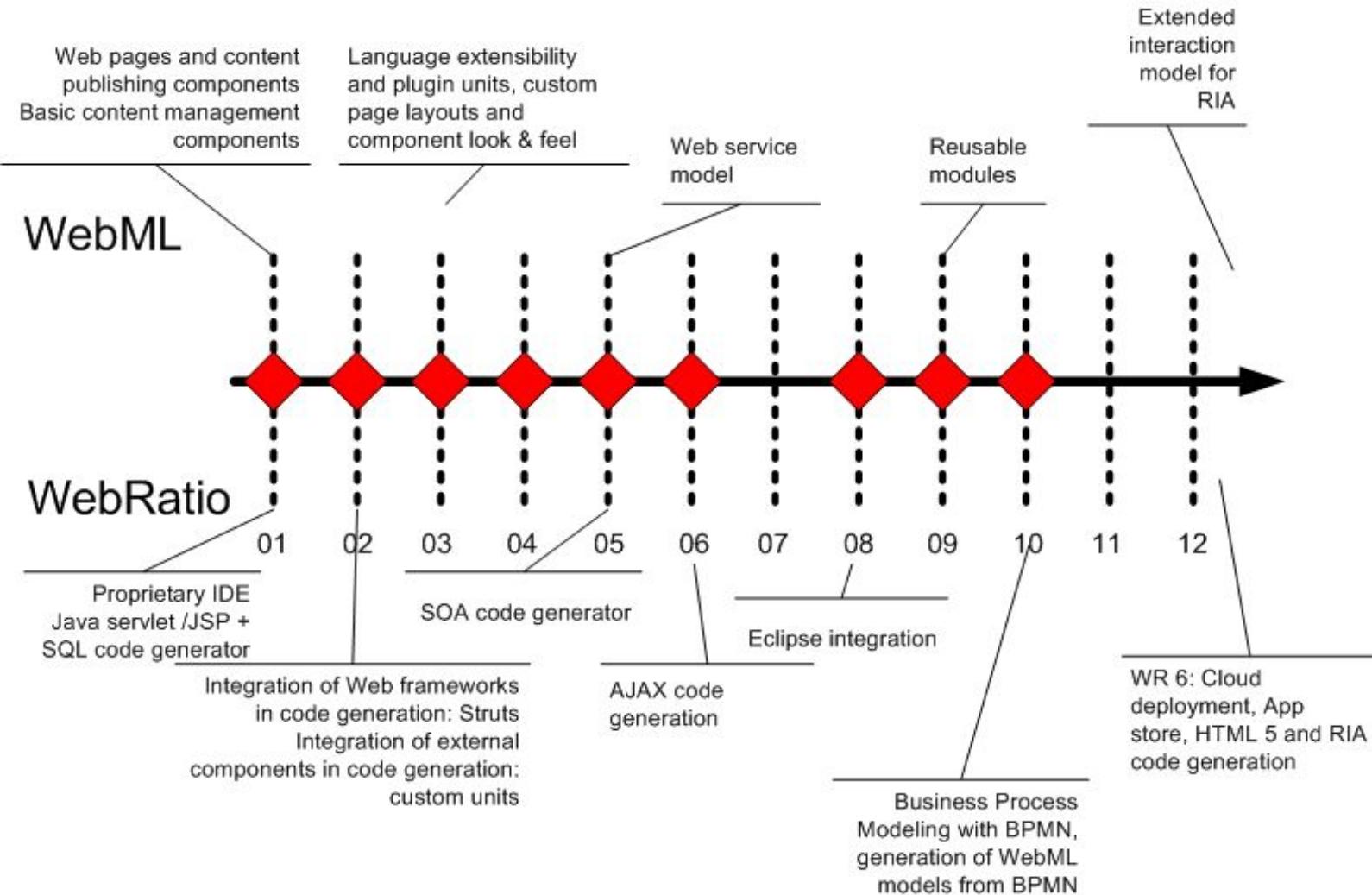
POLITECNICO DI MILANO

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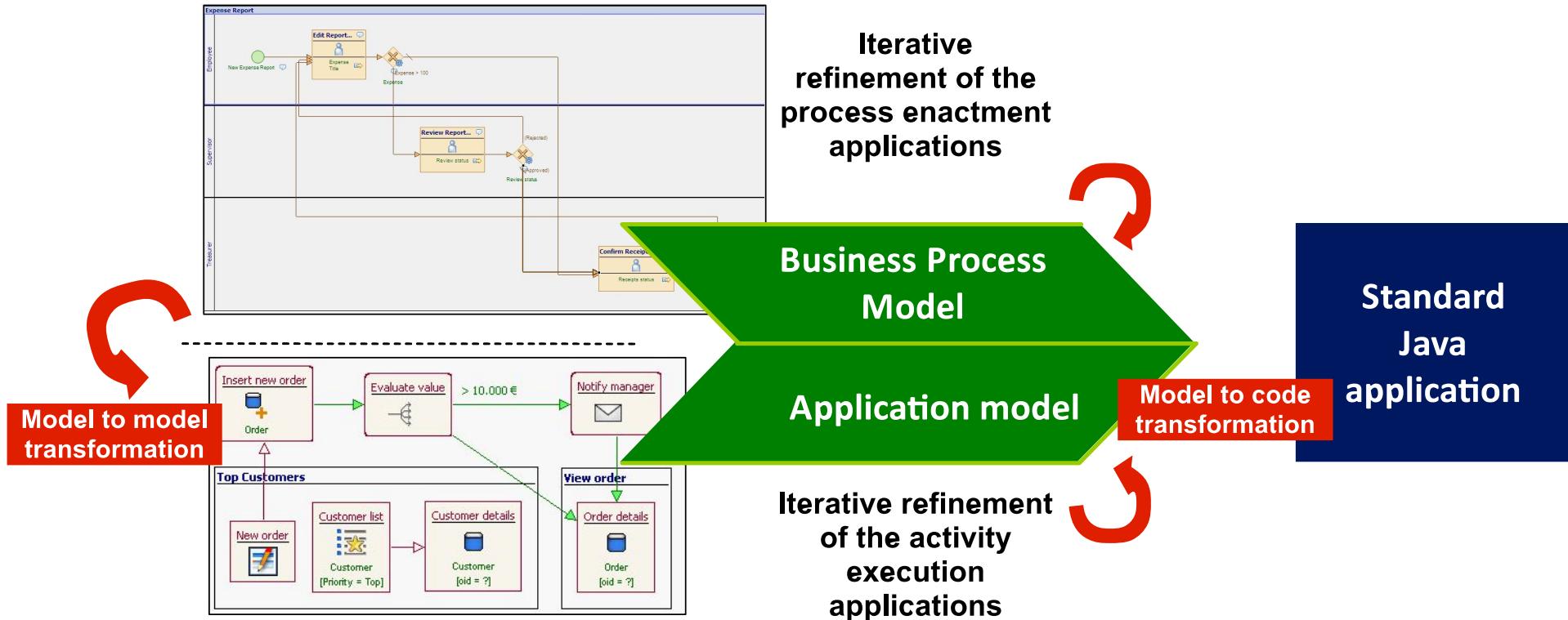


Evolution of tool (and language)



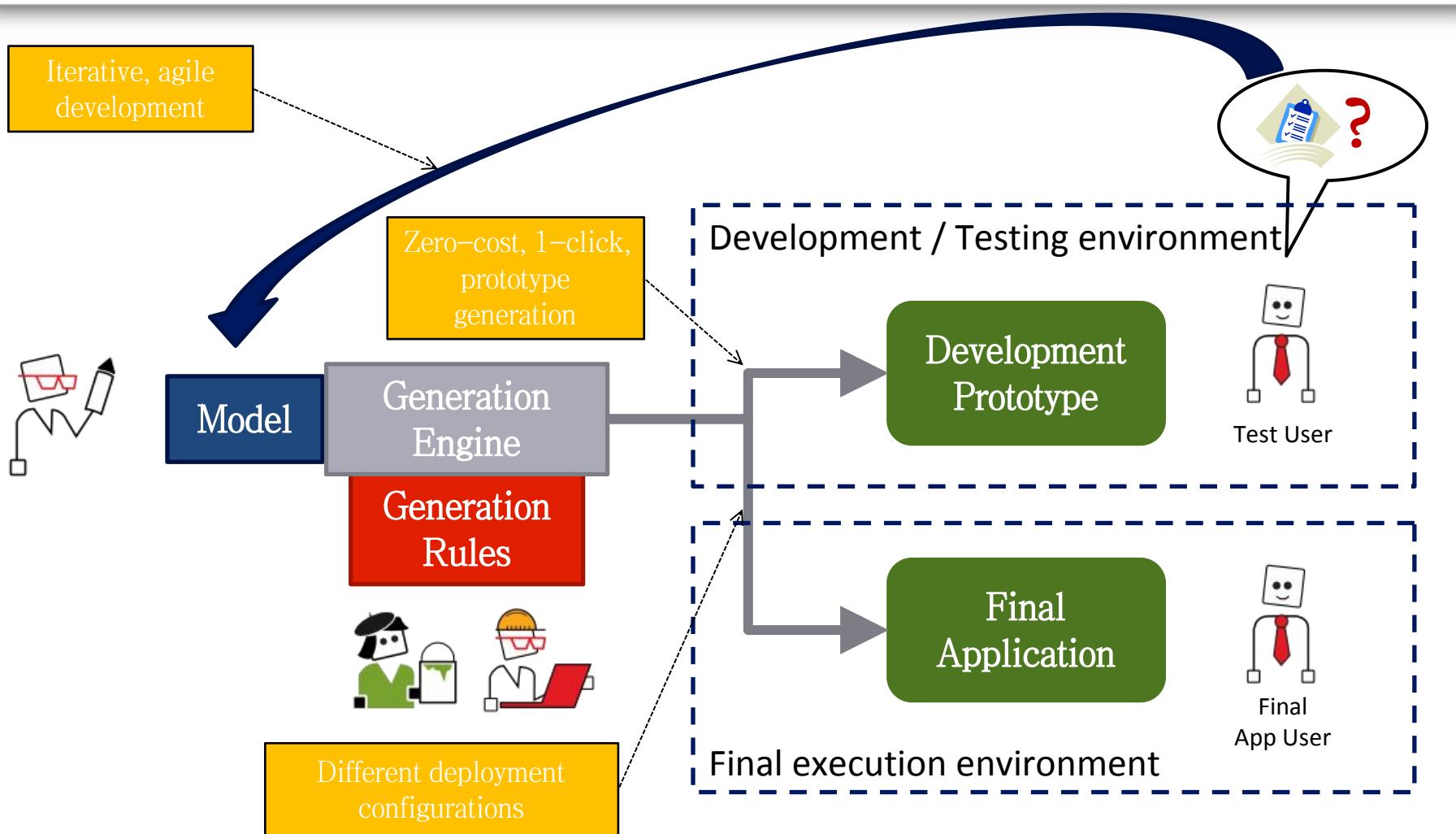


The final picture





Agility + MDD

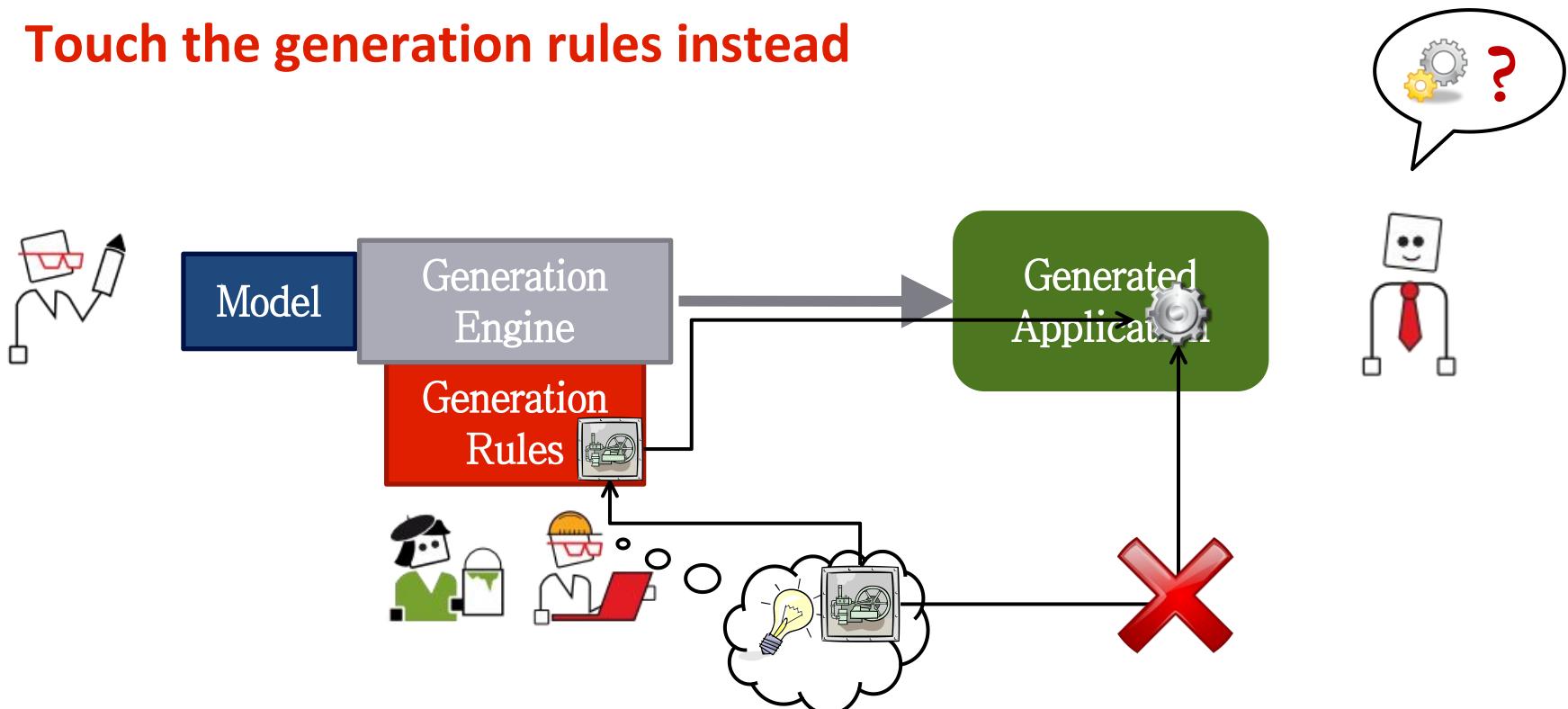




The MDE Virtuous Cycle

Do not change the generated application code

Touch the generation rules instead



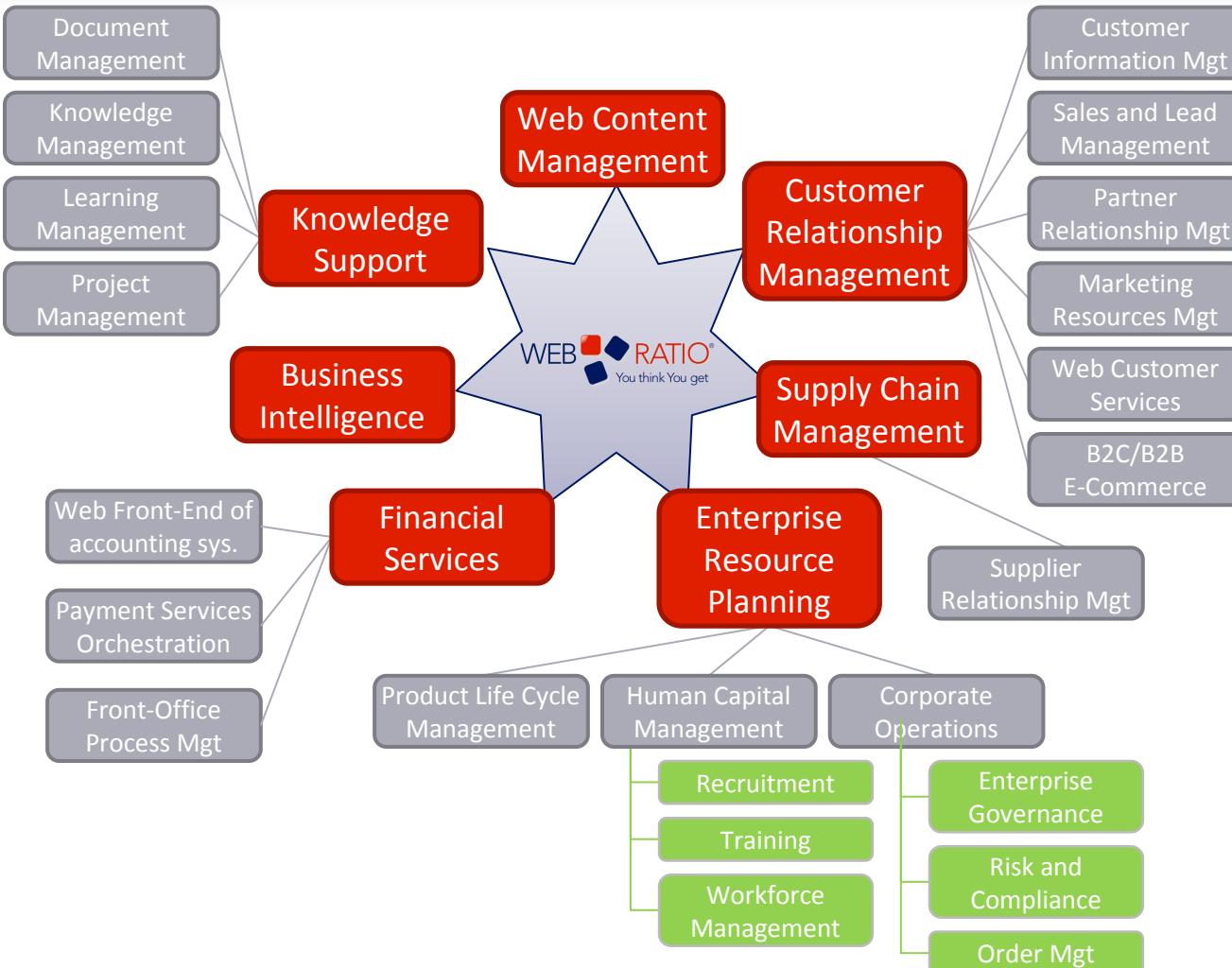


Case Studies





Kinds of application





Clienti e settori

Energy & Utilities



Industry



Finance



Public Services



Research





Acer

B2C + CMS Web applications initially for 14 EU countries

Corporate news, Product technical & commercial data, Service & Partner area, Where to Buy...

Multilingual, multi-actor, distributed workflows for local and central PMs, local and central MarCom managers

... and a: very limited Time to Market (7 weeks!!)



Size & effort

Class	Dimension	Value
Size	Number of localized B2C web sites	14
	Number of main CMS applications	4 (Admin, News, Product, Other content)
	Number of supported languages	12 for B2C Web sites, 1 for CMS
	Number of data entry masks	39
	Number of automatically generated database tables	46
	Number of automatically generated database views	82
	Number of automatically generated database queries	279 for data extraction, 89 for data update
	Number of automatically generated JSP page templates	48
	Number of automatically generated or reused Java classes	250
Time & effort	Number of automatically generated Java lines of code	12500 Non commented lines of code
	Number of elapsed workdays	49
	Number of development staff-months (analysts and developers)	6 staff-months (6 weeks x 4 persons)
	Total number of prototypes	9
	Average elapsed man days between consecutive prototypes	5,4
	Average number of development man days per prototype	15,5



Size & effort

DEGREE OF AUTOMATION	
Number of manually written SQL statements	17(SQL constraints)
Percentage of automatically generated SQL code	96%
Number of manually written/adapted Java classes /JSP templates	10% JSP templates manually adapted
Percentage of automatically generated Java and JSP code	90% JSP templates, 100% Java classes
COST AND ROI	
Total cost of software development of first version	75.000 €
HW, SW licenses, and connectivity cost of first version	70.000 € (db server license)
Return on investment of first version	12-15 months
Average effort of extension to one additional country	0,5 staff-months
Average cost of extension to one additional country	7.500 €
Average ROI of extension to one additional country	2 months
PRODUCTIVITY	
Number of function points	177 (B2C web site) + 612 (CMS) = 789
Average number of function points delivered per staff-month	131,5



Comments

On the positive side:

- Almost 80% of the delivery effort concentrates in the phases of data design, hypertext design and prototyping:
 - more development time is spent with the application stakeholders

MDD allows a more flexible distribution of responsibilities between the IT department and the business units

The peak productivity rates has reached five times the number of delivered function points per staff-month of a traditional programming language like Java



Comments (continued)

On the negative side..

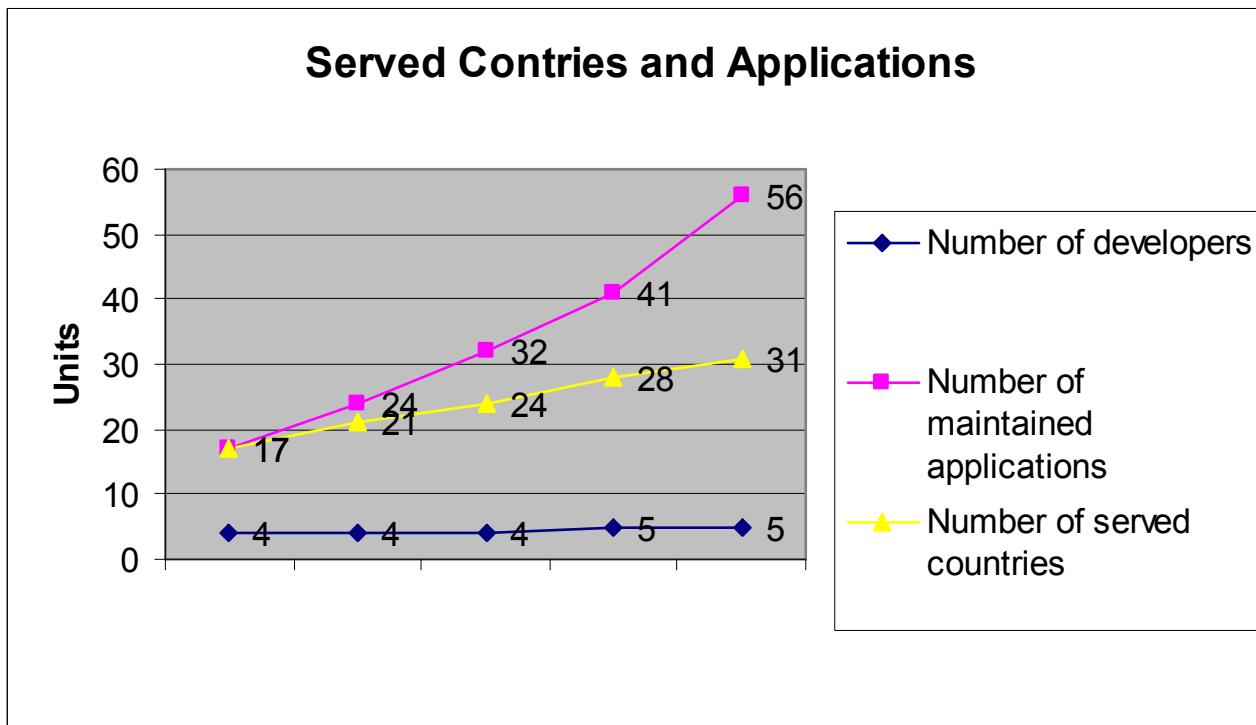
- Acer estimates that it took from 4 to 6 months to have fully productive developers with MDD, IFML, and WebRatio
- Difficult to find skilled people

..but..

- The initial investment in human capital required by MDD pays off in the mid term
 - MDD benefits testing, maintenance, and evolution (which account for over 60% of the total lifecycle cost)
 - reasoning on the system is far more effective at the conceptual level



Maintenance effort





GTT: Turin Transportation Group

- Public company owned by the City of Turin in Italy
- Local public transport serving 190 million passengers every year.
- A new e-ticketing system (available at <http://ecommerce.gtt.to.it> and serving 64,000 daily passengers)
- published on-line in only 2 months.
- The application comprises 100 page templates (IFML pages) and 1215 IFML units.
- KEY: iterative and quick prototyping approach supported by WebRatio



A2A: Utility in Milan

- Multi-utility company buying and selling wholesale electric power.
- Integrated Energy Management System that replaced individual productivity tools used by traders for the management of electric power.
- KEY: quick prototyping approach and involvement of actual users in the development process.
- Deployment of final app in 6 months after the initial meeting with WebRatio (time to market that took one-third of the time estimated in case of adoption of a traditional development)



Other experiences

- Banking (UniCredit)
 - BPM + SOA + Web interfaces
 - Crucial points: modularization, multiple models integration, multiple tools integration, strict runtime platform requirements
- Banking (ABI)
 - System integration (Pure backend!)
 - Why IFML?
- Latin America
 - Cooperatives, banks, public bodies, central government
- Wholesale (IKEA)
- Financial / leasing (GE Capital)

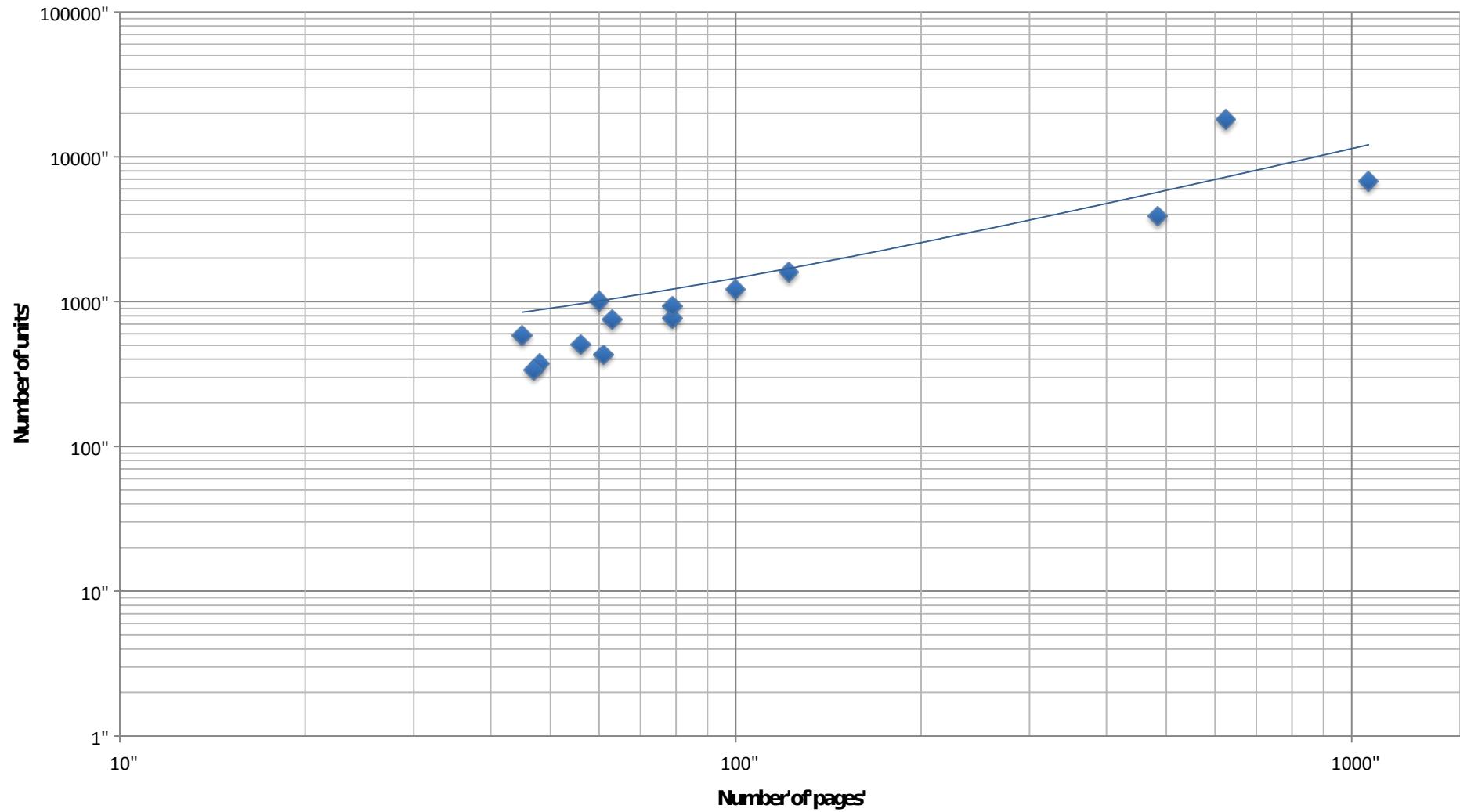


Where IFML works

- **Models integration**
- **Large applications with strong need for coherence and standardized paradigms**
 - Cooperatives, banks, public bodies, central government
- **Service orientation**
- **No pure modeling exists**
- **Code generation still win-win**

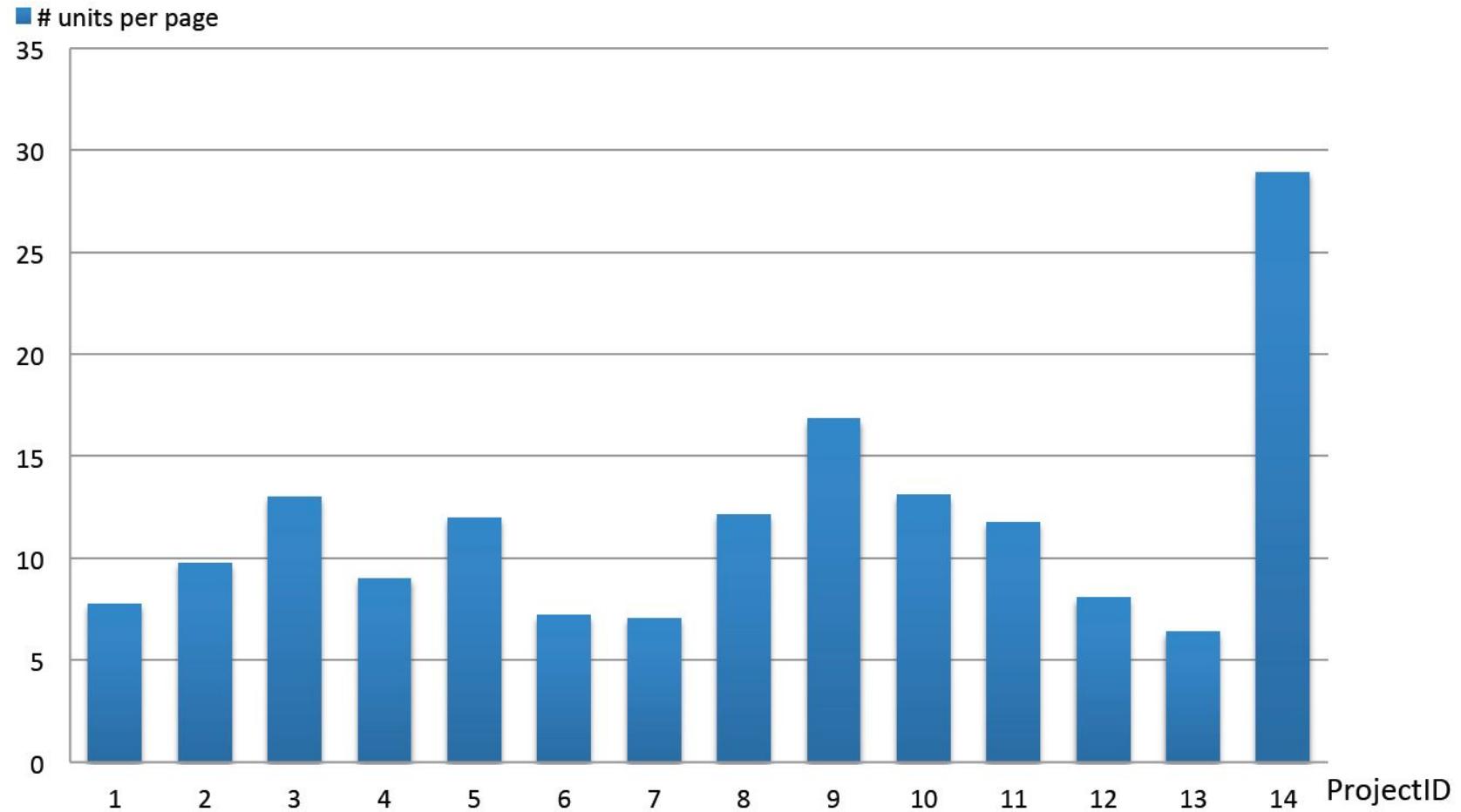


Components and pages per project



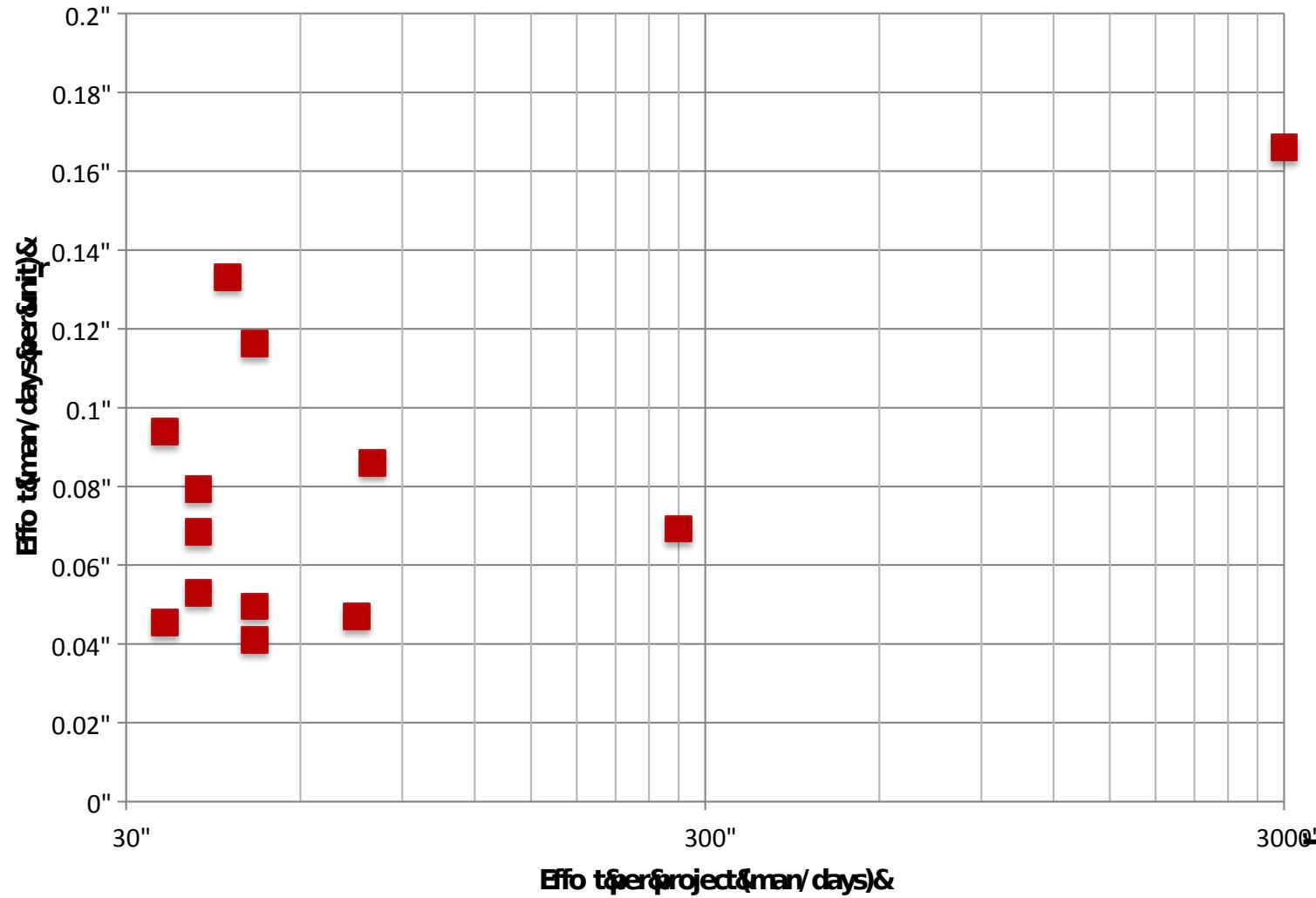


Components per page (avg)



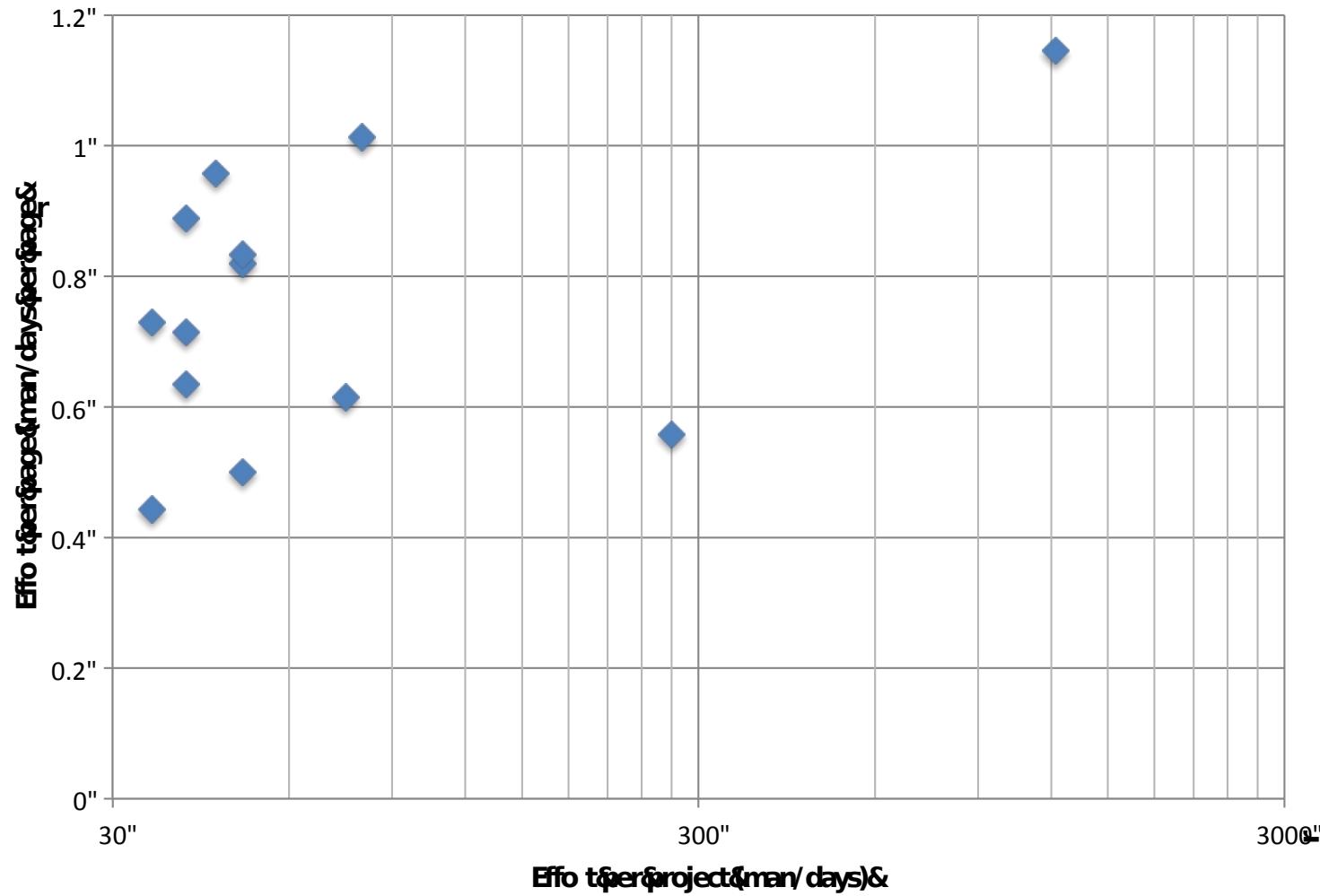


Man/days per component





Man/days per page





Tool usage stats

Description	Value
# of times the tool has been opened daily	1.79
# of daily code generations	11.76
# of 1-click generation and publishing of the application	0.26
# of checks of the modelling warnings	2.09
# of checks of graphical layout warning	0.11
# of automatic generations of the documentation	0.02



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M. Brambilla, J. Cabot, M. Wimmer: Model Driven Software Engineering in Practice. Morgan & Claypool, USA, September 2012, foreword by Richard Soley (OMG), 184 pages. ISBN 978-1608458820.

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Some Ads

MD* blog

www.modellivenstar.com

MD*: The Model-Driven Star blog

Model-driven engineering, Model-Driven Application, Business Process Modeling, and BPMN

Marco Brambilla, Jordi Cabot, and Manuel Wimmer

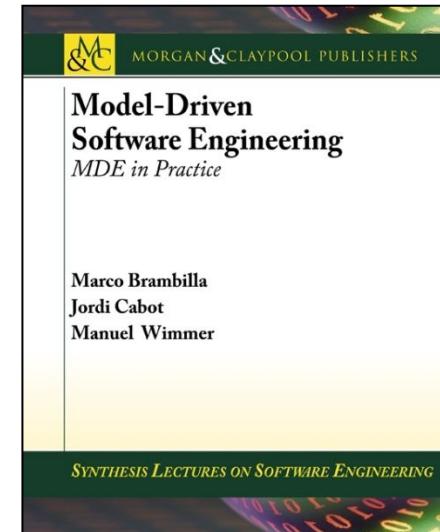
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Marco Brambilla is currently a research professor at Politecnico di Milano, Italy, and a visiting professor at the University of Twente, The Netherlands. He received his Ph.D. in computer science from the University of Twente, The Netherlands, in 2002. He has been a visiting scholar at the University of California, Berkeley, and at the University of Illinois Urbana-Champaign. He is a member of the IEEE Computer Society, ACM SIGART, and ACM SIGART.

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“Model Driven Software Engineering in Practice”.
Brambilla, Cabot, Wimmer.

Morgan&Claypool, USA, 2012



And the upcoming IFML book!

See draft made available



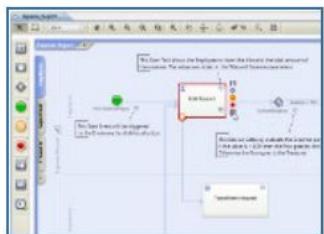
Webratio

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WebRatio Download Center

WebRatio 7 editions currently available for download:

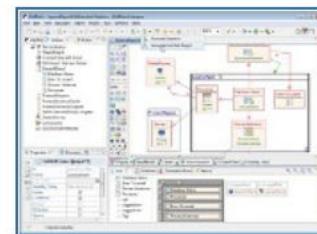
Bpm Free



Dedicated to business process analysts wanting to edit BPMN diagrams and rapidly get a prototype of their BPM application.

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Thanks!



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