

# **Enterprise UML & MDA 2004 conference**

**The New Connaught Rooms  
12 & 13<sup>th</sup> May 2004**



IBM Software Group

# Model Driven Software Development Platform using Eclipse, EMF and UML

**Sridhar Iyengar**  
IBM Distinguished Engineer

[siyengar@us.ibm.com](mailto:siyengar@us.ibm.com)

May 12-13, London

**Rational.** software



ENTERPRISE  
**UML & MDA**  
2004

@business on demand software

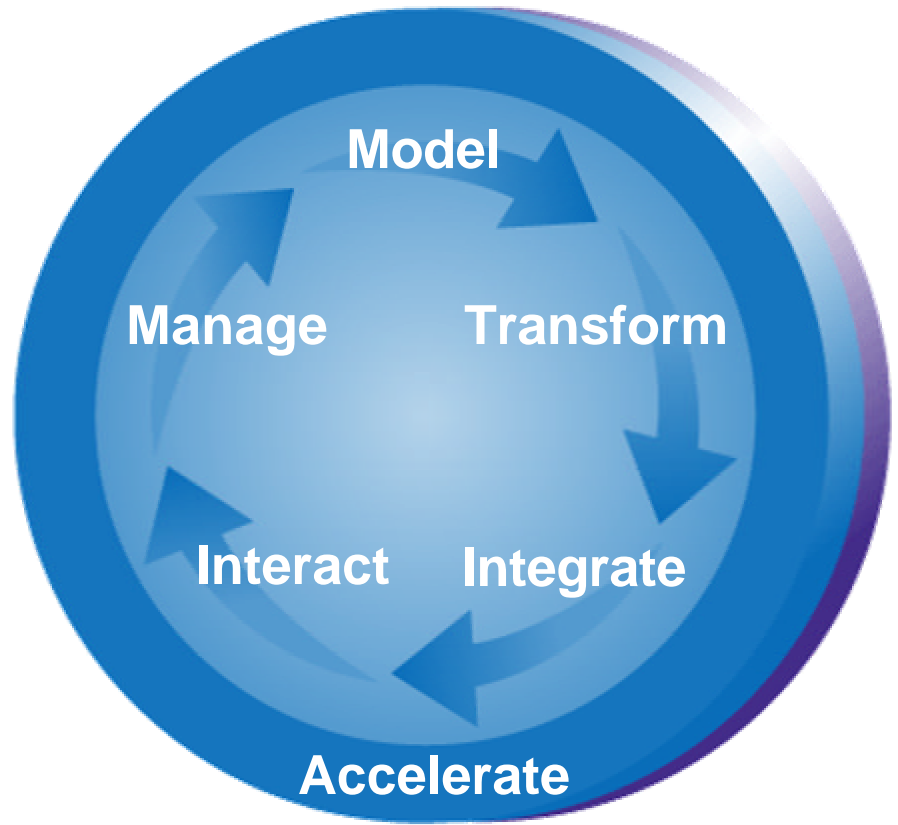
# Agenda

- **Software Development as a Business Process**
  - ▶ Implications for a software development platform
- **MDA in a nutshell**
  - ▶ Key MDA concepts
  - ▶ Key Standards
- **Eclipse in a nutshell**
  - ▶ Eclipse core and the plug-in architecture
  - ▶ Eclipse Modeling projects
    - EMF, UML2, Hyades...
- **Building a Software Development Platform using Eclipse and MDA**

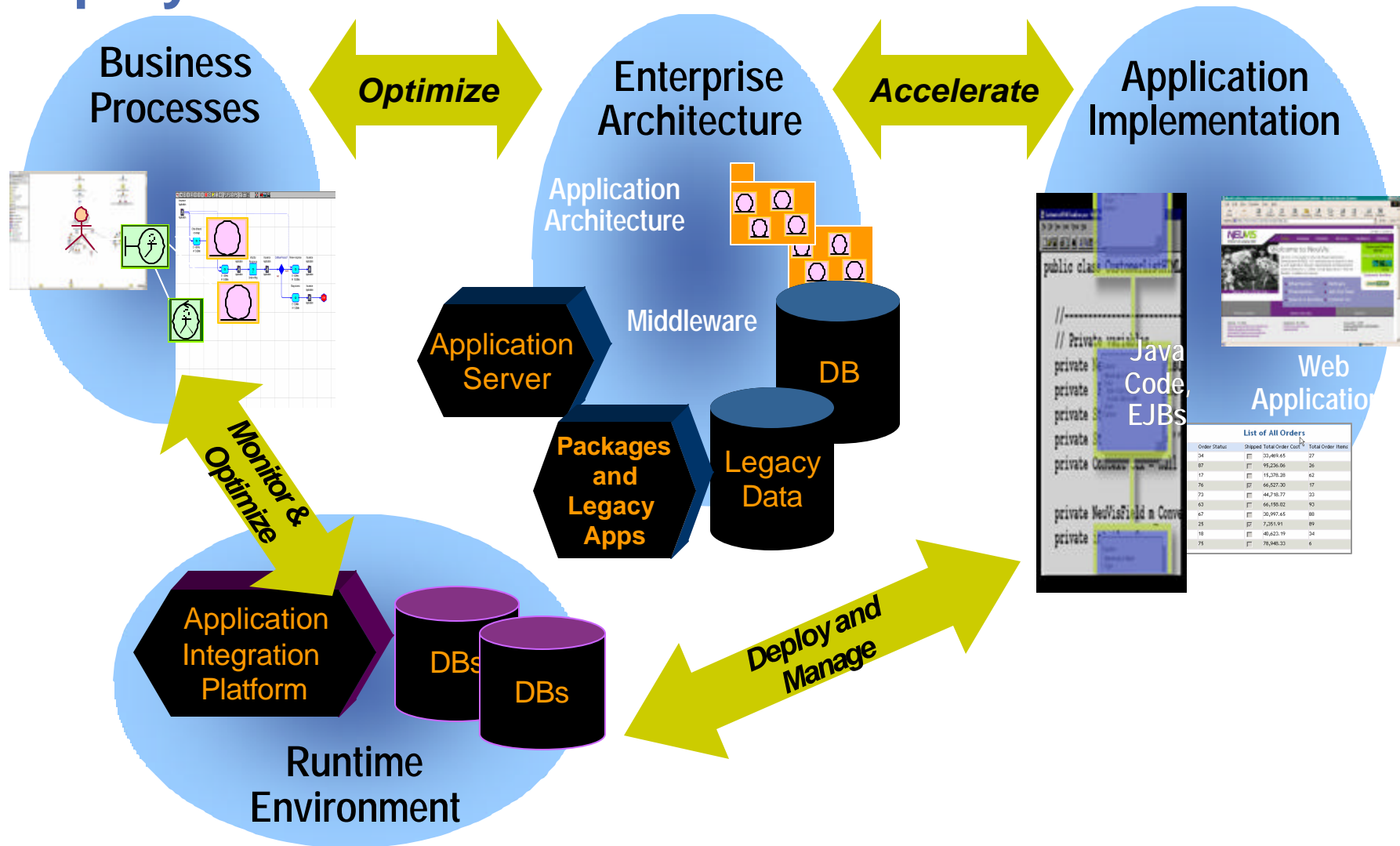


# Integration Capabilities for the On Demand Enterprise

- Model**      business functions and processes
- Transform**    applications, processes and data
- Integrate**    islands of applications, processes and information
- Interact**     with resources anytime, anywhere with any device
- Manage**      performance against business objectives
- Accelerate**    the implementation of intelligent processes



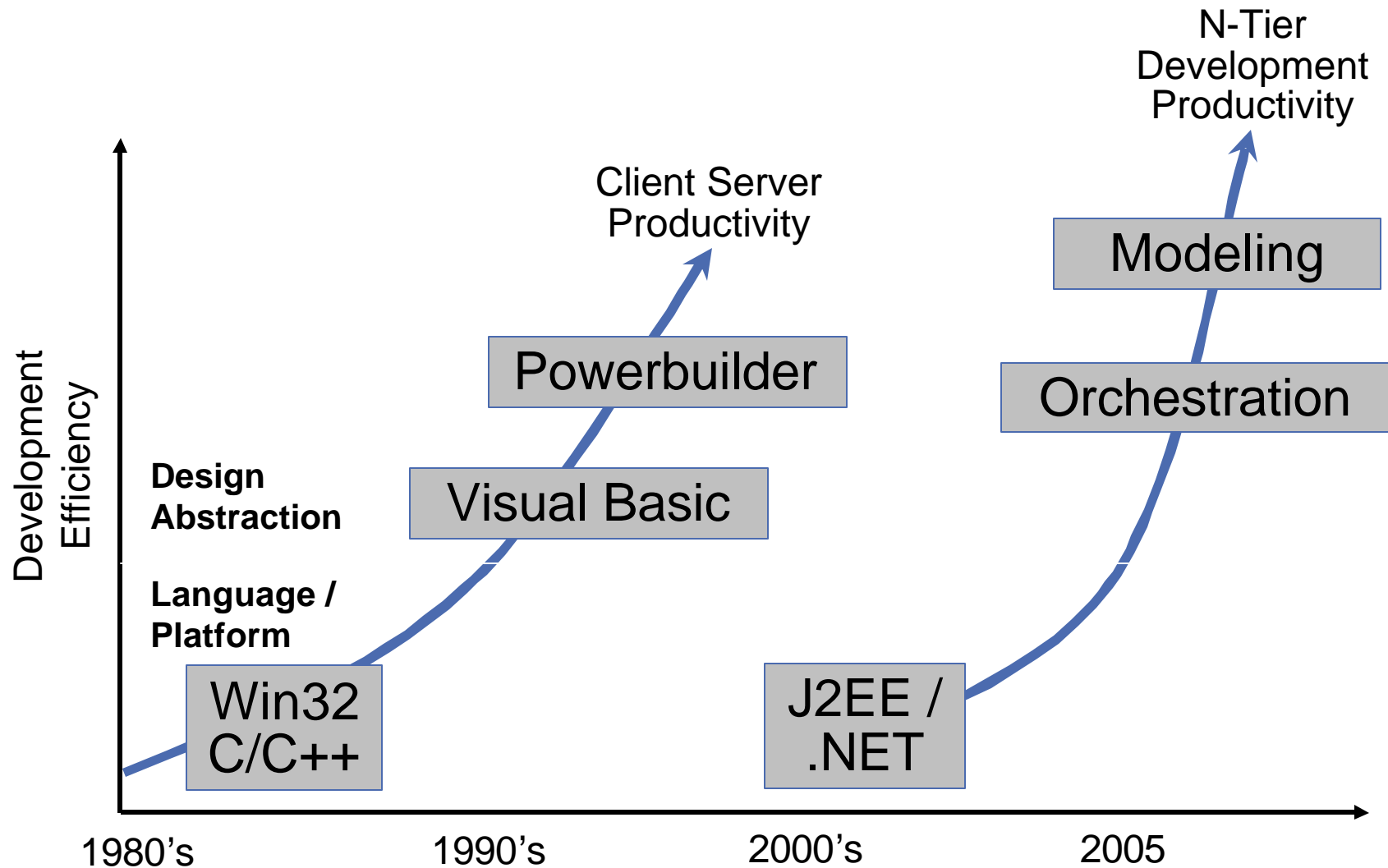
# Accelerating Development, Integration, and Deployment



List of All Orders

| Order Status | Shipped | Total Order Cost | Total Order Items |
|--------------|---------|------------------|-------------------|
| 04           | 0       | 33,469.65        | 27                |
| 07           | 0       | 19,236.06        | 26                |
| 17           | 0       | 11,276.28        | 42                |
| 76           | 0       | 66,527.20        | 17                |
| 73           | 0       | 44,746.77        | 23                |
| 63           | 0       | 46,780.02        | 53                |
| 67           | 0       | 20,997.45        | 89                |
| 25           | 0       | 7,251.91         | 89                |
| 18           | 0       | 48,622.19        | 34                |
| 75           | 0       | 78,946.33        | 6                 |

# Development Efficiency Is Driving ...

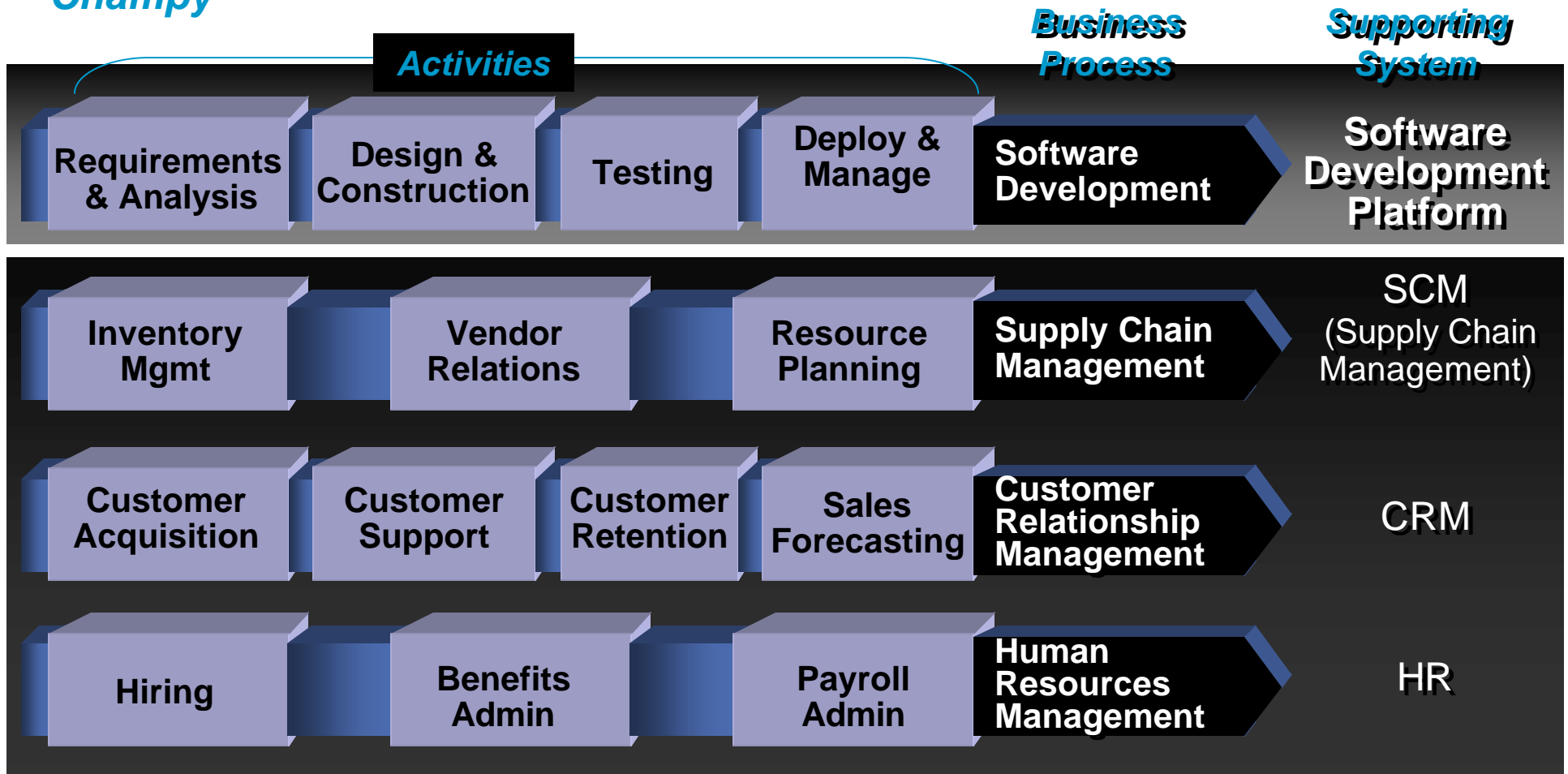


Source: Giga Research



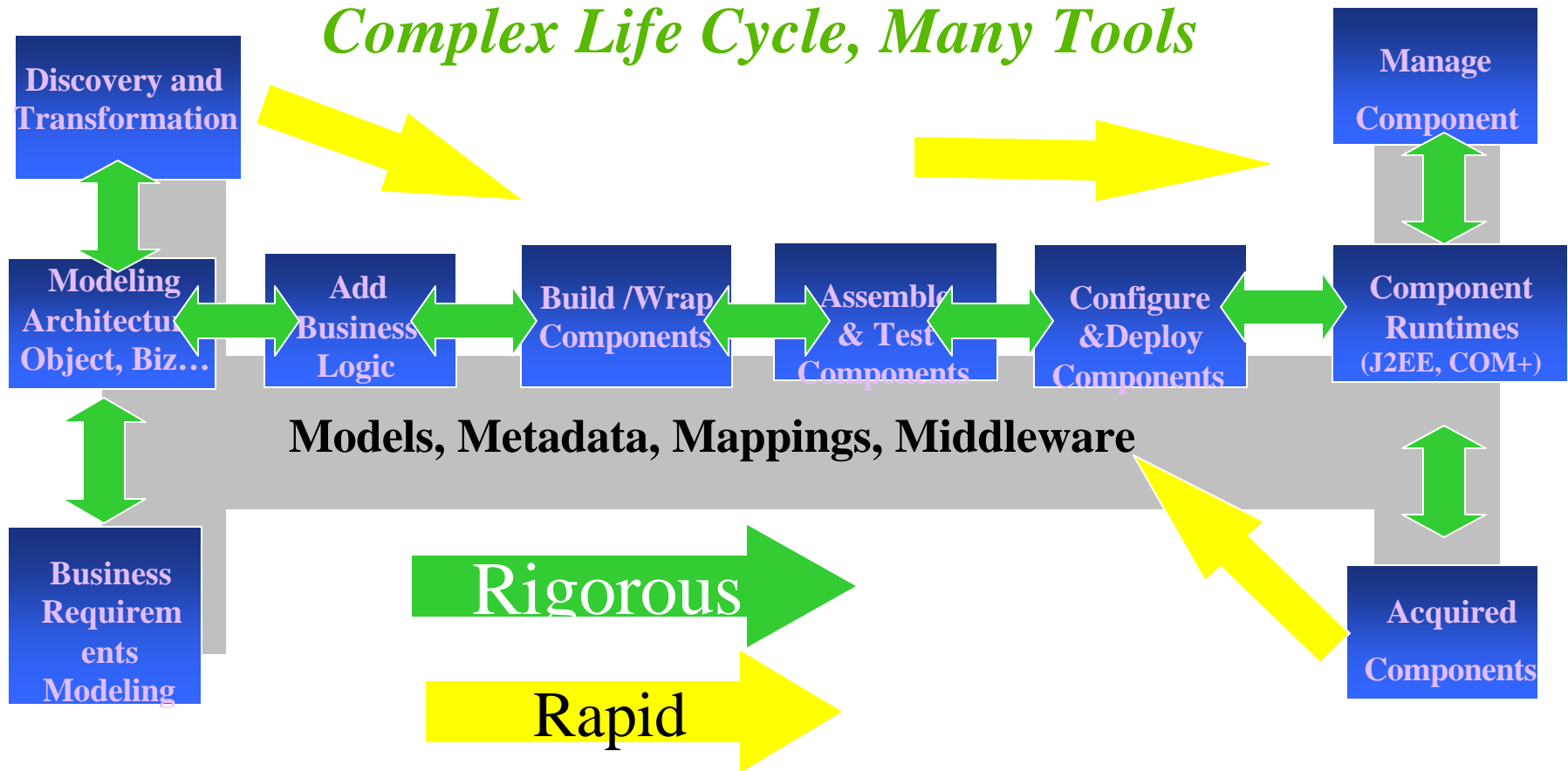
# Software Development: A Core Business Process

*Business process: "A collection of activities that takes in one or more kind of input and creates an output that is of value to the customer." Hammer & Champy*



# An Enterprise Application Development Life Cycle

*Architecture Centric, Business driven,  
Complex Life Cycle, Many Tools*



And do this with quality in a distributed environment



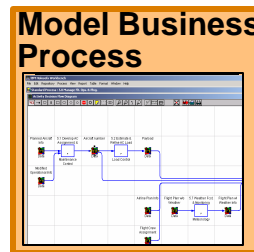


# The Business Driven Lifecycle

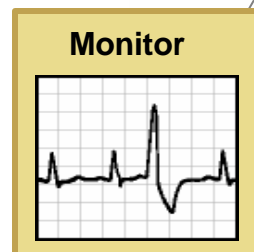
- Document and specify As-Is Process with Metrics
- Specify and construct goals, objectives and requirements
- Apply Technology to Improve the Process
- Model the To-Be Process....



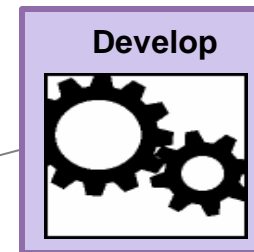
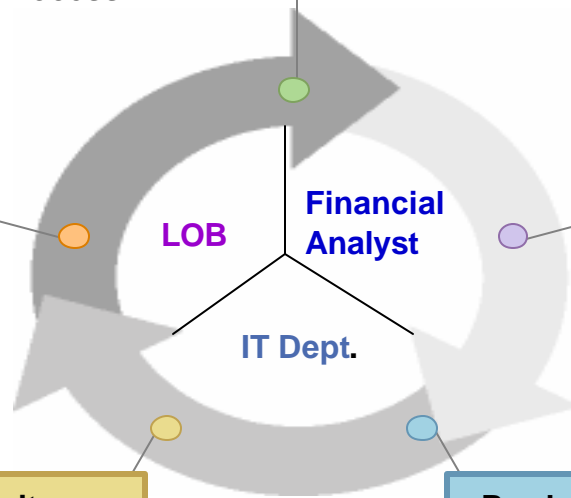
- Model and simulate business processes
- Model Applications and Data
- Analyze the financials & prioritize the areas that bring maximum business value
- Identify / prepare existing assets or reuse



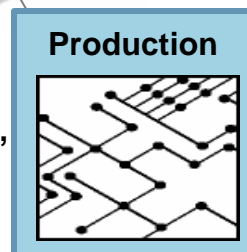
- Audit processes and improvements
- Make Iterative Improvements
- Model the Next As-Is and To-Be Process....



- Manage testing, requirements, configuration, and project management



- Rapid integration and/or application development
- Visual construction and programmatic code generation
- Functional and load testing
- Generate XML code & manage UML blueprints & Automated Workflow
- Apply Patterns to Accelerate Development

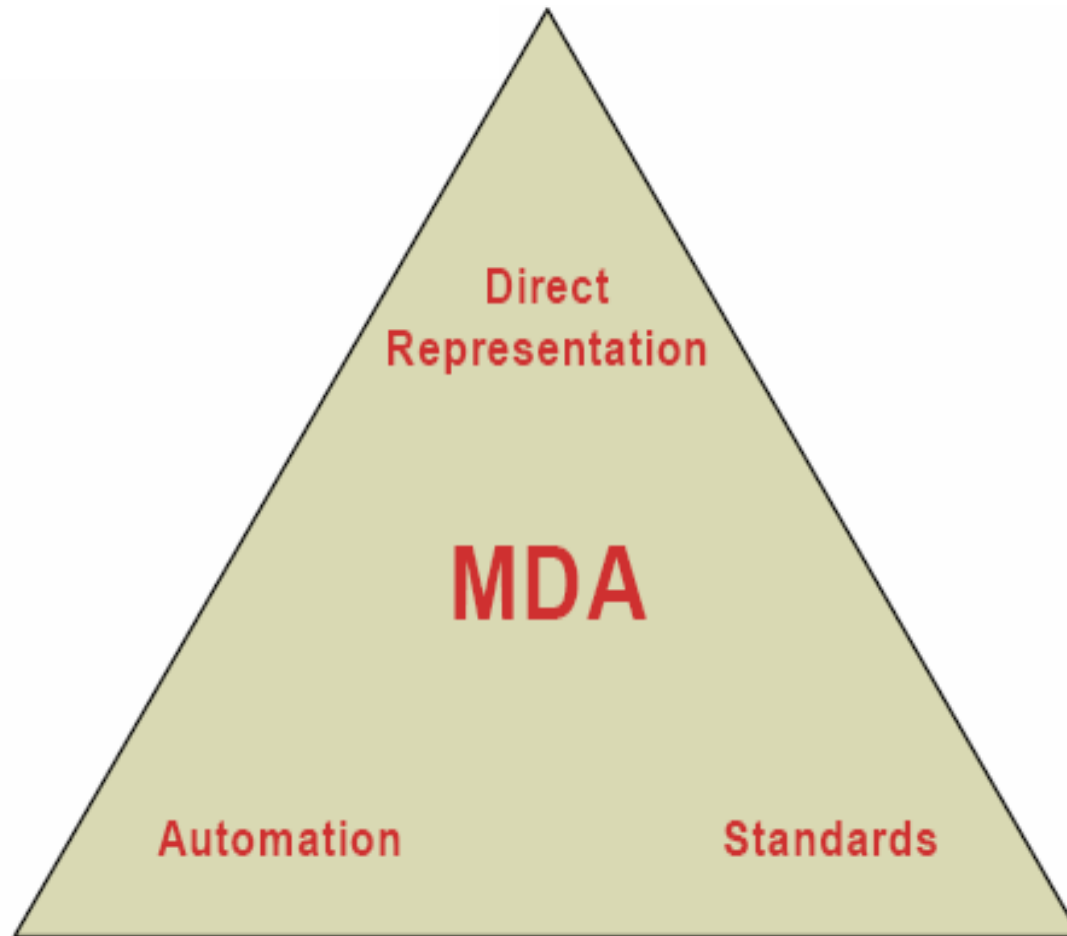


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  - ▶ Key MDA concepts
  - ▶ Key Standards
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  - ▶ Eclipse Modeling projects
    - EMF, UML2, Hyades...
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# The MDA Manifesto

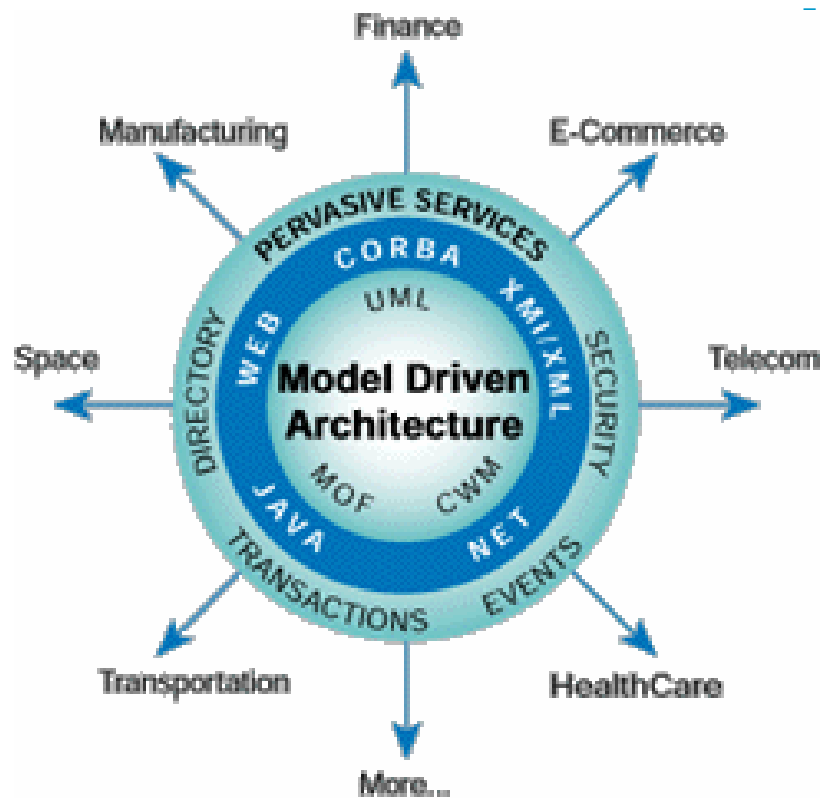


[www.bptrends.com](http://www.bptrends.com)

(Booch, Brown, Selic, Rumbaugh, Iyengar)



# A Solution for Managing IT Complexity: Model Driven Architecture (MDA)<sup>TM</sup>



- An integration of best practices in Modeling, Middleware, Metadata, and Software Architecture

## Model Driven (UML, MOF, CWM...)

- ▶ Platform Independent Models (PIM) – Technology or increasingly Business Models
- ▶ Platform Specific Models (PSM) - J2EE, .Net, SQL
- ▶ Mappings : PIM<->PIM, PSM<->PSM, PIM<->PSM
- ▶ Applies across the software life cycle

## Key Benefits

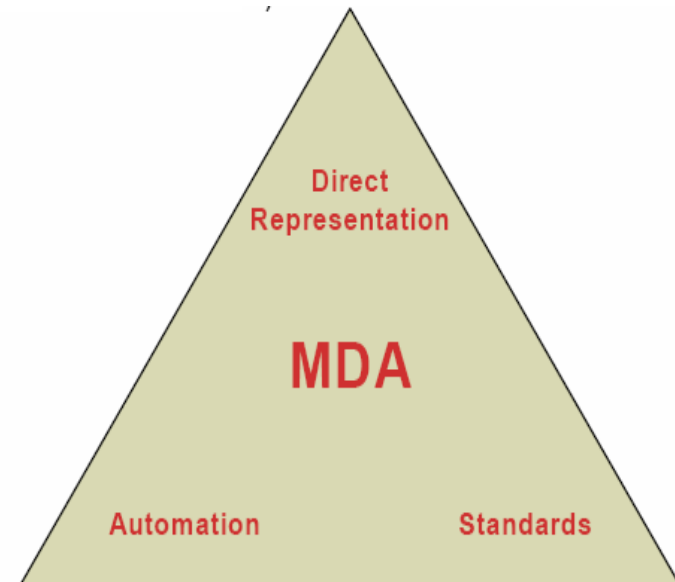
- ▶ Improved Productivity for Architects, Designers, Developers and Administrators (Faster, Consistent)
- ▶ Lower cost of Application Development and Management (Cheaper)
- ▶ Enhanced Portability and Interoperability (Open)
- ▶ Business Models and Technologies evolve at their own pace on platform(s) of choice (Responsive)

Source: OMG



# The 'MDA Manifesto'

- Direct Representation
  - ▶ Speak the language of the stake holder (UML, MOF, XSD, Business Process, Business Rule or specific Industry Domain Model)
  - ▶ Be as precise and formal as needed
  - ▶ Abstract away irrelevant detail
- Automation
  - ▶ Transform models to models, code and other artifacts
  - ▶ Interpret/Execute models when the models are complete enough
- Standards and Open Source
  - ▶ Customer choice
  - ▶ Innovation
  - ▶ Interoperability

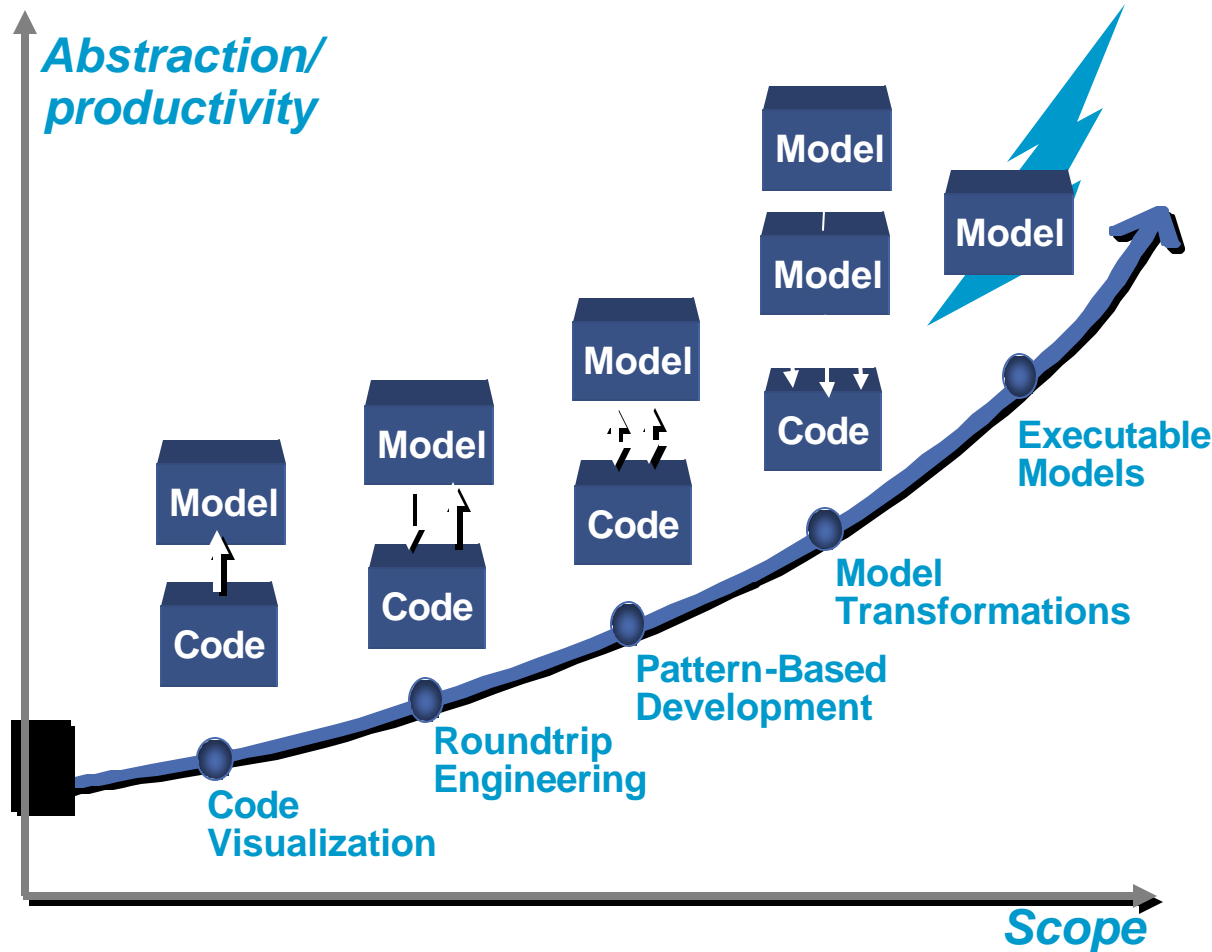


[www.bptrends.com](http://www.bptrends.com)

**Booch et al**



# Adopt The Right Modeling Paradigm For Your Needs



## MDA Standards-

*Supports multiple:*

- ▶ Development languages
- ▶ Operating environments
- ▶ Skill levels
- ▶ Modeling paradigms
- ▶ Modeling Languages
  - ▶ General Purpose
  - ▶ Domain Specific
- ▶ Model & Metadata based

## Open Standards: The Foundation of MDA

- Unified Modeling Language (UML)
  - ▶ For describing the problem domain and the solution architecture
- Meta Object Facility (MOF)
  - ▶ For describing and manipulating general or domain specific modeling and metadata languages
- XML Model Interchange (XMI)
  - ▶ For exchanging model information in XML format and generating XSD
- Common Warehouse Model (CWM)
  - ▶ For describing data mappings and database schemas
- Supported by UML profiles
  - ▶ For customizing UML to specific domains (e.g., J2EE, EAI, Real-time, Systems Engineering...)
- Technology and Industry Domain Specific Standards

**Members of OMG are driving the core MDA standards**

**Members of Eclipse Foundation are driving pragmatic implementation of MDA**



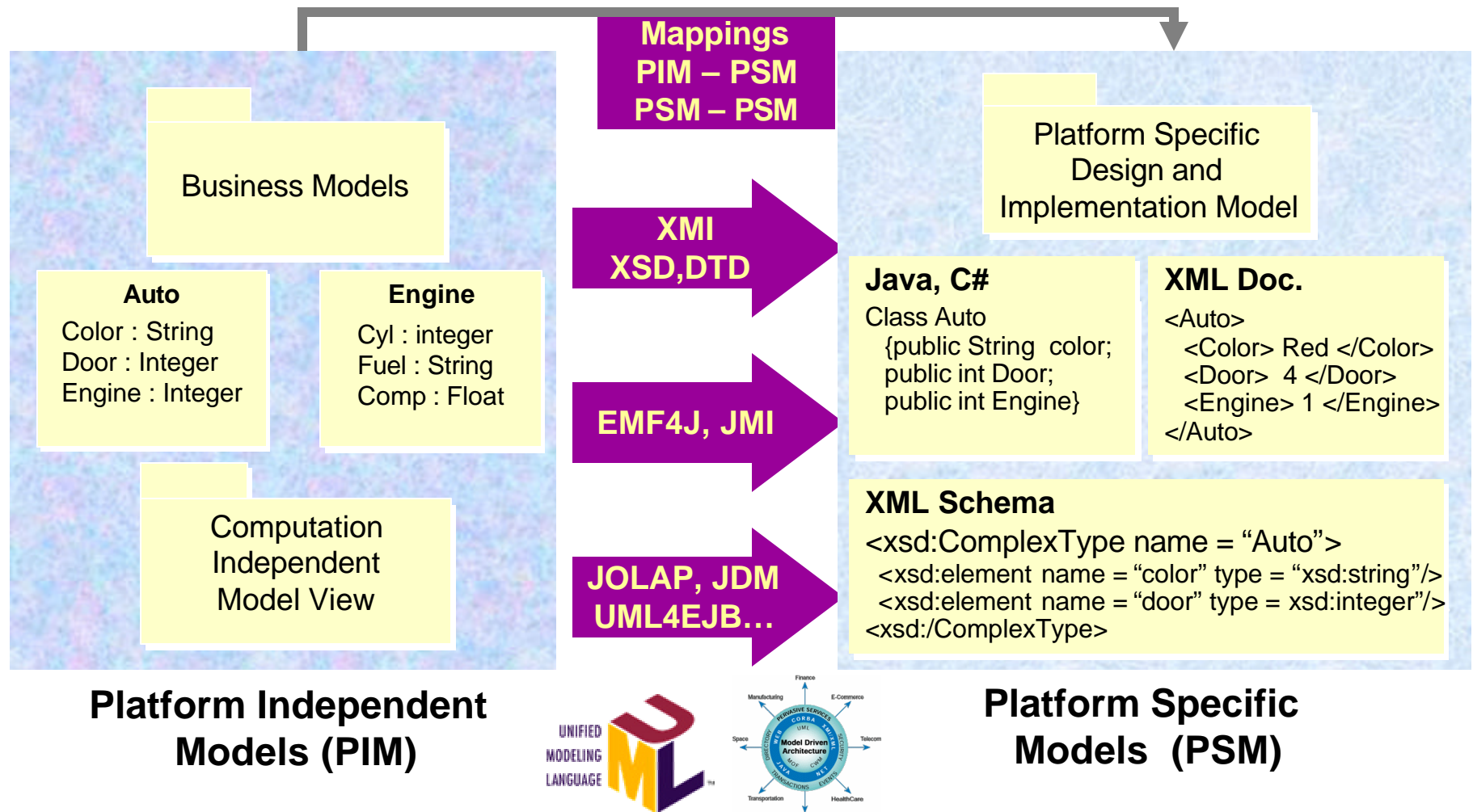
## What Is MDA?

- Development through transformation of models using metadata
  - ▶ Usually refinement of more abstract models to more concrete models
  - ▶ Refinement can be incremental & iterative or a bulk transformation
- A process & philosophy for developing and integrating software
  - ▶ Rational XDE pattern transformation, Rational Rapid Developer and Rose Technical Developer for full code generation, and Rose's Extensibility Interface *support* MDA implementations
  - ▶ **Rational XDE MDA Toolkit available to implement MDA transformations as Eclipse plug-ins**
  - ▶ Eclipse EMF uses core MDA standards and concepts to enable model driven tool integration
- Models are defined in context of "Platforms"
  - ▶ Platforms are technology choices at some level; e.g., J2EE for middleware, SQL for data management etc.
- Transformations are usually between models - Platform Independent Model (PIM) to a Platform Specific Model (PSM)
- Can be between two PSMs (J2EE & .Net)





# Model Transformations using OMG Model Driven Architecture (MDA)



Mappings to UDDI, WSDL, BPEL4WS in progress

# MDA as an 'Architectural Style' for Model Driven Development & Integration

- **Understand** the problem domain (technology or business)
- **Model** the problem domain
  - ▶ Use UML for the visual modeling, analysis & design of the application
  - ▶ Use UML profiles & Domain Specific Metamodels/Languages as needed
  - ▶ Note: DSLs can be defined using UML, MOF, XSD, Java and transformed to MOF (See [www.eclipse.org/emf](http://www.eclipse.org/emf))
- Formally represent the **models and metadata** using UML, MOF & XML
  - ▶ Simple class modeling is all you need to know
  - ▶ OCL (Object Constraint Language) can capture additional semantics
  - ▶ Reverse engineer existing DTD, XSD, XMI, Java to MOF (jump start)
- Use Standard transformation (**mappings & patterns**) for
  - ▶ Metadata Interchange (XMI – MOF to XML, DTD, XSD)
  - ▶ Metadata Interfaces (JMI – MOF to Java, EMF4J, MOF to WSDL etc.)
- Use open source modeling frameworks for **model integration and management**
  - ▶ **Eclipse EMF** : [www.eclipse.org/emf](http://www.eclipse.org/emf) , **Eclipse UML** : [www.eclipse.org/uml2](http://www.eclipse.org/uml2)
  - ▶ **Summary** : Understand, Model, Map and Manage metadata to integrate





IBM and MDA

<http://www-306.ibm.com/software/rational/mda/index.html>

<http://www-106.ibm.com/developerworks/rational/library/3100.html>

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# The Eclipse Project

- Eclipse is an open extensible Universal Tooling Platform
- Now an Independent Eclipse Foundation (Feb 2004)
- Universal Tooling Platform has been open sourced:
  - Licensed via Common Public License
  - Managed via the Eclipse Project ([www.eclipse.org](http://www.eclipse.org))
- IBM contributed \$40M software/R&D as initial Eclipse technology
- Enables customers to develop, customize and integrate tools and repositories via open standards
  - Provides frameworks for tool builders to focus on tool development (not infrastructure)
- Initial consortium members include:
  - IBM, RedHat, SuSE, Rational, Merant, QNX, TogetherSoft, WebGain, and Borland

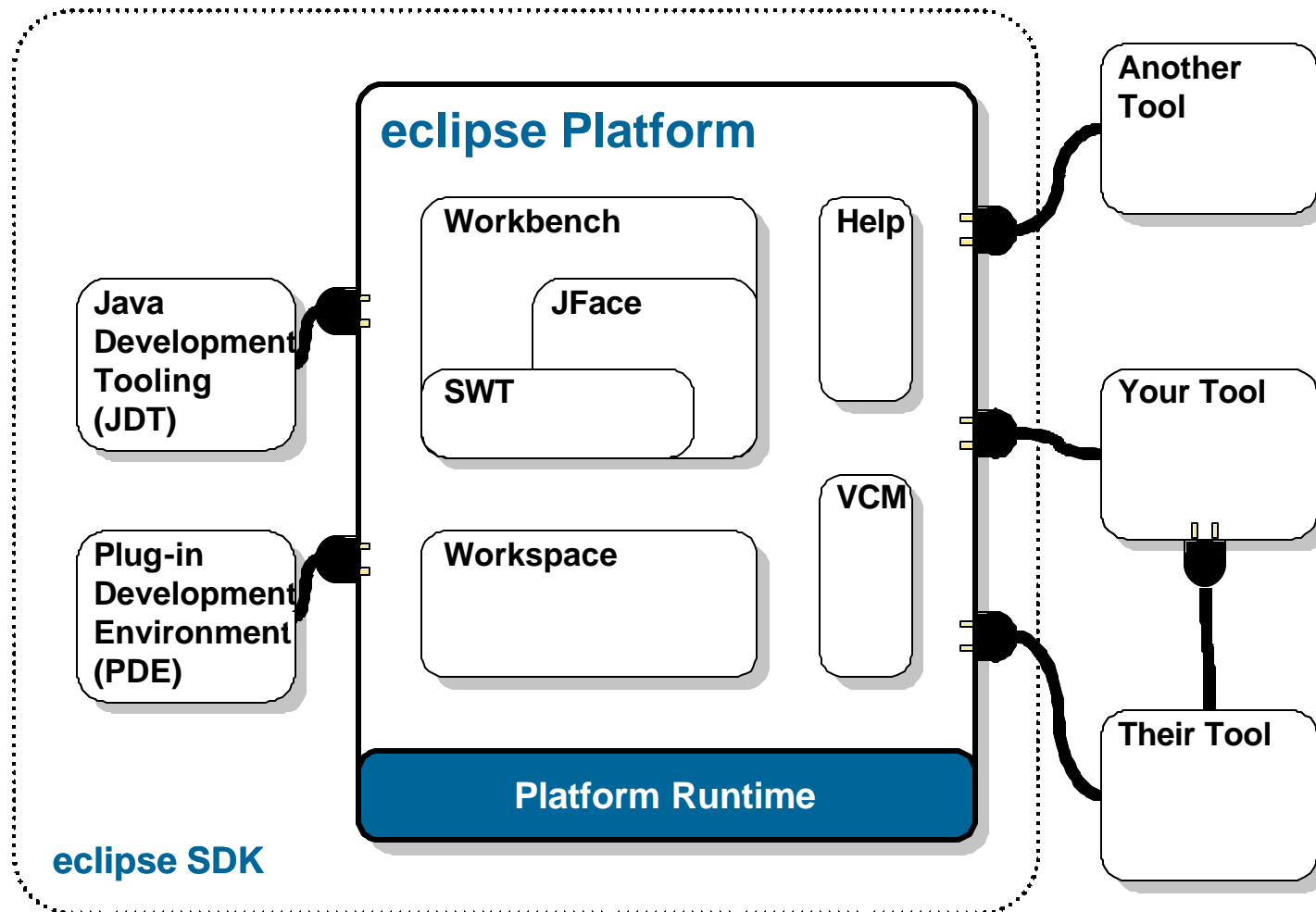


# Eclipse: A Universal Platform for Development Tools

- Open, extensible architecture based on plug-ins
- Highly extensible by design
- Out-of-box functionality and quality to attract developers
- Endorsed by major tool vendors
- Open-source



# Eclipse Structure



# Eclipse Architecture: Layers & Subsystems

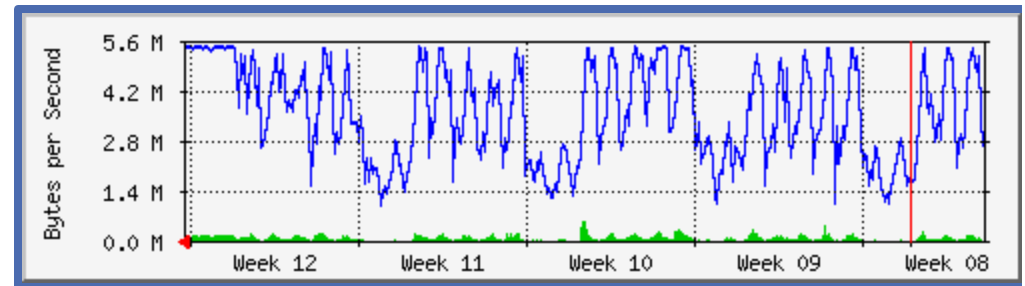




# Lights Dimmed When Eclipse 2.1 Went Live

- Grassroots enthusiasm from developers
  - ▶ 18 Million downloads to date, 90 TB data\*
  - ▶ T3 saturated for 60 hours at 2.1 launch
- Expanding Vendor community
  - ▶ Over 175 vendors
  - ▶ 50 Eclipse Innovation Grants approved
- Plug-ins growing exponentially
  - ▶ C/C++ IDE plug-in for Linux underway
  - ▶ 395: eclipse-plugins.2y.net
  - ▶ 130: eclipse-workbench.com
  - ▶ 100+ : SourceForge.net
  - ▶ 28: freshmeat.net

# Downloads  
(Weekly Thirty Minute Average)

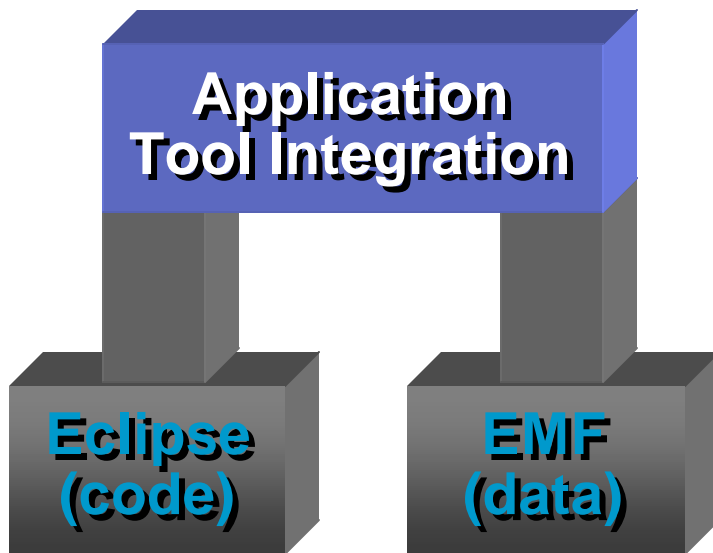


*The development community is embracing Eclipse!*

# Who's on Board? – 49 Industry Leaders Join Forces



# Eclipse Modeling Framework



## What is EMF?

- Supplies the **data integration** technology for Eclipse
  - ▶ Eclipse supplies **code integration**
- Transforms models into efficient, correct, and customizable Java code
  - ▶ The middle ground in the modeling vs. programming world
  - ▶ An infrastructure to use models effectively in code
- Open source project
  - ▶ EMF is free
  - ▶ Integrates UML, XML and Java

[www.eclipse.org/emf](http://www.eclipse.org/emf)



## EMF Benefits

- The industry's leading platform for integrating tools based on common model & semantics
  - ▶ In addition to just common APIs and presentation (as in VS.Net)
  - ▶ Java interfaces, implementations as well as XML serialization & simple UI is automatically generated from the model
  - ▶ Simplifies development & more importantly integration of tools into a unified suite
  - ▶ Accelerates the move of Eclipse from Java tools platform to an application life cycle tools platform
- Bridges the gap between modeling and programming
  - ▶ From schema to model to eclipse tool with little programming
  - ▶ Works with Java, XML, UML
- Improved productivity, time to value for the Eclipse community in building a compelling integrated tool suite
- Implementation of OMG XMI2 and MOF2 (EMOF)



## Eclipse Hyades Project

- Provides key integration points for cross vendor tooling, focusing on Automated Software Quality (ASQ) and Problem Determination
  - ▶ EMF based models for data integration across the domain
    - Test model based on UML2 Test Profile (base for the UML2TP workgroup)
      - Allows test design in a language and execution environment neutral way
    - Trace/profiling model for performance analysis
    - Statistical model for trend collection and analysis
    - Common Base Event logging model for generic log analysis and problem determination (base for Oasis proposal)
    - Symptom Database for CBE analysis and capturing autonomic response definitions
  - ▶ Open distributed execution and monitoring framework for runtime management and analysis
  - ▶ Extension points for UI integration across the domain
- Several offerings already do or plan to leverage subsets of the project so they can be extended by other vendors and offerings, as well as avoid writing common code.

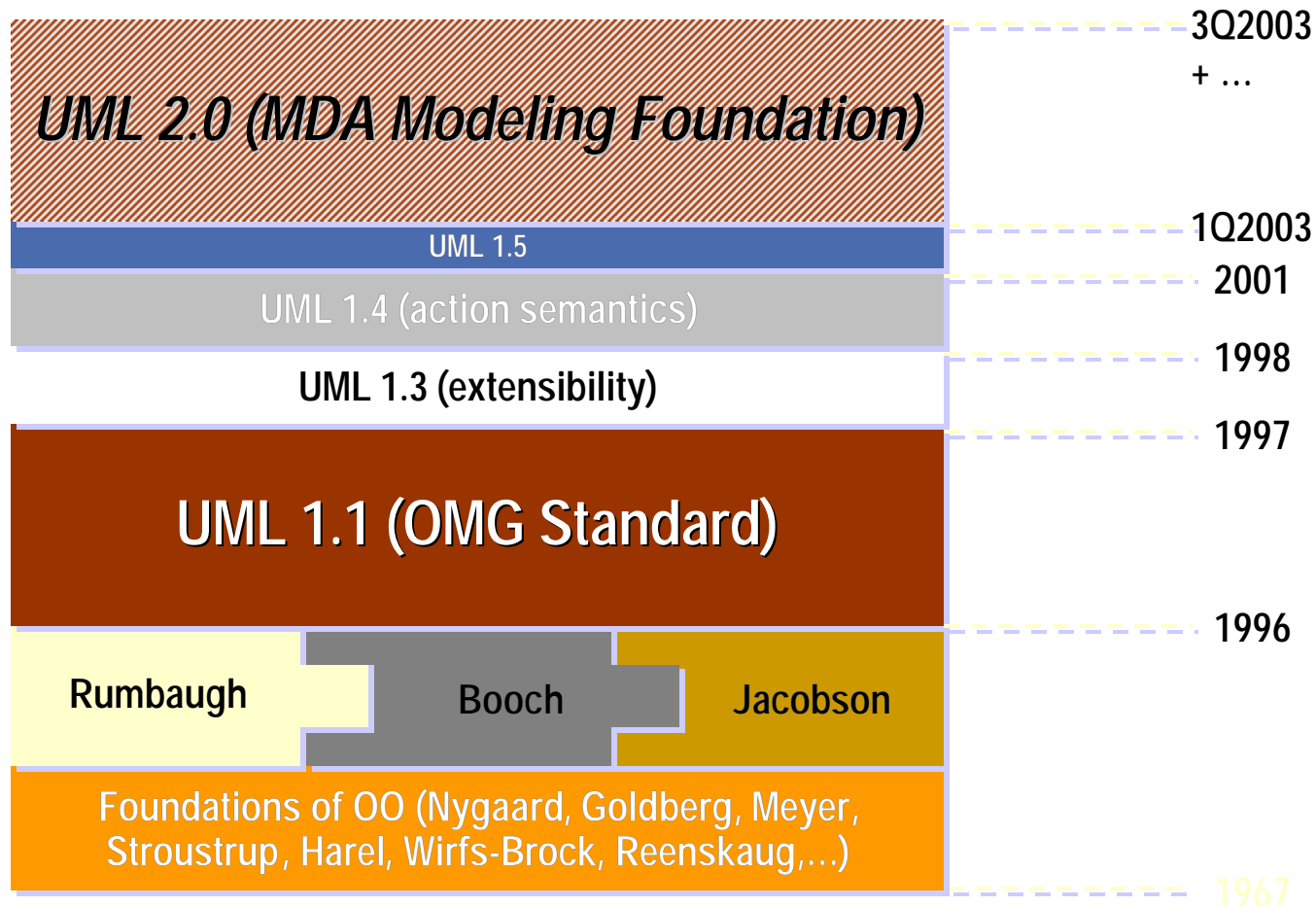


## Eclipse UML2 Project

- Coupled with EMF provides a solid foundation for Model Driven Development and Integration
- UML tools
  - ▶ Tools that exploit specific UML Profiles
  - ▶ The Metamodel, XML Interchange (XMI) and Java APIs (EMF Java Interfaces) are available for download at [www.eclipse.org/uml2](http://www.eclipse.org/uml2)
    - Several vendors (IBM included) are building development, design and integration tools using this foundation
- Foundation for Domain Specific Modeling Solutions and Frameworks
- Will implement (and is influencing) the results of UML2 standardization efforts at OMG



# UML: The Modeling Foundation of MDA

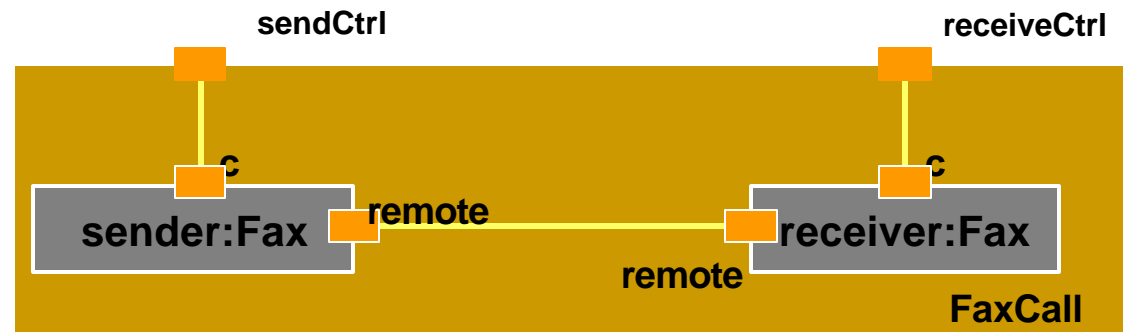


Defined and implemented using UML/MOF, Serialized using XML (XMI)



## UML 2.0: Reusability and Scalability

- Most significant release since the original standard
- Addresses scalable development
- A major enhancement in UML2 is Structured Classes
  - Structuring concepts come from IBM Rational Rose RealTime
- Modular
- Improved support for Business Modeling, Components and SOA
- UML 2.0 FTF to complete Sep 2004



IBM's implementation : Rose/XDE (UML 1.4), [www.eclipse.org/uml](http://www.eclipse.org/uml) (UML2)





## New in Eclipse 3.0 – Mid 2004

- A new look and feel
  - ▶ Not just for IDEs anymore!
- Rich Client Support
  - ▶ Equinox project
- OSGi runtime & more
- The momentum continues to grow
- Previewed at EclipseCon2004 : 600+ attendees
- Download at [www.eclipse.org](http://www.eclipse.org) (milestone 8)

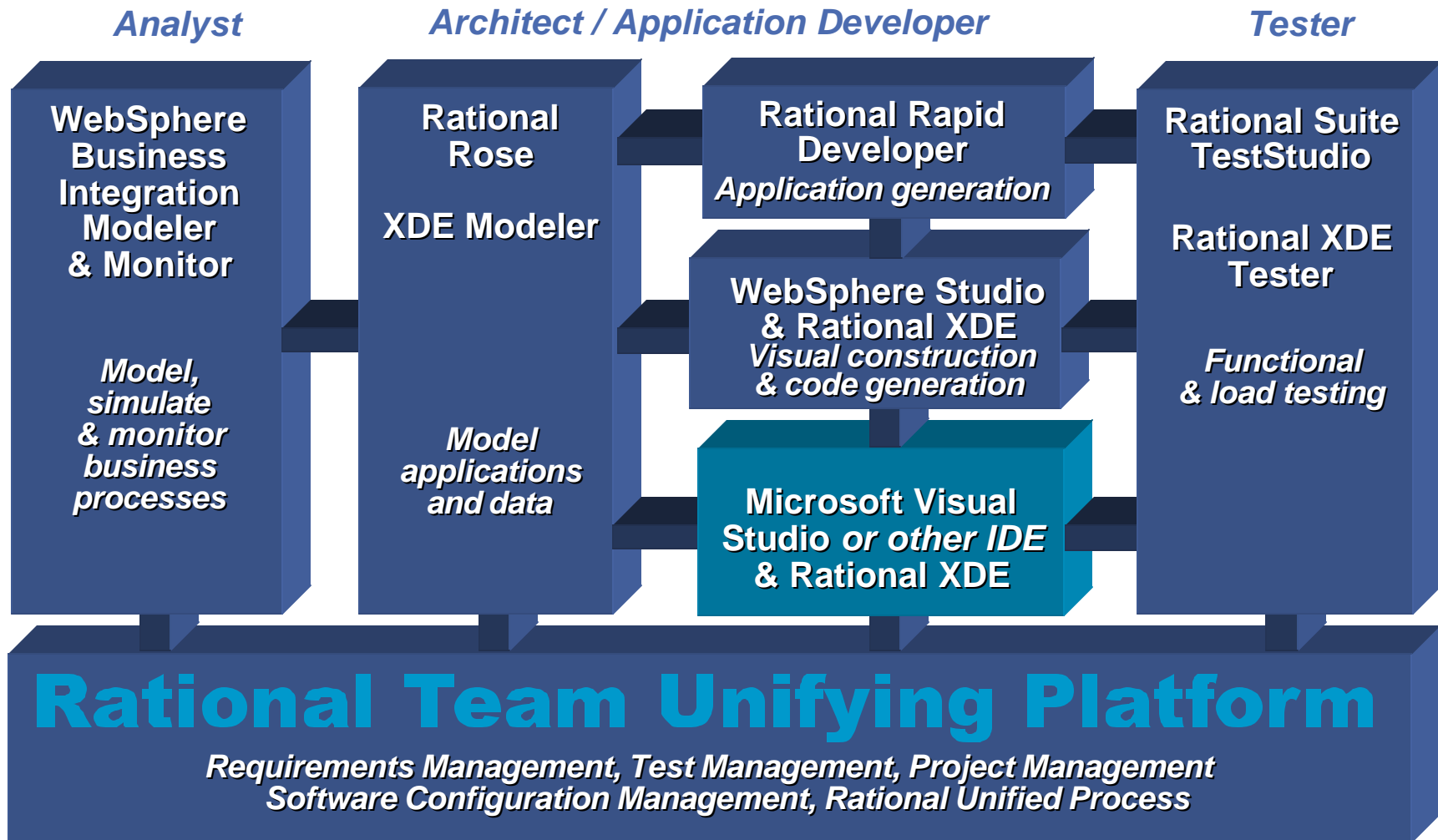


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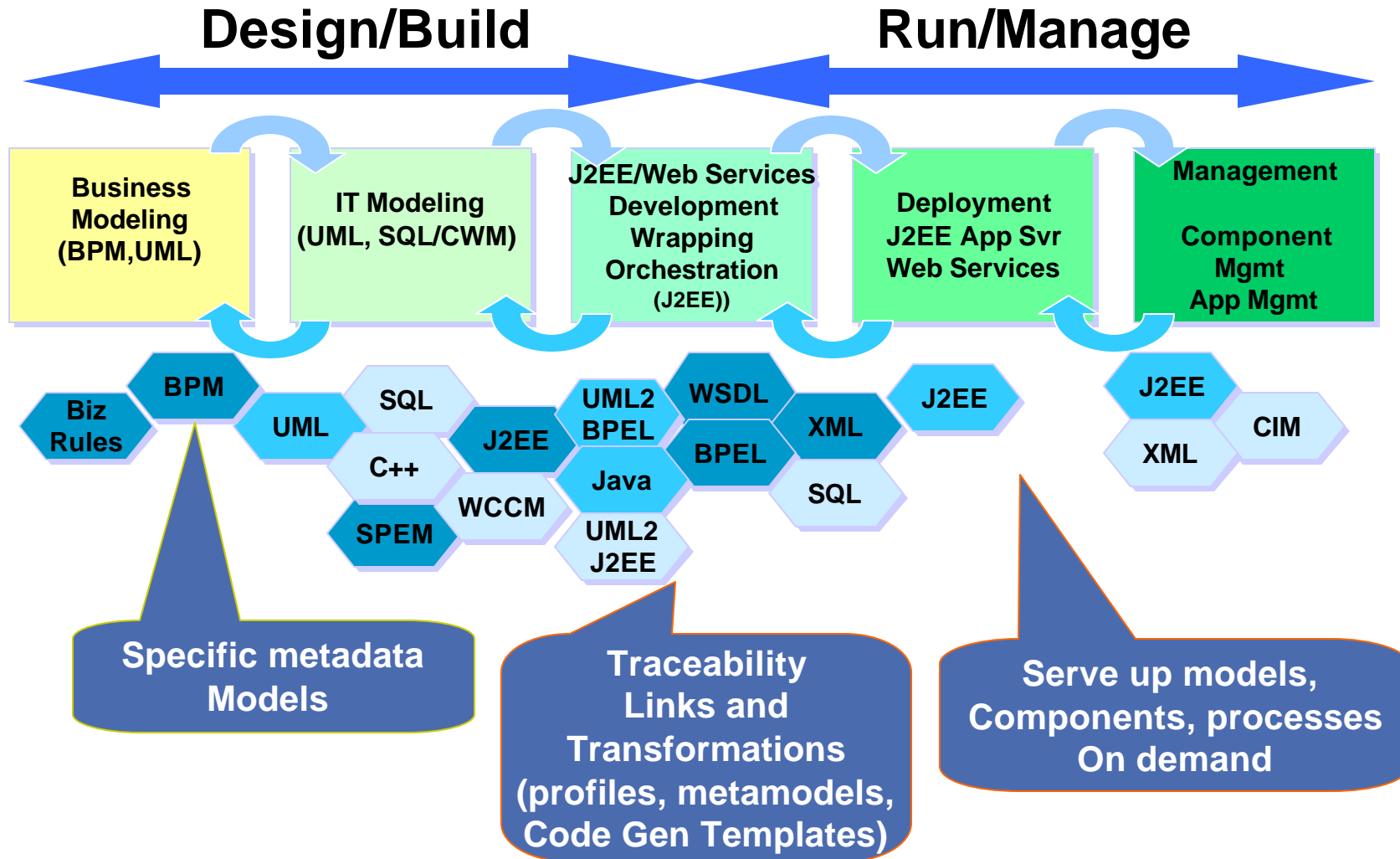
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  - ▶ IBM Software Development Platform example



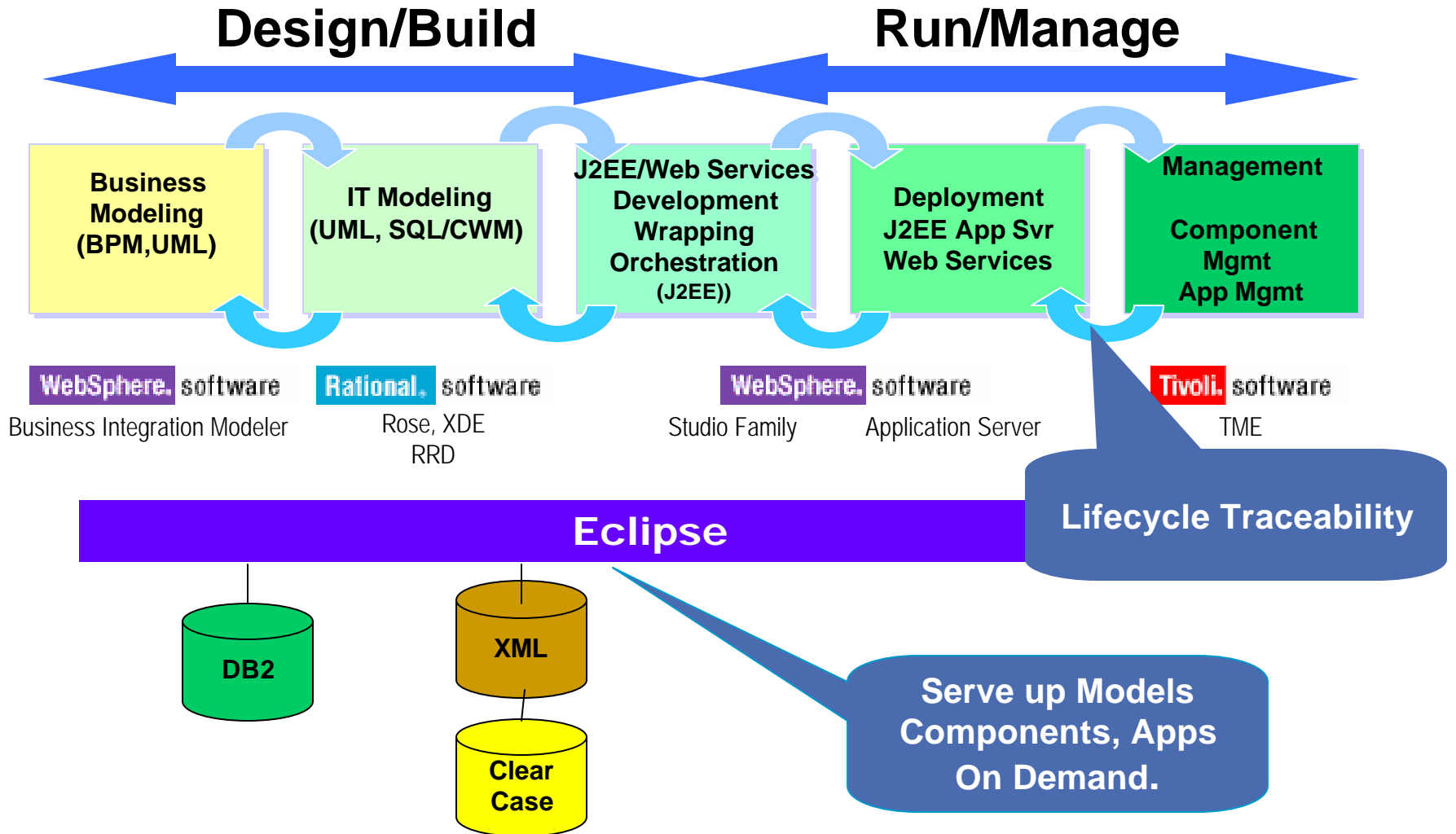
# Today's IBM Software Development Solution



# Model Driven Business Integration: Managed Models

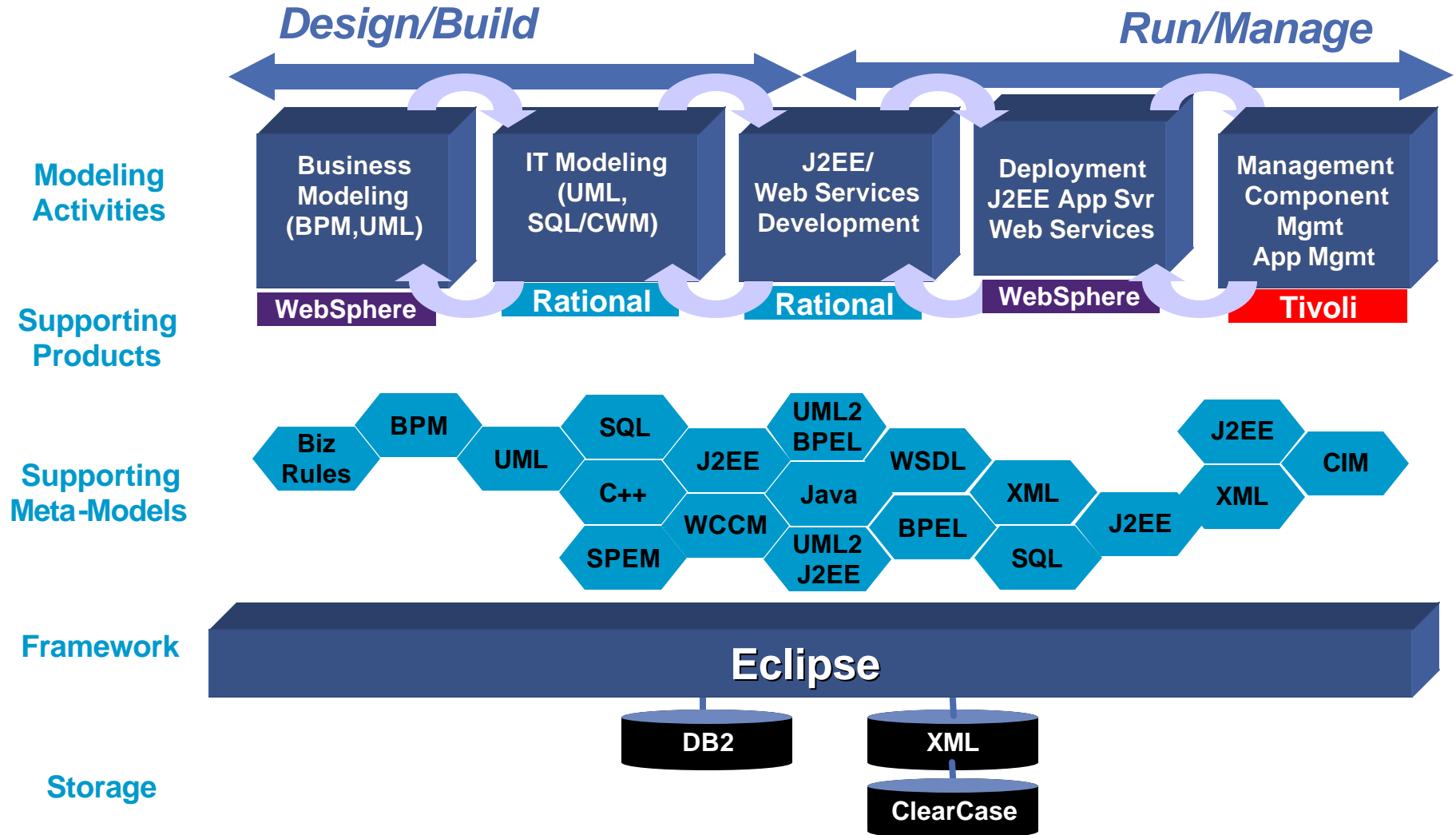


# Model Driven Business Integration: Full Lifecycle



# Model Driven Business Integration

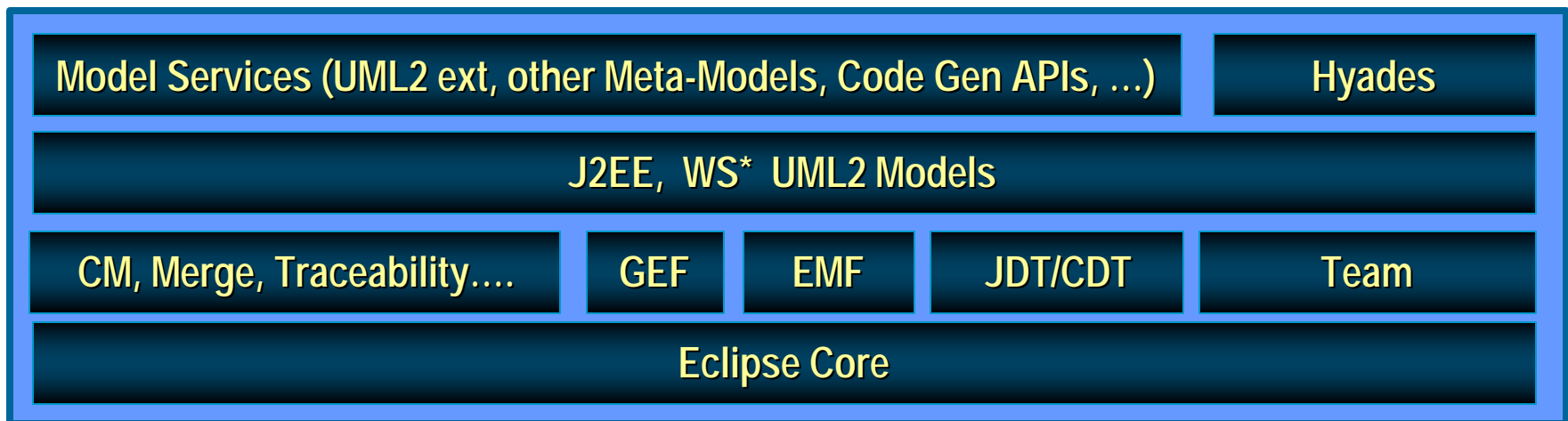
*Bridging the gap between business, IT, and operations teams*



# Eclipse MDD Platform Evolves

Open Source

Vendor Value Add



# Evolving the IBM Software Development Platform



## Business Architect

*Business process and information modeling*



## IT Architect

*Application logic and data modeling, Pattern creation*



## Developer

*Traditional Corporate J2EE, DB2 .Net Technical*



## Tester

*Functional and load testing*

**Eclipse Platform, EMF (UML, J2EE, Web Services...) models**  
(Integration with Team Unifying Platform)

## Team Unifying Platform

*Requirements Management, Test Management, Change Management Software  
Configuration Management, Rational Unified Process  
Integrate with WebSphere Portal, DB2 and Lotus WorkPlace*





# Modeling Languages, Metamodels and DSLs

- Both general purpose modeling languages (UML), programming languages (Java, C++,,,) as well as custom languages (for scripting) for industry specific domains (life sciences, systems engineering, software radio...) continue to evolve
  - ▶ Recent increase in interest on Domain Specific Languages (DSLs) using purpose built XML Schemas
    - Problem : How do you use these schemas together and integrate them when integration across domains is needed
  - ▶ We recommend the use of UML Profiles and MOF to build DSLs.
    - Where the domain is close to the modeling concepts in UML, use a UML profile
    - Where the domains are diverse and need integration using MOF to define a domain specific Metamodel
      - Can be bootstrapped from UML models, XML Schemas, Annotated Java, XMI etc
    - Define and manage the metadata needed for model transformations
    - Advantage of starting from a UML model – much richer set of modeling constructs for structural and behavioral modeling
- The modeling artifacts and related metadata are the lasting intellectual capital – protect and manage it (RAS)

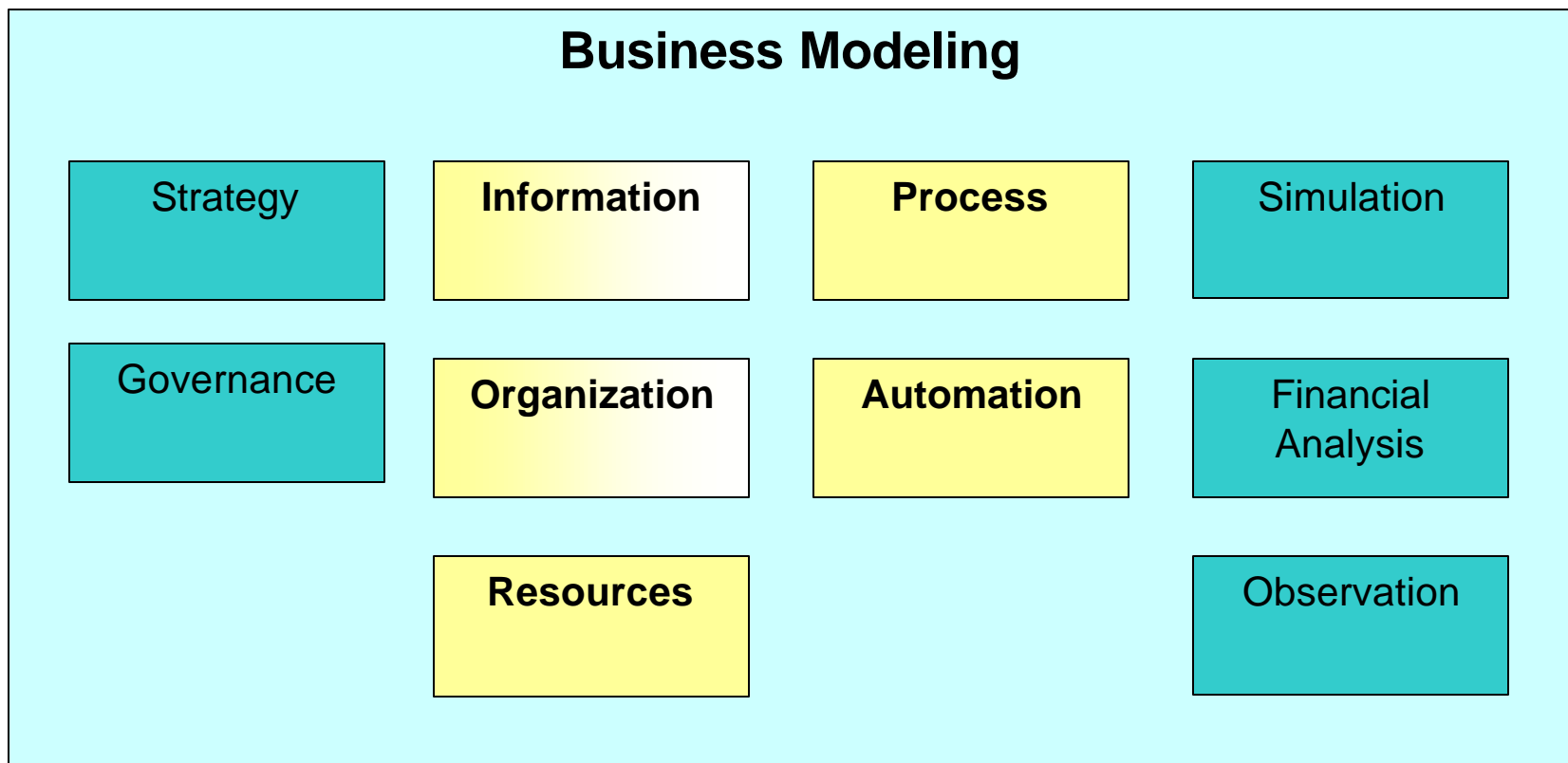


## How are Metamodels (some call these DSLs!) defined and implemented now?

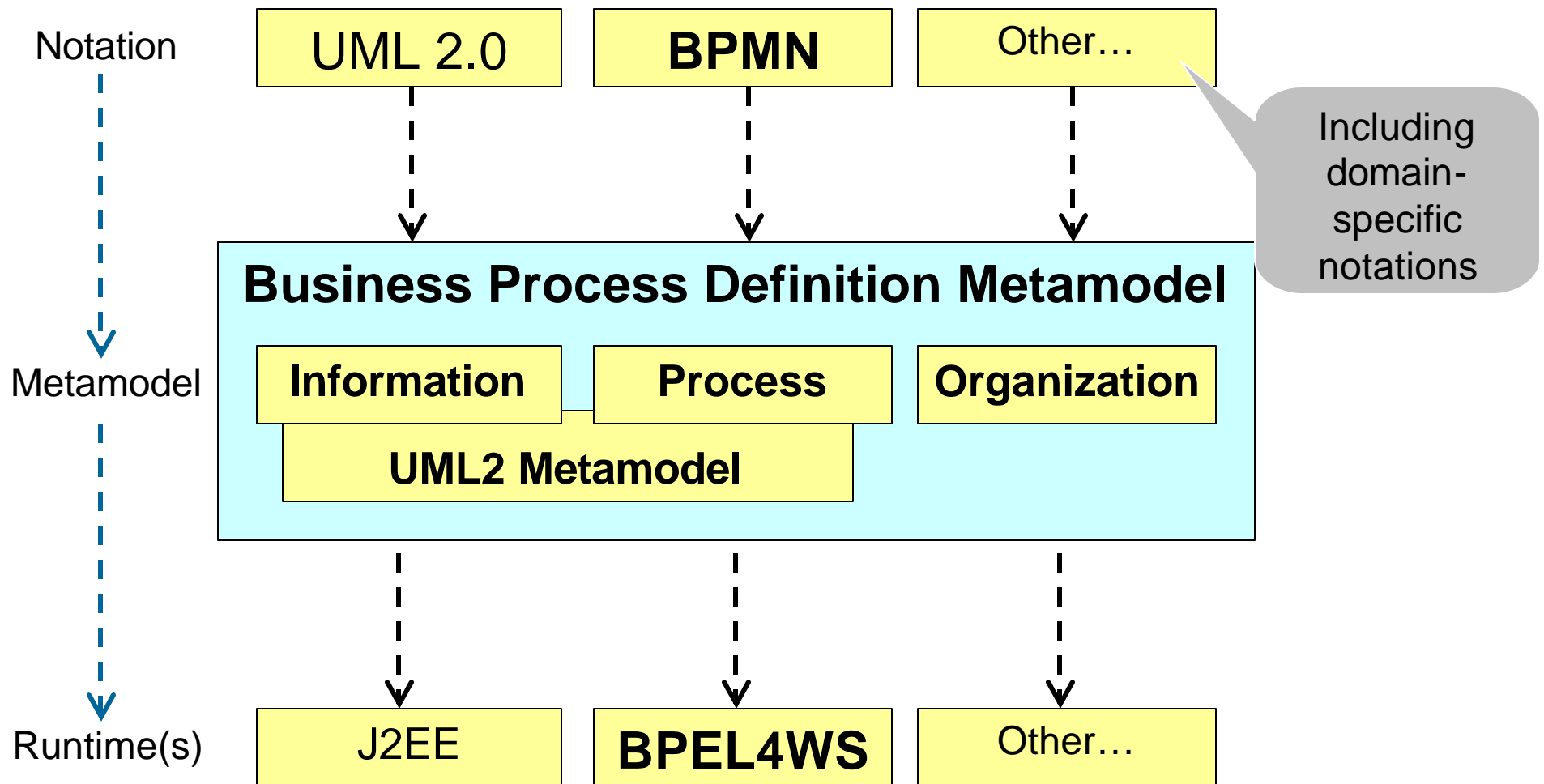
| Terminology                 | MDA Representation  | IBM Implementation using Eclipse  |
|-----------------------------|---|---|
| Notation                    | UML, Custom (See BPD for example : BPMN or UML Notation for process models) | UML or Custom depending on domain (text, graphical... use GEF for JSF- Graphical Editing Framework to build up) |
| Concepts                    | UML Profiles, MOF Metamodels (with XML serialization)                       | EMF models (J2EE, Web Services, UML...)   |
| Well Formedness Rules       | OCL, BSBR (Business Rules)  | Simple constraints in EMF, rest in Java implementation  |
| Serialization Formats       | XML (based on XMI for Metamodel) or as defined by W3C, OASIS...             | XML (based on XMI for Metamodel) or as defined by W3C, OASIS...   |
| Interactive Behavior        | UML Behavioral models, Custom MOF models                                    | UML Behavioral models, Custom MOF models  |
| Mapping & Transforms        | MOF Q/V/T (coming)<br>Custom profiles, generators                           | EMF mapping framework, Custom profiles, generators using JET, Velocity...                                       |
| Tools for tool implementors | Implementations of MOF, UML, XMI  | <a href="http://www.eclipse.org">www.eclipse.org</a> : Eclipse core, EMF, GEF, XSD, CDT, JDT, UML....           |

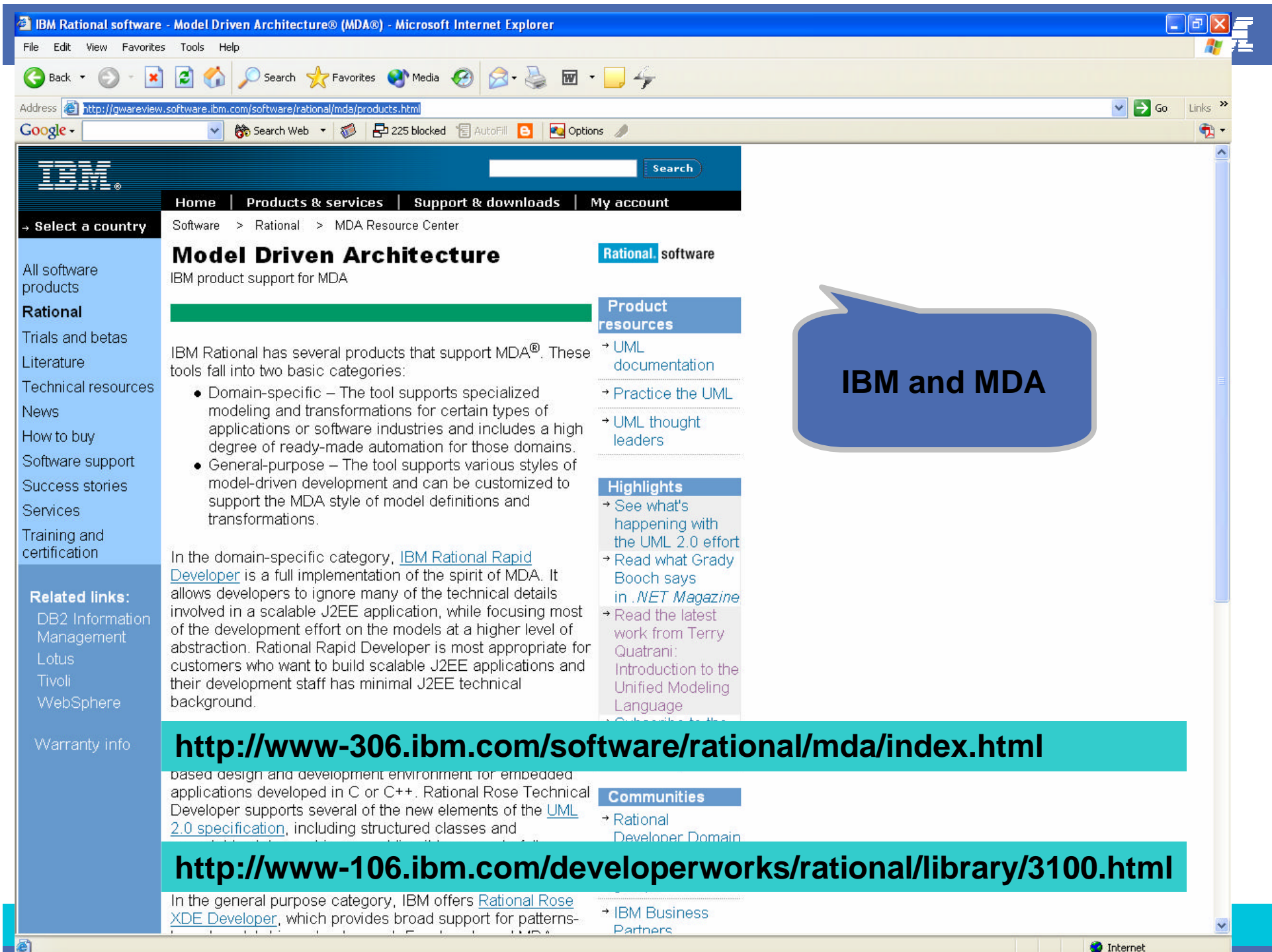


## Business Modeling Context : Example Domain Specific Metamodels in development (in IBM)



## MDA Spec proposal with multiple notations, multiple target platform mappings (BPD spec : IBM, BEA, Borland...)





IBM and MDA

<http://www-306.ibm.com/software/rational/mda/index.html>

<http://www-106.ibm.com/developerworks/rational/library/3100.html>

## Summary

- A unique integration of open standards (MDA, Web Services and J2EE) & open source (Eclipse, Linux, Apache) is well underway
- MDA is moving from a set of ideas and standards to reality as vendors implement, validate and improve standards
  - ▶ Work in progress
- MDA, J2EE and Web Services Standards are being implemented in the IBM Software Development Platform
- Use a combination of general purpose modeling languages and Domain specific modeling languages (built using UML profiles and MOF metamodels) for integrating across the application lifecycle
  - ▶ Serialization is usually an XML language (can also be SQL, Java...)
- IBM and members of OMG as well as eclipse.org are pragmatically integrating modeling, middleware, web services and metadata technologies
  - ▶ Come join the party
- The software development platform is evolving as a core business process that supports businesses
  - ▶ Built using open standards and open source



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