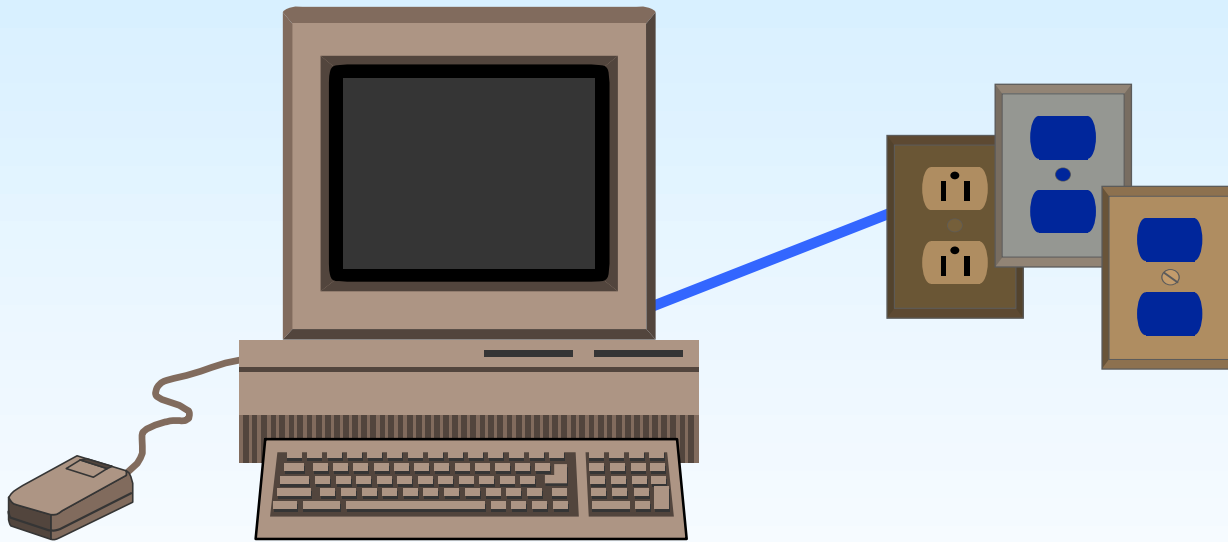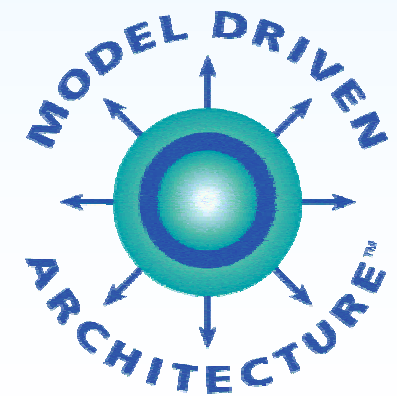# Model Driven Architecture: An Introduction

Richard Mark Soley, Ph.D.
Chairman and CEO

OMG's Vision

OBJECT MANAGEMENT GROUP

The Global Information Appliance

MODEL DRIVEN ARCHITECTURE™

Heterogeneity is Permanent

- **Programming languages**
  - ~3 million COBOL programmers
  - ~1.6 million VB programmers
  - ~1.1 million C/C++ programmers
- **Operating systems**
  - Unix, MVS, VMS, MacOS, Windows (all 8!), PalmOS…
  - Windows 3.1: it's still out there!
  - Embedded devices (mobile, set-top, etc.)
- **Networks**
  - Ethernet, ATM, IP, SS7, Firewire, USB
 - Bluetooth, 802.11b, HomeRF
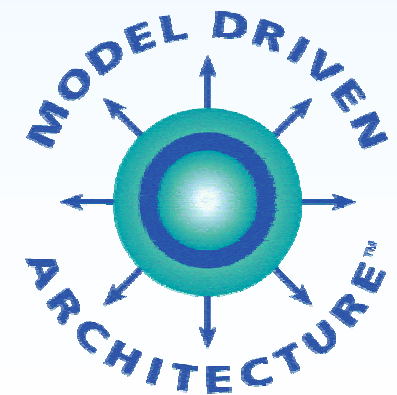
Where Can We Agree?

- There will not be consensus on hardware platforms
- There will not be consensus on operating systems
- There will not be consensus on network protocols
- There will not be consensus on programming languages

- ***There must be consensus on interfaces and interoperability!***
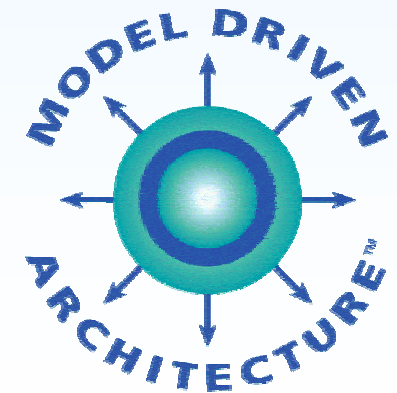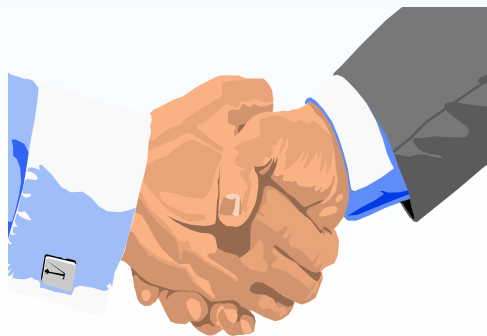
OMG's Mission Since 1989

- Develop an architecture, using object technology, for distributed application integration, guaranteeing:
  - reusability of components
  - interoperability & portability
  - basis in commercially available software
- Specifications *freely available*
- Implementations exist
- Member-controlled not-for-profit
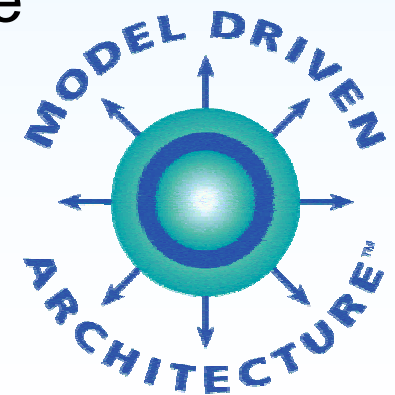
Who Are OMG?

|				
AT&T	Fujitsu	John Deere	Pfizer	Vertel
BEA	Glaxo SmithKline	Microsoft	Rational	
Borland	Hewlett Packard	MITRE	SAGA Software	
Boeing	Hitachi	MSC.Software	SAP	
CA	Hyperion	NASA	SAS Institute	
Citigroup	IBM	NEC	Secant	
Compaq	IONA	NetGenics	Siemens	
Compuware	io Software	NTT	Sprint	
Ericsson	Kabira	OASIS	Sun	
Ford	Kennedy Carter	Oracle	Unisys	
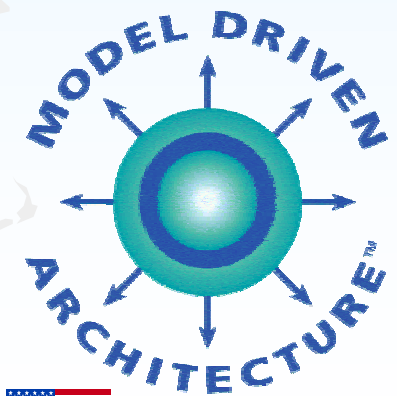
OMG's Major Successes

- ## Common Object Request Broker Architecture
  - CORBA® remains the only language- and platform-neutral interoperability standard

- ## Unified Modeling Language
  - UML™ remains the world's only standardized modeling language

- ## Common Warehouse Metamodel
  - CWM™, the integration of the last two data warehousing initiatives

- ## Meta-Object Facility
  - MOF™, the repository standard

- ## XML Metadata Interchange
  - XMI™, the XML-UML standard
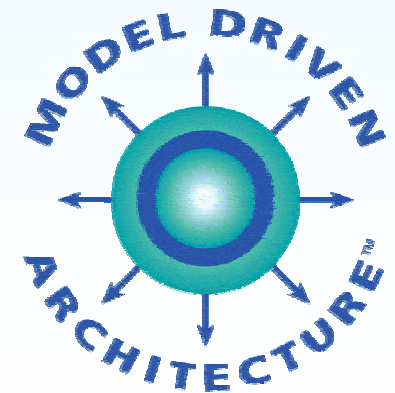
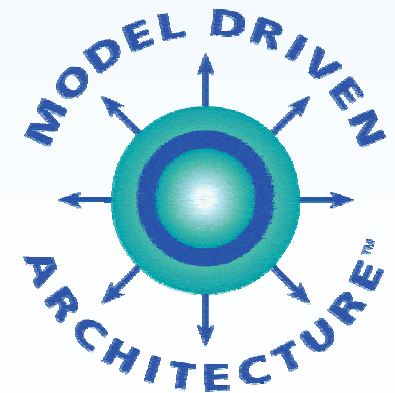# But Nothing Stands Still!

- Middleware *itself* has proliferated:
  - CORBA®: Vendor, OS & language independent middleware
  - COM/DCOM/MTS
  - Java/EJB
  - XML/SOAP
  - C#/.Net
  - What will be *Next Best Thing?*

- You must preserve your software investment as the infrastructure landscape changes around it
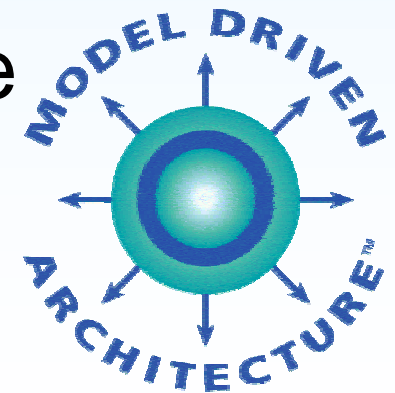
How Can We Protect Software Investment?

- The problem remains
  - Tracking the *next best thing*
  - Protecting your investment in existing software base
  - Retaining qualified staff
  - Maintaining existing code base

- Integrating what you've built
 - *With what you will build!*

The Model Driven Architecture

- OMG's *Model Driven Architecture* (MDA™) initiative is aimed precisely at this problem
- You have an opportunity to increase your bottom line by *integrating your assets*
- Industry standards support that goal by future-proofing your application design
- The MDA will help you integrate the mix you have today, and give you an architecture to support the unexpected
- Focus on integrating legacy applications
- Ensure smooth integration of COTS applications
- Models are *testable* and *simulatable*
- The aim: *a 20-year software architecture*
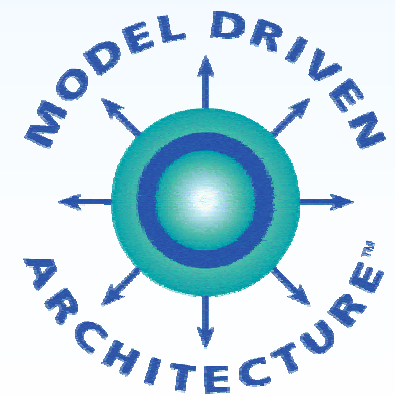
What is Model Driven Architecture?

- A New Way to Specify and Build Systems
  - ***Based on modeling with UML***
  - Supports full lifecycle: analysis, design, implementation, deployment, maintenance, evolution & integration with later systems
  - Builds in Interoperability and Portability
  - Lowers initial cost and maximizes ROI

  - Applies directly to the mix you face:
    - Programming language
    - Operating system
   - Network
    - Middleware
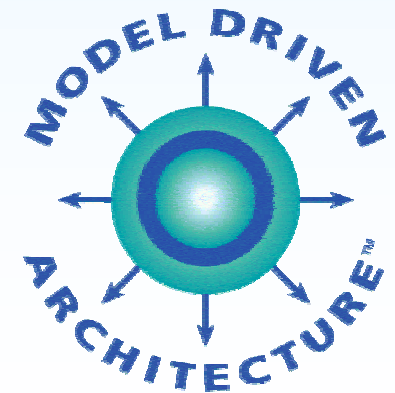
Model Driven Architecture
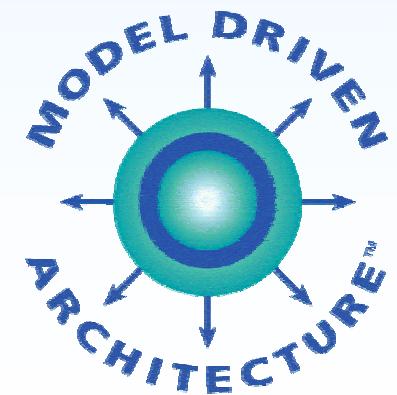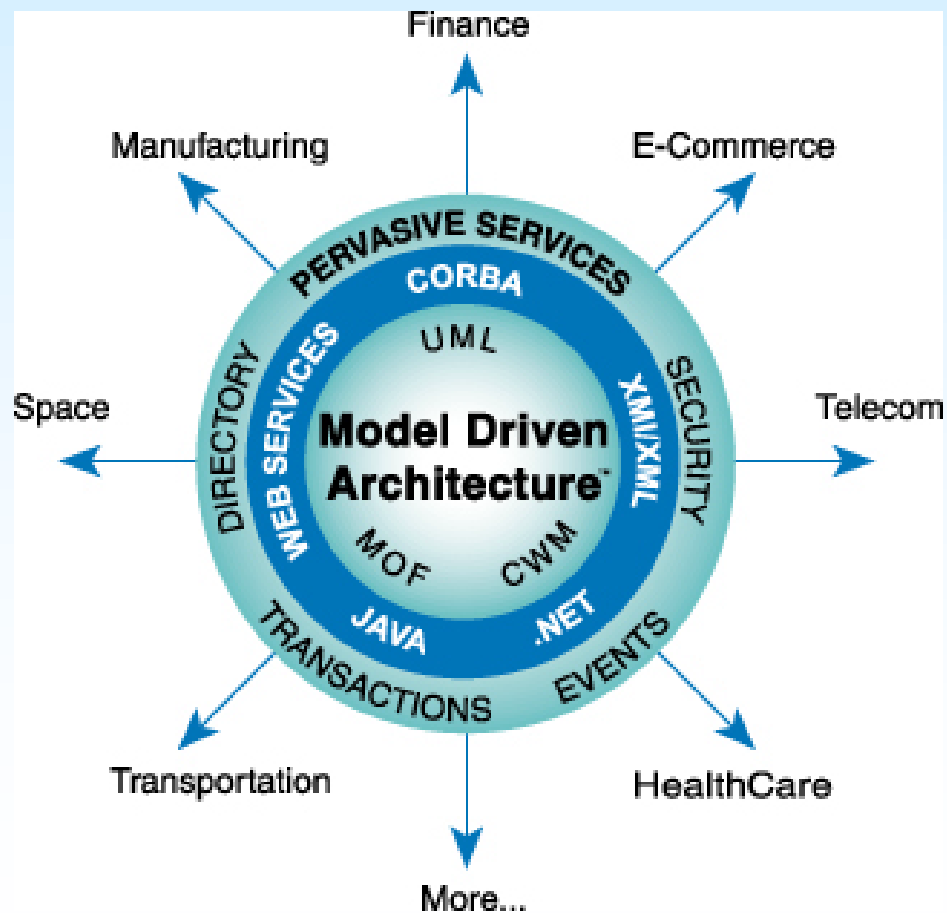
Leveraging UML is Critical

- The Unified Modeling Language is the successor to the dozens of OO A&D notations of the early '90s.
- Result of an OMG adoption begun in '96 and completed in '97
- Complemented with repository (MOF) and XML Metadata specs (XMI)
- Standardization primed the market
  - Over 100 books
  - Dozens of commercial tools
  - Widely available training
- Supported by an open process
  - UML 2.0 process under way now
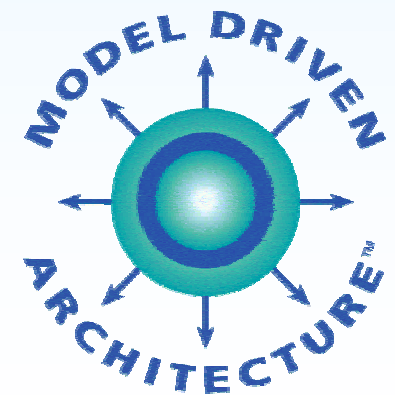
The Dream: Web Services
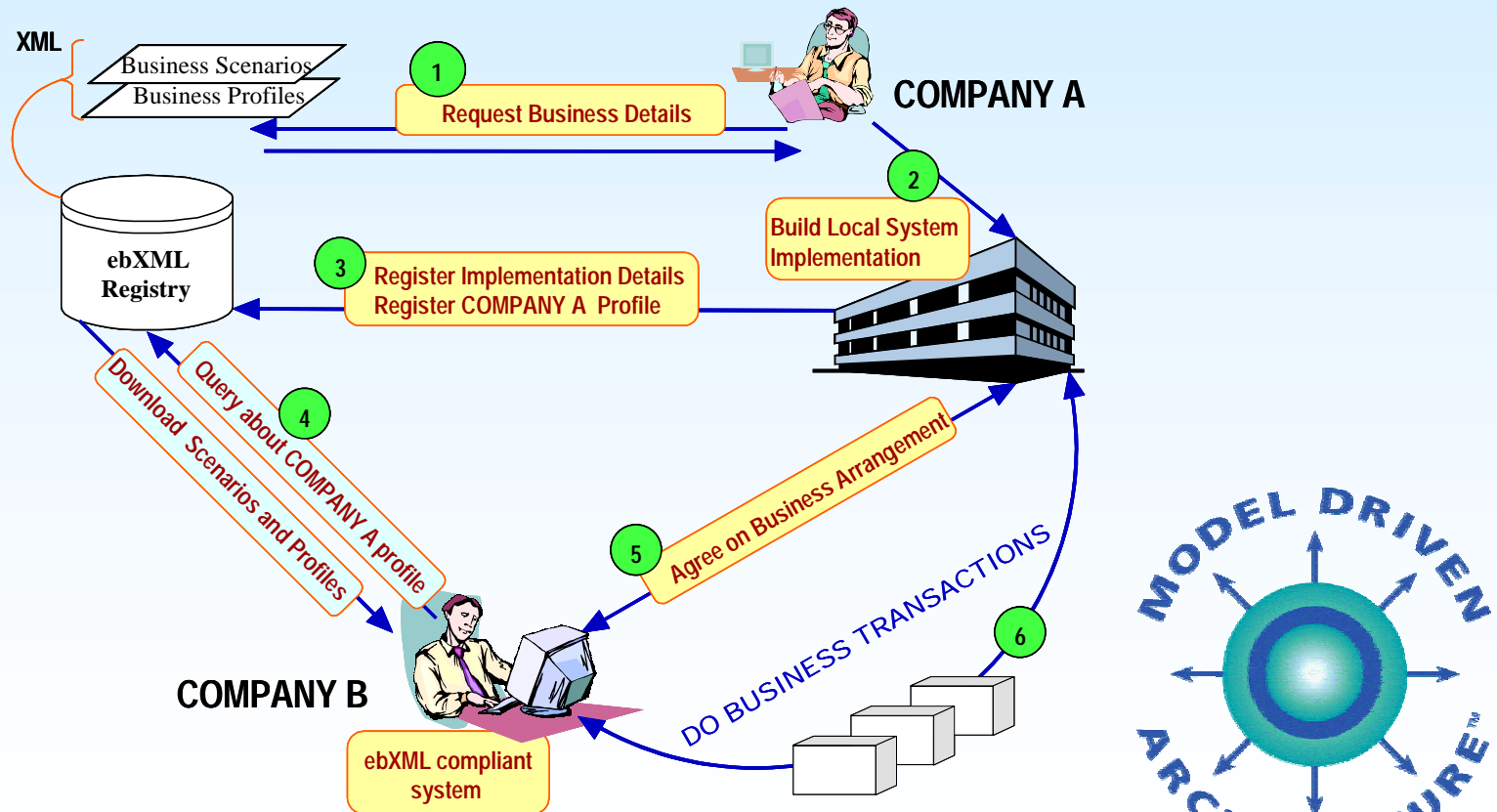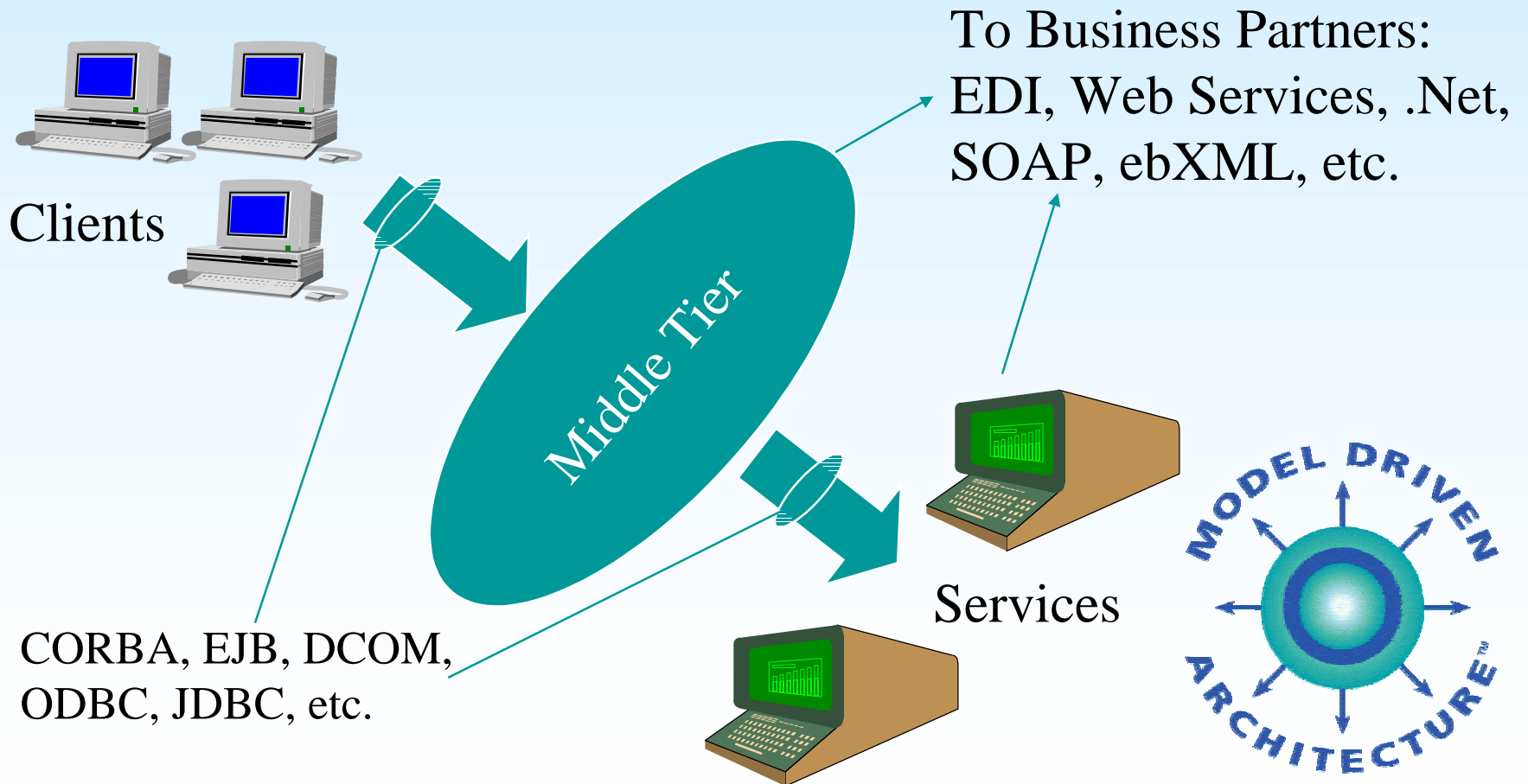

(Clipped from ebXML Technical Architecture)

The Reality: Integration

Clients

CORBA, EJB, DCOM,
ODBC, JDBC, etc.

Middle Tier

To Business Partners:
EDI, Web Services, .Net,
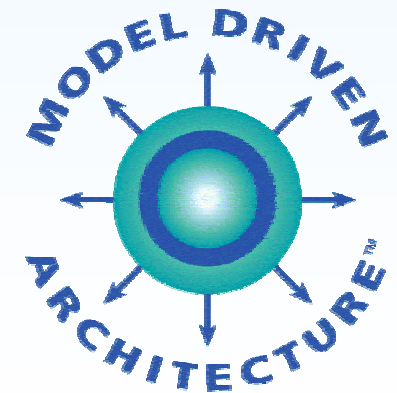SOAP, ebXML, etc.

Services

MODEL DRIVEN ARCHITECTURE™

Building an MDA Application

Platform-Independent Model

A Detailed Model, stating Pre- and Post-Conditions in OCL, and Semantics in Action Language

Start with a *Platform-Independent Model* (PIM) representing business functionality and behavior, undistorted by technology details.
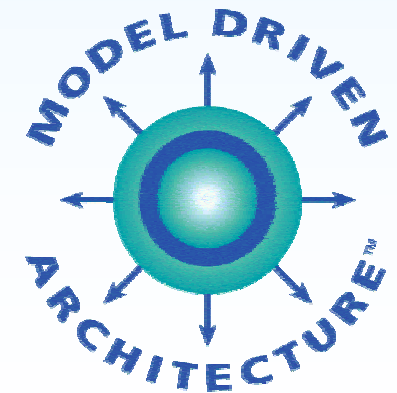
Generating Platform-Specific Model

Platform-Independent Model
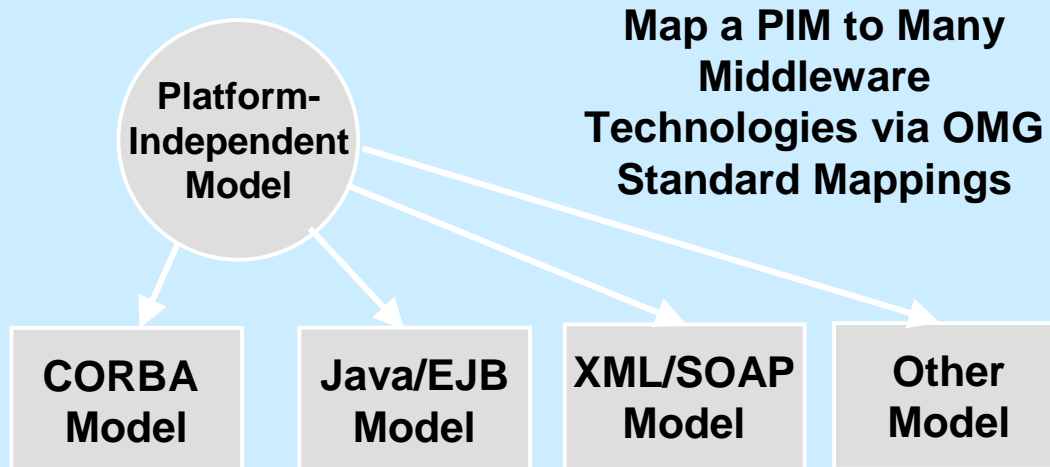
CORBA Model

Map a PIM to Specific Middleware Technologies via OMG Standard Mappings

MDA tool applies a standard mapping to generate *Platform-Specific Model* (PSM) from the PIM. Code is partially automatic, partially hand-written.

Mapping to Multiple Deployment Technologies

Map a PIM to Many Middleware Technologies via OMG Standard Mappings

Platform-Independent Model
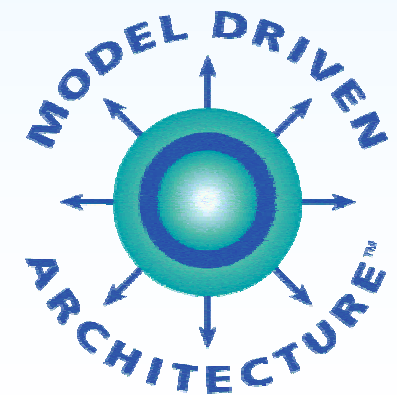
CORBA Model

Java/EJB Model

XML/SOAP Model

Other Model

MDA tool applies an standard mapping to generate *Platform-Specific Model* (PSM) from the PIM. Code is partially automatic, partially hand-written.
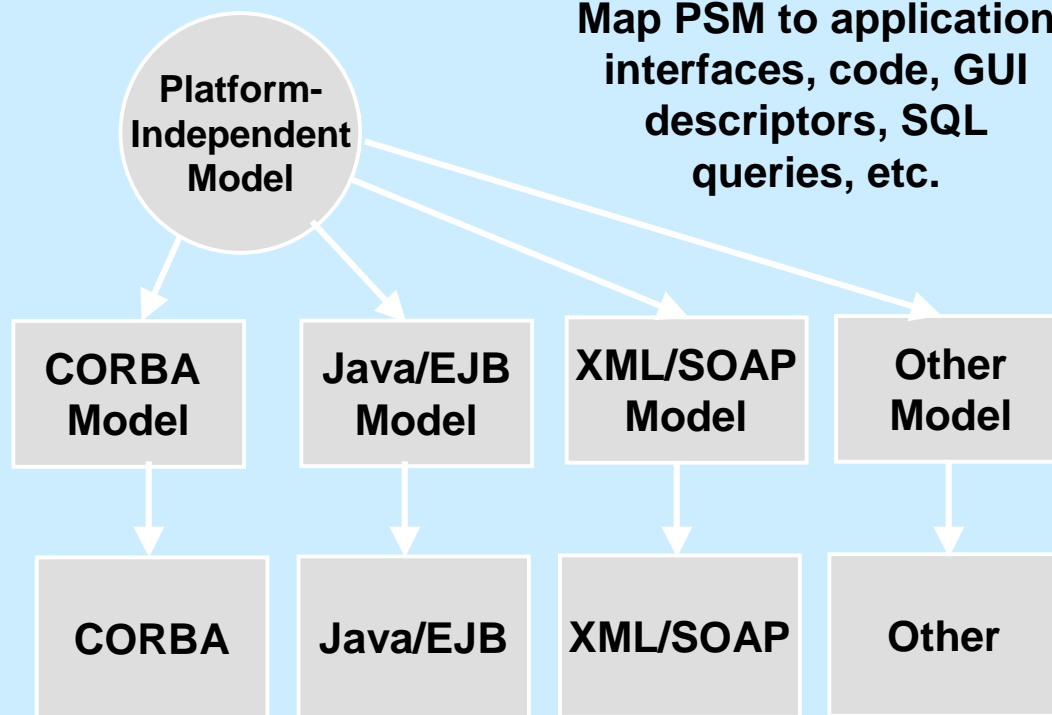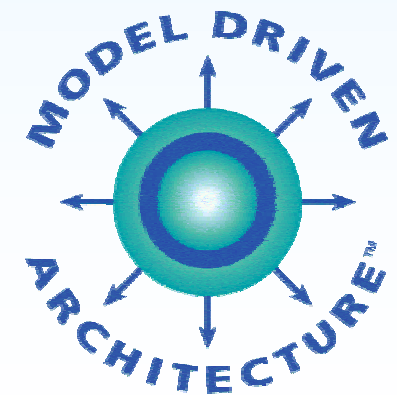
MODEL DRIVEN ARCHITECTURE™

Generating Implementations

Platform-Independent Model

Map PSM to application interfaces, code, GUI descriptors, SQL queries, etc.

CORBA Model	Java/EJB Model	XML/SOAP Model	Other Model

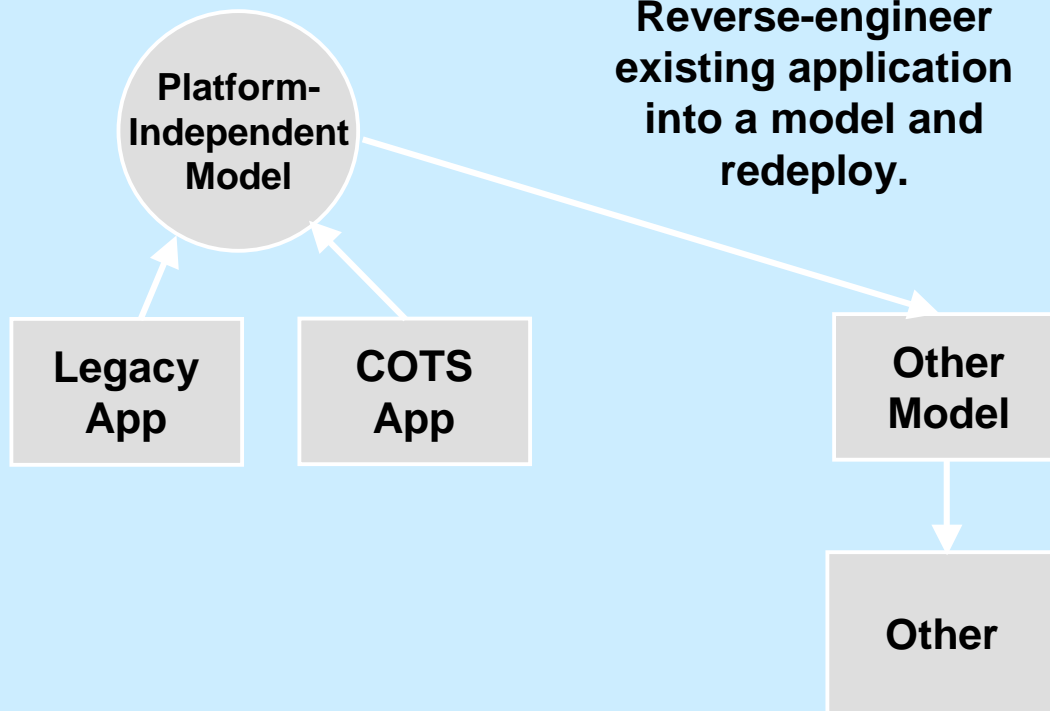| CORBA	Java/EJB	XML/SOAP	Other

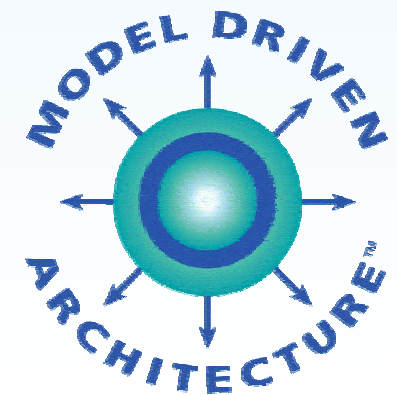**MDA Tool generates all or most of the implementation code for deployment technology selected by the developer.**

Integrating Legacy & COTS

Platform-Independent Model

Reverse-engineer existing application into a model and redeploy.
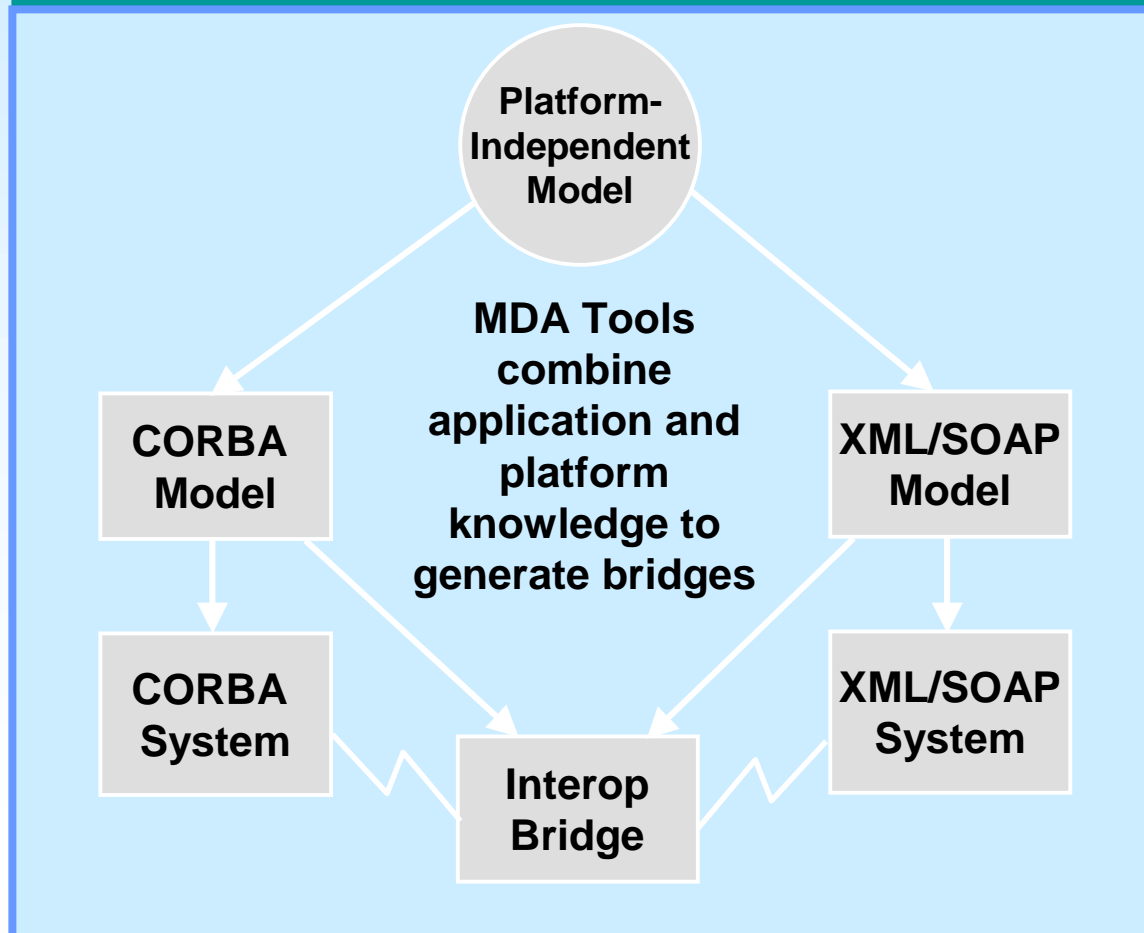
Legacy App

COTS App

Other Model

Other

MDA Tools for reverse engineering automate discovery of models for re-integration on new platforms.

Automating Bridges

Platform-Independent Model

MDA Tools combine application and platform knowledge to generate bridges

CORBA Model

CORBA System

XML/SOAP Model

XML/SOAP System

Interop Bridge

Bridge generation is simplified by common application models, simplifying creation of integrated applications both within and across enterprises.

MODEL DRIVEN ARCHITECTURE™
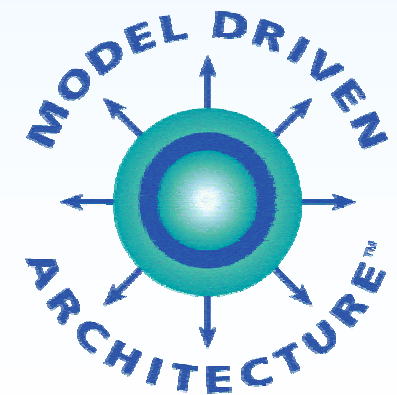
# MDA in Industry Standards

- The MDA promotes standards that are valuable *across deployment technologies*
  - Applicable to large & small deployments, new applications, legacy and COTS
  - Applicable to CORBA, DCOM, .Net, etc.
  - Allows knowledge leverage for the long-term, standards that persist
- MDA has been quickly adopted by OMG's standardization groups
  - Both PIM and PSM(s) adopted by process
 - Standard model lasts decades
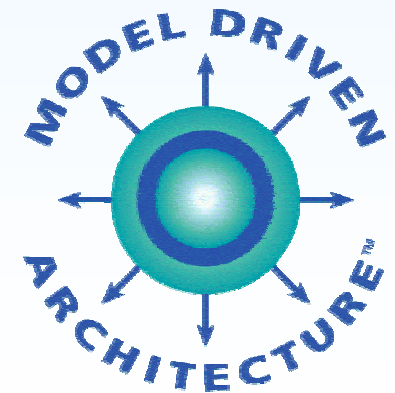
MDA in Practice

- Several excellent proofs-of-concept:
  - Wells Fargo (an architecture that has already been resilient through a decade of change)
  - Lockheed Martin Aeronautics
  - GCPR in US government
- These are "MDA-like"
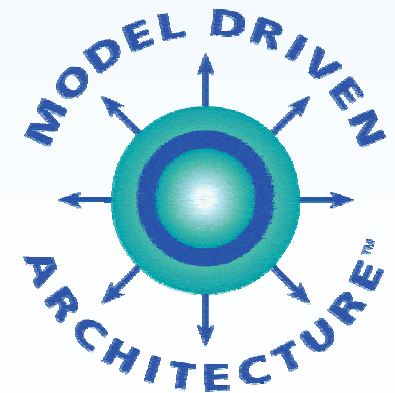 - Standards make it portable
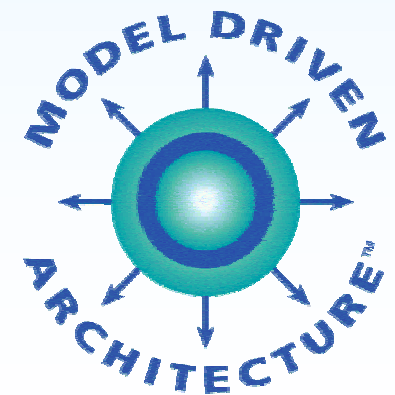
OMG MDA Adoption Status

- Major direction agreed March '01; overall architecture adopted September '01.
- UML 1.4 complete; 2.0 in process.
- Mappings (*"profiles"*) underway:
  - EDOC (adopted)
  - CORBA (adopted)
  - EAI (in process)
  - EJB (adopted by JCP)
  - SOAP/XML (in process)
 - .Net (to be started)
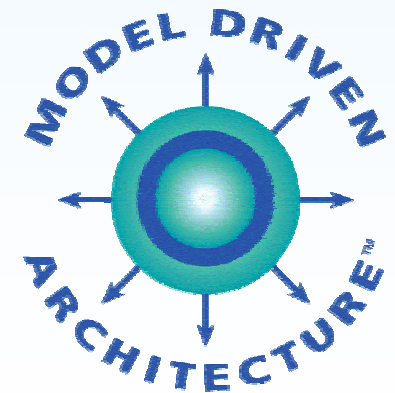
OMG MDA Adoption Status

- More importantly, *vertical market groups* are thriving on MDA approach:
  - Electronic Commerce
  - Financial Services
  - Healthcare
  - Life Sciences Research
  - Manufacturing
 - Space & Ground Systems
  - Telecommunications

MDA Benefits

- Full support for your "20 year architecture" across the application lifecycle
- Smooth integration across intra- and inter-business boundaries (across deployment technologies)
- Reduced costs from beginning to end
- Reuse of applications, code, training and people
- Technology-independent representation of the *business*
- Scalability, robustness & security via generated code
- Stable model-based approach maximizes ROI
- Rapid inclusion of the *next best thing*

The CIO Problem Solver
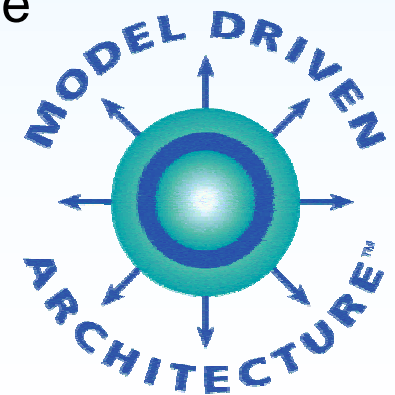
To Get More Information

- MDA Information Page
  - http://www.omg.org/mda/
- OMG General Information
  - http://www.omg.org/
- Contact the Author
  - soley@omg.org
- See the first products!
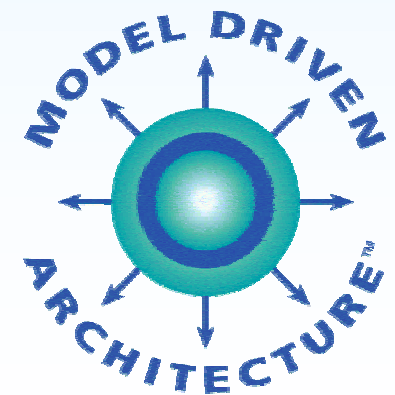
Interactive Objects Software

- **Model Driven Architecture™ with ArcStyler**

- The ArcStyler assists an IT Organization along the entire critical development path in line with the Rational Unified Process (RUP) and with the concepts of MDA. Along this path, platform-independent business models are created and subsequently transformed, automatically or semi automatically, into more detailed platform-specific models while preserving the relationship to original business viewpoints along the way.

  Interactive Objects Software GmbH
  Basler Straße 65 D - 79100 Freiburg, Germany
  Tel: +49 761 400 73 0 Fax: +49 761 400 73 73
 www.io-software.com
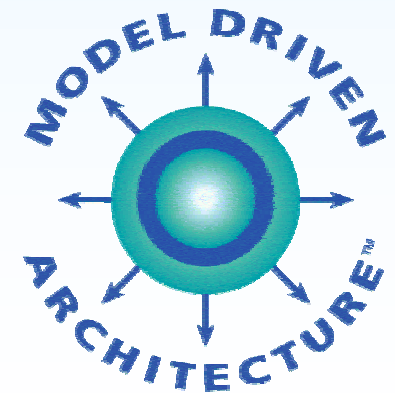
Kabira Technologies Ltd.

- Adaptive Realtime Infrastructure (ARI) software for the creation and deployment of high-availability, transactional 'software engines' directly from high-level, standard OMG MDA™ models. Kabira's server software is a fully compliant platform for applications built on the OMG™ Model Driven Architecture™.

  Kabira's infrastructure software, in combination with development tools from Rational Software, IONA, SUN, HP and Microsoft, is utilized for the creation and deployment of next-generation convergent services over the Internet, traditional enterprise and telecommunications networks.

  Kabira Technologies Ltd.
  One McInnis Parkway San Rafael ,CA 94903
  Tel : +1.415.446.5000 Fax: +1.415.446.5199
  www.kabira.com
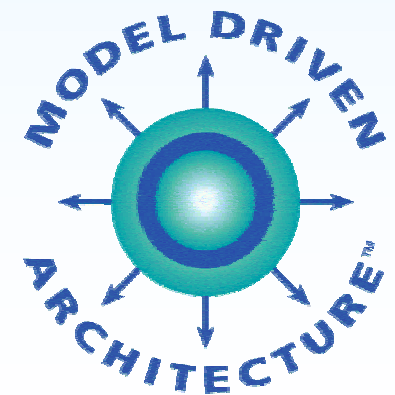
Kennedy Carter

- Supporting MDA with eXecutable UML tools
- iUML: build, test and integrate multiple platform-independent models
- iCCG: specify PIM to PSM mappings in xUML (and generate your code generator!)
- Users: Lockheed Martin (F16 mission computer), Nortel (Passport), GCHQ, TRW Automotive, BAE Systems (Stingray torpedo), Lucent, et al
- Benefits: (according to Lockheed Martin): better analysis, MUCH less maintenance, lower defect injection, less rework, shorter schedule, cross platform compatibility
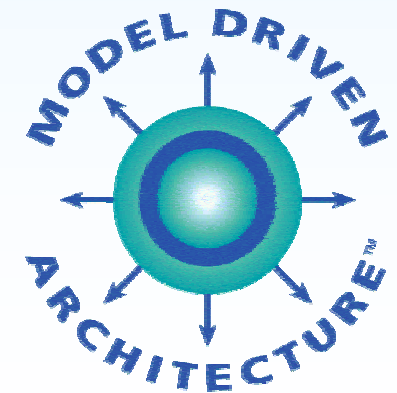
Kennedy Carter Ltd.

14 The Pines, Broad Street, Guildford, Surrey

GU3 3BH, UK

Tel: +44(0)1483 483200, Fax: +44(0)1483 483201

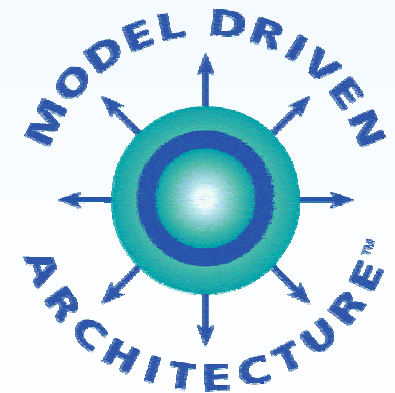www.kc.com

Secant Technologies, Inc.

- Secant Technologies is a provider of model-driven, application development and knowledge discovery platforms. Secant provides industry-specific platform solutions for knowledge discovery in addition to providing its core technologies as separate products.

- Secant provides Model-Driven Infrastructure™ software that enables organizations to build, power and evolve large-scale transactional and knowledge discovery software platforms using visual modeling tools.

Secant Technologies, Inc.

4853 Galaxy Parkway, Suite S, Cleveland, OH 44128

Tel: +1-216-595-3830 Fax: +1-216-595-0199

www.secant.com

See Some Proof of Concept!