Atego – Introduction & Vision on Model-based Systems Engineering

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Agenda

- Introducing Atego
- Industry Challenges
- Atego Vantage
- Vision Summary
Market Position

- Thought Leaders – Drive Standards while Implementing Pragmatically – Customer Driven
- Focus on Collaboration & Scale – Distributed SoS
- Innovators – Reuse & Product Lines for Model-based System & Software Engineering
- Lifecycle Tool-chain Integrated

Vision

Eliminate Engineering Inefficiencies for Systems & Software Engineers Designing, Developing & Maintaining Complex Systems and Software
Agenda

- Introducing Atego
- Industry Challenges
- Atego Vantage
- Integration with PTC Integrity
Systems Engineering Issues & Challenges

- **Growing Complexity & Functionality of Systems & Software**
  - Larger Share of a Products Cost & Capability is Software
  - System & Sub-system Integration
  - Certification, Regulation & Standards Compliance
  - The Move to ‘Systems Thinking’ – Requirements, Design, Integration, Testing

- **Larger & More Distributed Teams**
  - Communication & Collaboration
  - Implementing Common, Architected Goals

- **Increasing Time Pressures**
  - Shorter Development Cycles
  - Delivering on Schedule

- **Quality Assurance**
  - Risk of Building the Wrong System
  - Increased Costs of Later Stage Errors

- **Cost Reduction Demands**
  - Total Development Cost
  - Risks & Costs of Delays or Cancellation
Model Based Systems Engineering Provides Dramatic Improvements

- Model-Based Systems Engineering (MBSE)
  - More Efficient Engineering Management Process
  - Improving Communication, Understanding Complexity & Finding Problems Earlier
  - Deliver Cost Savings not achievable using other Methodologies
    - Halving the Total Cost of Development

- Wide & Deep Lifecycle Coverage
  - Abstraction with Platform Independent Modeling
  - More than Software
  - Enables Rapid Prototyping, Simulation & Trade Studies

- Reduces the total ‘Cost Spectrum’ – Money, Time & Risk
  - Design & Build the Right Systems, the Right way
  - Long-term Design, Legacy Integration & Upgrade Backbone
  - System & Code Portability for Future Proofing
  - Auto-Generation & Maintenance of Documentation
  - Capture IP to Reduce Risks & Learning Curves

* (EMF 2013 Independent Survey Results from 667 Systems Engineering respondents)
Challenges when Product Engineering is the Core Business

- Engineering to Order (EtO) Organizations
  - Need to Customize Existing Capabilities to suit Client Requirements
  - Bid Process Impacts Project Profitability & Success
  - Drive to reduce Time from Order to Cash

- Product Development (PD) Organizations
  - Need to redeploy common systems & software to the Market or 3rd Parties
  - Development Cycle Times

- Iterative & Common Product Development
  - Increasing number of Products
  - Increasing use of Product Families
  - Understanding Product Similarity
  - Trade-Off Analysis & Decision Making

- Failing to Capture the Full Value of Existing IP

- Historical Best Practices are Inefficient, Complex, Not Scalable or Error-prone
Enhancing MBSE with Product Line Engineering

- The Goal of PLE is to Reduce the Time, Cost and Effort required to Create, Deploy and Maintain Similar Products
  - By Leveraging Product & System Commonality
  - And Designed-in Variation (More than just Asset Reuse)

- To achieve this goal, the solution must
  - Minimize duplicate effort
  - Maximize commonality among design and implementation assets
  - Optimize reuse of effort across similar products within each of its product lines
  - Manage product line variations and complexity

- Model Based PLE offers a fundamental shift in approach
  - “A broader perspective that views product line engineering as designing a single system rather than as creating a multitude of products”

- Designing your products as a single system can deliver considerable development cost savings
  (Dr Jerry Krasner, EMF 2013)
Applying Re-Use is Not New...

- Atego’s Integrated, Practical & Pragmatic Solution is New
- Combining 2 Powerful Paradigms for ‘Model-Based Product Line Engineering’
- Model-base Systems & Software Engineering (MBSE)
- Extending into Variable Product Families (PLE)
- with a Well Documented Value Proposition

(Linda Northrop, SEI SSPL 2008-2012)
Development Cost Reduction & Delivery Time Improvements

- **SE (Non-Modelled Systems Engineering)**
  - 59% of Projects Delivered on Time

- **MBSE (Model Based Systems Engineering)**
  - 62% of Projects Delivered on Time
  
  Compared to SE
  - 55% Reduction in Total Development Cost per Project
  - 16% More Project Delivered on Time

- **MB-PLE (Model Based Product Line Engineering)**
  - 75% of Projects Delivered on Time
  
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Standards - Summary
OMG & ISO Standards

Our Customers & Our Competitors Customers

- OMG Standards
- ISO Standards
- Requirements Engineering
- SysML + OVM
- BPMN
- ISO15288
- ISO26550
- ALM
- UML + OVM
- RAS
- Electrical
- Mechanical
- Operations & Support
- PLM
Proven Best Practices combining ISO Standards & Atego Expertise

*ISO 15288:2008* Systems Engineering standard covering processes & life cycle stages


Process **MAP**
- **M**odel Based Systems & Software Engineering
- **A**sset-Based Modular Design
- **P**roduct Line Engineering

Full Systems & Software Engineering Lifecycle
- Not Limited to the Atego Product Portfolio
- Requirements from PTC Integrity
- Outputs; Documents, Test Plans, BoMs, etc

Horizontal, Cross Industry Process
- Ideal for ‘Product Development’ & ‘Engineer to Order’ organizations
The **atego Vantage™ Modular Products**

**ategoModeler™** (Artisan Studio)
- SysML, UML & Variant Modeling Language to Design Before you Build
- Model Reviewer, Model Simulator, Trade Study Analyzer and Artefact Generator
- Delivers Dramatic Savings in Time, Cost & Risk

**ategoAssetLibrary™**
- Repository for Modular System/Software Design Links
- Also Drives Reuse, Legacy Integration and ROI Tracking
- Enables & Measures IP Management, Modular Construction & Reuse

**ategoProcessDirector™**
- Process Authoring, Management & Deployment Tool
- Pre-loaded with the Atego Perspective for MB PLE
- Implements the Consistent use of Process, Corporate Best Practices & Governance
Focus on Live Collaboration

- Federated Modules running Line on Multi-User Databases
- Interfaces with existing tool chain
Tool Chain Integration

- Requirements import/export
- Requirements Trace
- Diagram Export

- Word
- Excel
- Project

- Web Browsers

DOORS

- Bidirectional link
- Simulation

MATLAB/SIMULINK

- Interfaces with solvers
- Open Modelica
- Mathematica, Excel

Any Code IDE

- Visual Studio
- Eclipse
- ...

Component Interface Specifications

- IDL
- AUTOSAR
- WSDL
- ...

ERP

- ClearCase
- Synergy/CM
- Serena Dimensions
- Serena VM
- Visual Source Safe
- ...

External CM

- Your own tool!

PTC
Document, measure, manage & improve your organizations operational, engineering and development processes

- Process Inventory in the Box
  - Full Lifecycle; Systems, Software,
  - Atego Perspective + Others
- Rich Process Content Authoring
- Project Initiation Wizard
- Project Plan Generation
- Process Deployment
  - Browser & To Do Dashboard

- Merge Industry Best Practices and your Experience to improve Quality
- Achieve the Promised Productivity Improvements from your Processes
- Reduce Costs of Process Definition and Rollout
OMG BPMN Views
Atego’s Model-based Product Line Engineering

- Model Based Systems & Software Engineering (MBSE)
- Asset-Based Modular Design
- Model-based Product Lines
  - Variant Modeling
  - Variant Selection
  - Product Model Creation
- Model-based Product Line Engineering (MB-PLE)
Visual Modeling for System & Software Design

- Scalable UML, SysML, UPDM
- Repository Collaboration
- Built-In Traceability
- Document Generation
- Automated Design Review
- System Simulation
- Code Generation & Sync
  - C, C++, C#, Java, Ada

- Improved Quality through Early Design Review and Consistency
- Bring Systems to Market Faster with Parallel Design Effort
- Cost Reductions from Design and Development Automation
Automated Model Review & Fix

- 100+ out-of-box Model Reviews
- Browser Look & Feel
- Summary & Details
- Fix-it Features
- Active Mentoring
- Modeling Standards

- Improves your Model Completeness, Correctness and Consistency
- Easy to Use, even from outside Artisan Studio
- Save Time with 100+ Predefined Reviews, plus full Flexibility to Add Your Own Reviews
Visual SysML Model Simulation

- Early Complex Behavior Validation
- Block Level Reuse
- Drop-&-Play Simulation
- Connect to External Simulators
  - MATLAB Simulink™, etc.

- Typical 20% reduction in model ‘Design Walkthrough’ effort
- Up to 30% reduction in design errors
- Significant reduction in overall project costs
Generate Code from your Models & Synchronize Changes Back

**ACS (Automatic Code Synchronizer)**
- C, C++, C#, VB, Ada, SPARK & Java
- Silent, automated and continuous synchronization
- Extensible for any other Languages

**TDK (Transformation Development Kit)**
- UML Modeled Code Generation Patterns
  - Pre-Loaded examples
- Fully Configurable Code Generation
  - Precise Model to Code Mapping
  - Specific Coding Standards
  - Best Programming Practices
Modeling Based Systems Engineering

Package Diagram
Block Definition Diagram
Internal Block Diagram
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- Model-based Product Line Engineering (MB-PLE)
Sub-System & Software Component Publication & Reuse

- Standards Based
  - OMG Reusable Asset Specification
- Multi-User Web Architecture
- File Type Independence
- Atego Modeler Integration
  - Drag-&-Drop Publish & Reuse
- Management Reporting

- Improved Quality and Productivity through Reuse
- Measure the value of Assets Reuse
- Introduce ‘Product Line Engineering’ processes to reduce development and support costs
Asset-based Modular Design

- Design the same way you Build
  - Construct Systems of Sub-Systems (SoS)
  - Use Services to build your Application (SOA)
  - Plug Components together (CBD)

- Modular Design
  - Top-Down, Architected
    - Specification (& Requirements) Driven
    - Parallel Working
    - Separation of Concerns
  - Bottom-Up, Asset Mining
    - Un-modeled Assets
    - Other Modeling Tools
    - Legacy Integration
    - Published Interfaces (e.g. IDL)
Asset-based Modular Design

- Publish from Sub-system model into Atego Asset Library
  - Auto-creates Trace Links
Search Atego Asset Library for Sub-systems
Use Sub-system from Atego Asset Library in Super-system Model (BDD)

Auto-creates Trace Links
Asset-based Modular Design

- Use Sub-system Blocks & Ports Super-system Model (IBD)
Super-system Model = Configuration of Versioned Sub-systems

Super-system Models

Links via Assets

Sub-system Models
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Modeling Product Lines

Artisan Studio
Product Line Model

Variability Model

Decision Set

Base Model

MBSE

Create Product Model

Variant Selector

Product Base Model

Artisan Studio
Product Model

Remaining (Unresolved) Variability Model

Decision Set Editor

MBSE
1 - Variant Modeling

- Variant Diagram
- Variation on all Diagrams
- Simple Notation

Variation Point
Variant
Variability Dependency
Mandatory/Optional
Requires Dependency
Excludes Dependency
Artifact Dependency
Alternate Choice

OVM
- PALUNO, The Ruhr Institute of Software Technology
- Software Product Line Engineering (Pohl et al - Springer 2005)
2 - Variant Selection

■ Variant Selector
  - Browser User Interface
  - External Variation Points Only
  - Jump to Next Decision/Problem
  - Progress Bar

■ Decision Set Editor
  - Variant Debug
  - External & Internal Variation Points
  - Jump to Next Decision/Problem

■ Both Edit the Same Decision Sets
3 - Product Model Creation

- **Auto-Create Product Models**
  - Applies Variability Decisions
  - Unnecessary Variation Points, Variants & Base Model Artefacts Removed

- Creates New Product Model Branch, Original Product Line Model Retained

- Product Model suitable for Trade Studies, Simulation, Documentation & Generation
3 - Product Model Creation

Auto-Create Product Models (IBD)

Product Line Model

Product Model

No Gasoline Engine
Atego’s Model-based Product Line Engineering

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- Asset-Based Modular Design
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  - Variant Selection
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- Model-based Product Line Engineering (MB-PLE)
Publish from Sub-system model into Atego Asset Library

- With Variation
Use Sub-system from Atego Asset Library in Super-system Model (BDD)  
- With Variation
Include Asset Variation in Super-system Model Variation Design & Make Decisions
Create Product Model – Including Super-model and Asset Variation

Both Manual and 5 Gears selected
Modeling-based Product Line Engineering

- Integrated MBSE, Modular Design & Variability Modeling = Model-based Product Line Engineering
Atego Perspective ‘MAP’ - Expertise, Consulting and Training
- **Model Based Systems & Software Engineering with SysML & UML**
- **Asset-Based Modular Design for Systems of Systems**
- **Product Line & Variability Modeling**
- **ISO 15288 & ISO 26550**

- **Mentoring, Auditing & Ongoing Review**
- **Tool Training & Customization**

**Accelerated Knowledge Transfer reduces Training Costs & Time to Market**

**Quality Improvement through Mentoring and Project Review**

**Risk and Cost Reduction from Highly Experienced Consultants**
Features & Advantages Summary

- Atego Vantage MBSE and MB-PLE Benefits are greater than the sum of the parts of the individual Modular Products

- Increased Productivity
  - Abstraction, Simplification & Assembly through Integrated Graphical Modeling
  - Parallel Working with Top-Down & Bottom Up Sub-Systems Suppliers & Consumers
  - Timely, Self-service Best-Practice Process Mentoring

- Improved Quality
  - End to End Traceability with Automated Reviews, Simulation & Trade Studies
  - Improved Communication with Modeled Product Lines & Products
  - Architected Product Lines, Designed Up Front, Finding Problems Early
  - ‘Pluggable Maintenance’, Replacing Sub-Systems over time

- Reduced Cost
  - Automation for Engineering Lifecycle Tasks
  - Reduced Process Research & Learning Curve
  - Asset Reuse across Products in Family
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Summary

...we are different but proven

- Helping our Customers Remain Competitive
- Ready for Today and Tomorrow
- Partnered with our Customers on a shared view of the systems & software engineering world...

...to help them beat their competitors
Next Steps

- Find out more at
  - www.Atego.com
  - www.Atego.com/Products/Atego-Vantage

- Contact us at
  - www.Atego.com
  - Or Your PTC Representative