Data Exchange

Agenda

- > Define your Data Exchange/Management scenario
  - > 3 exchange secnearios
  - > Project and model management
  - > Blueprint of your solution
- > Model API starting guide
  - > Knowing the basic concepts
  - > Model objects and data traversing
  - > Optimization
  - > Resource and help

Data Exchange Scenarios

> File Exchange

- > Read/Write data to various file formats
- > Industry standards
- > Proprietary formats

> Database & Repository Exchange

- > Read/Write data to external Database systems

> Direct-Link Exchange

- > Exchanging model data in real time with other applications
- > Direct integration with other API, SDK

Scenario 1- File Exchange

> Formats not supported in Tekla Structures
> Contractual agreement or IPD process requirement

USE CASE

> Industry Standards

ISO International Organization for Standardization

> IFC, ISO-15926, AecXML

> Industry Initiatives & Projects

CSI The Construction Specifications Institute

OMNICLASS

> CSI Classification Systems: OminClass, Master/Unit Formats

gbXML

> FM and Commissioning - COBie2

> Other Industry consortium

> Proprietary formats

> Other software native formats Fabtrol KISS, CNC Fabrication formats, …. aSa rebar fabrication format

> General CSV file exchange

> General XML file exchange

Scenario 2- Database Exchange

> Linking to your ERP or MIS Systems
> Create daily dashboard-like summary
> Integration with in-house DB solution
> Project Data on mobile or handhold devices

USE CASE

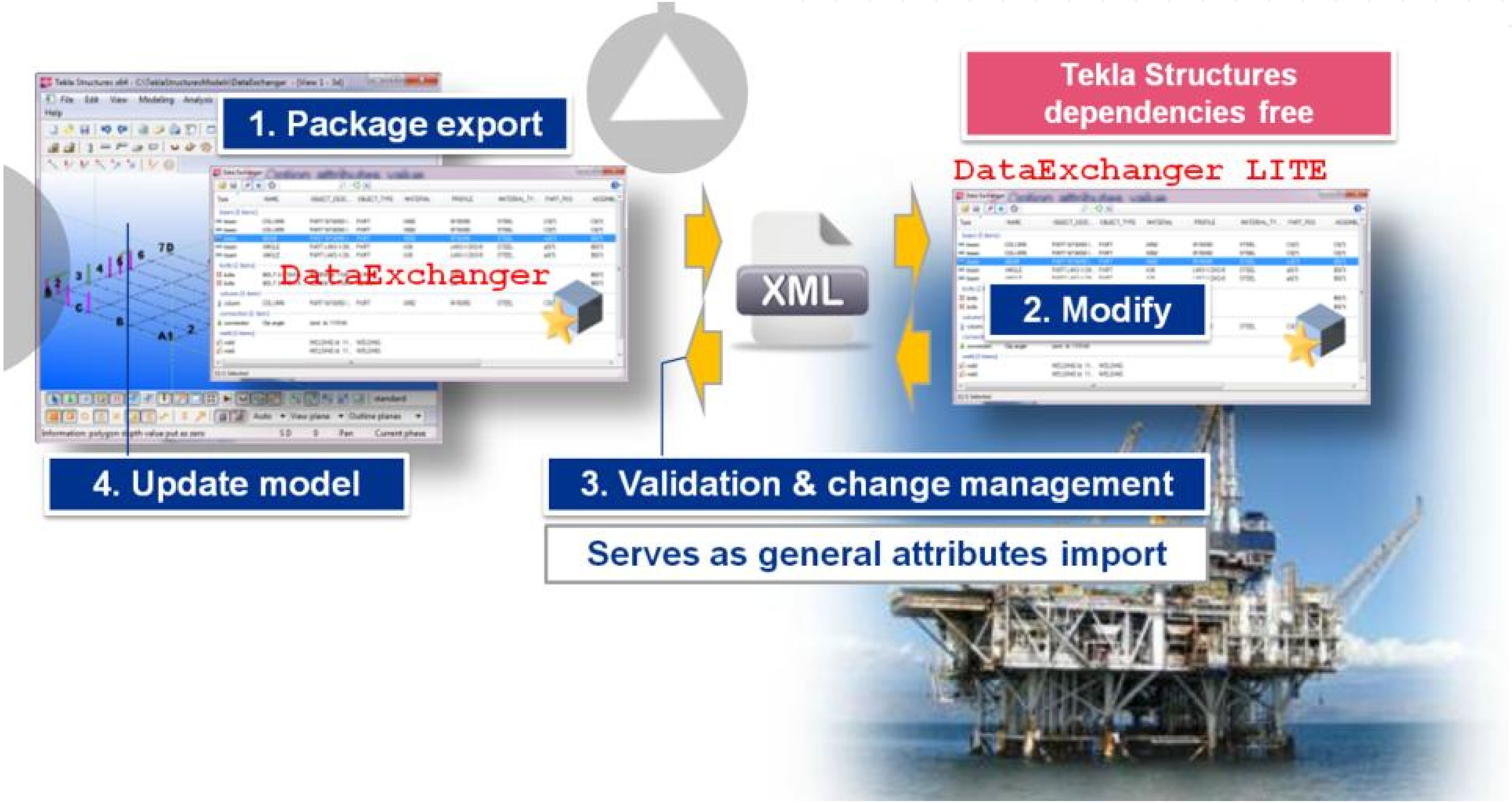
> Example extensions from US Solution Team

- UDA List
- Data Exchanger

more detail>

> UM2010 Presentation-"Steel Design Work Process"

EXAMPLE



1. Package export

Tekla Structures dependencies free

DataExchanger LITE

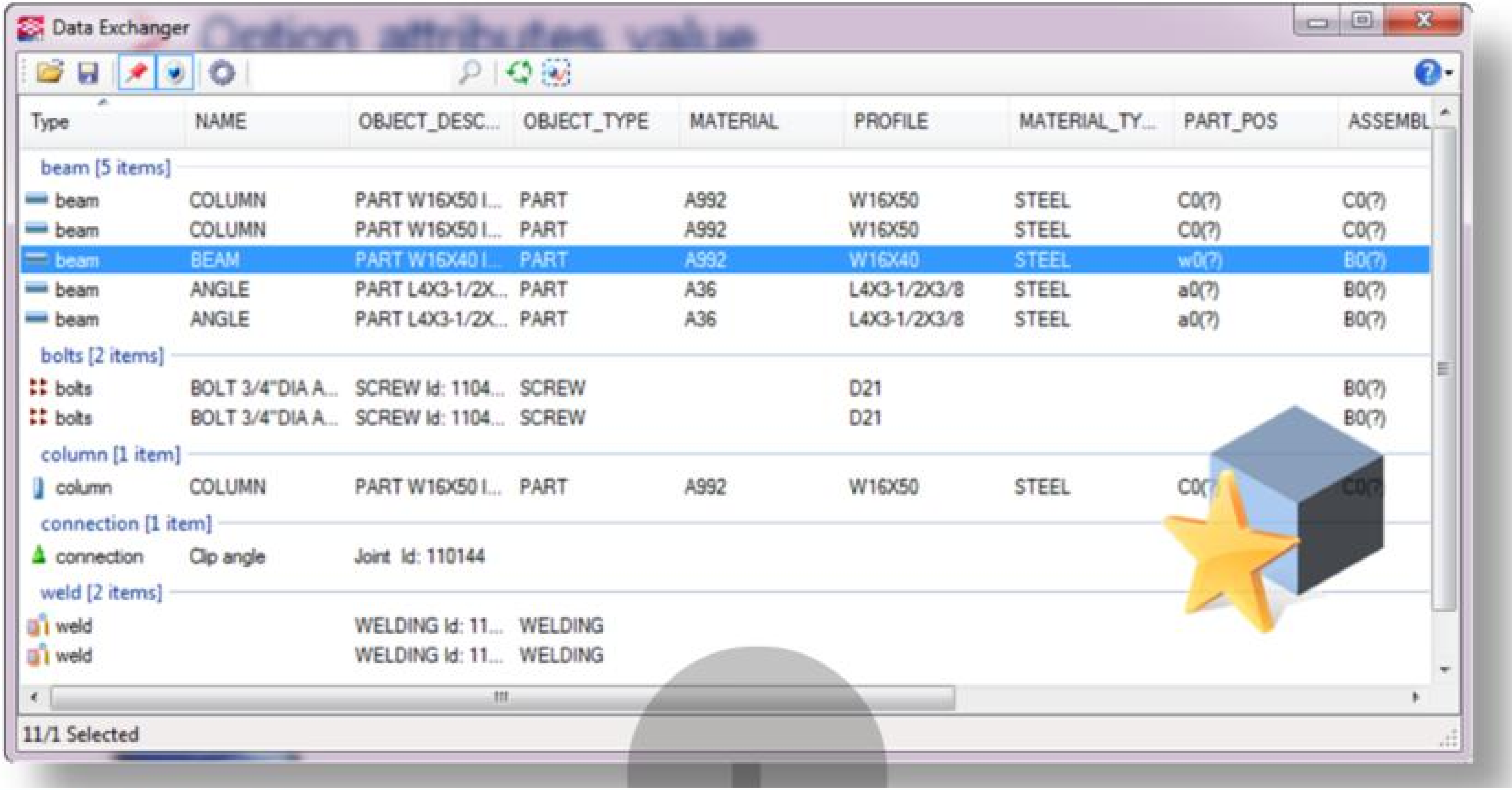
2. Modify

3. Validation & change management

Serves as general attributes import

4. Update model

Data Exchanger



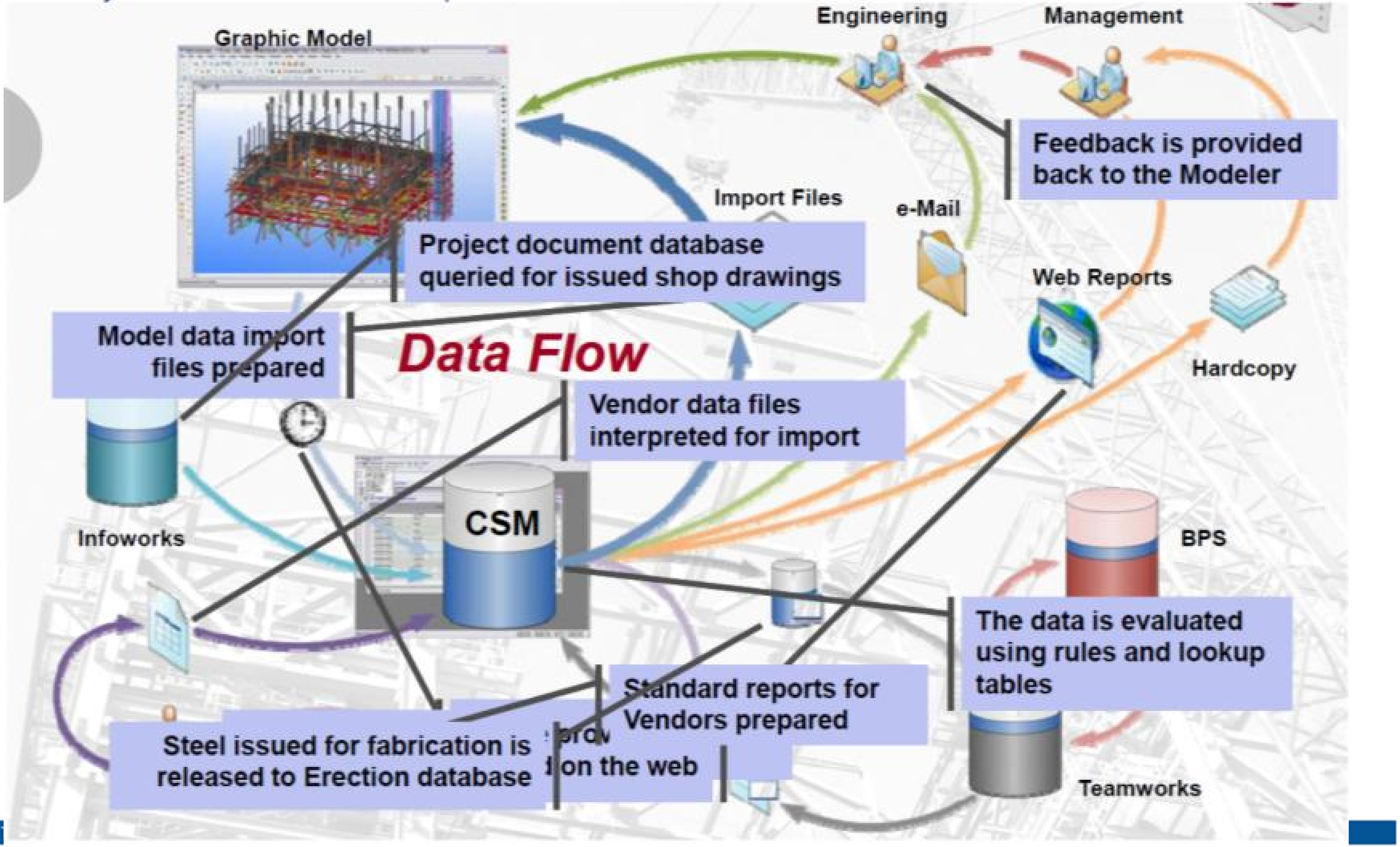
Data Exchanger

Type	NAME	OBJECT_DESC...	OBJECT_TYPE	MATERIAL	PROFILE	MATERIAL_TY...	PART_POS	ASSEMBL
beam [5 items]								
beam	COLUMN	PART W16X50 I...	PART	A992	W16X50	STEEL	C0(?)	C0(?)
beam	COLUMN	PART W16X50 I...	PART	A992	W16X50	STEEL	C0(?)	C0(?)
beam	BEAM	PART W16X40 I...	PART	A992	W16X40	STEEL	w0(?)	B0(?)
beam	ANGLE	PART L4X3-1/2X...	PART	A36	L4X3-1/2X3/8	STEEL	a0(?)	B0(?)
beam	ANGLE	PART L4X3-1/2X...	PART	A36	L4X3-1/2X3/8	STEEL	a0(?)	B0(?)
bolts [2 items]								
bolts	BOLT 3/4"DIA A...	SCREW Id: 1104...	SCREW		D21			B0(?)
bolts	BOLT 3/4"DIA A...	SCREW Id: 1104...	SCREW		D21			B0(?)
column [1 item]								
column	COLUMN	PART W16X50 I...	PART	A992	W16X50	STEEL	C0(?	C0(?)
connection [1 item]								
connection	Clip angle	Joint Id: 110144						
weld [2 items]								
weld		WELDING Id: 11...	WELDING					
weld		WELDING Id: 11...	WELDING					

11/1 Selected

Multiple Database and In-house ERP System Integration

> Tekla User In-house Database Integration
Curtesy of Bechtel Tekla UM10 presentation



Feedback is provided back to the Modeler

Project document database queried for issued shop drawings

Model data import files prepared

Vendor data files interpreted for import

The data is evaluated using rules and lookup tables

Standard reports for Vendors prepared

Steel issued for fabrication is released to Erection database

prov

on the web

Scenario 3- Direct-Link Data Exchange

USE CASES

> Integrating Tekla Structures with other software

> Runtime API-to-API data exchange

> Example extensions from US Solution Team

- Layout Manager

Project Management & Workflow

> IPD process requirement
> Model content management
> Status visualization

Model based communication

construction/fabrication status

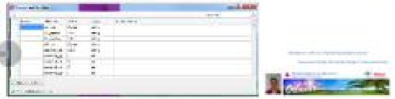
USE CASES

> Workflow Management & Visualization

> In-Model Reviewer

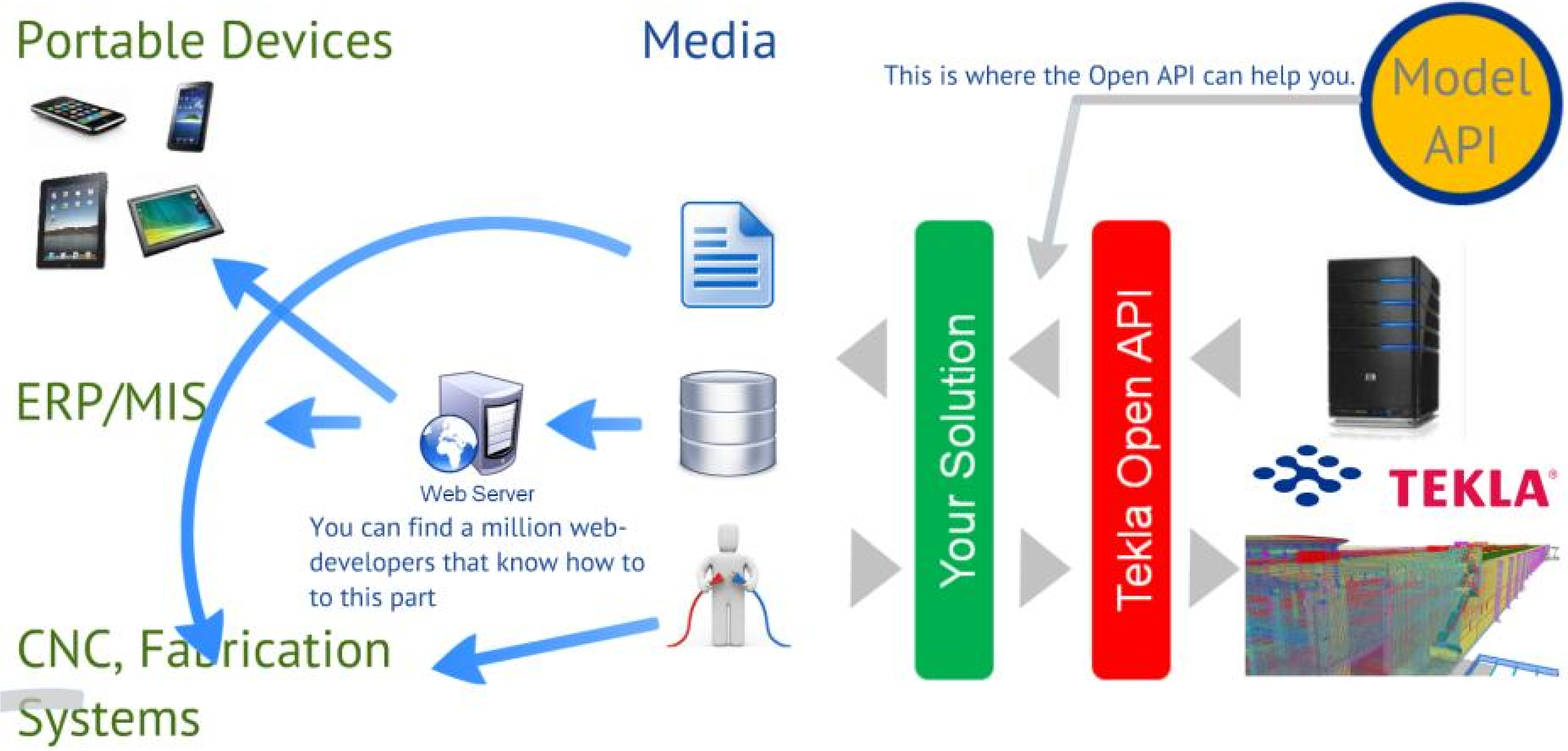
> Project & Model Management

> Component Manager
> Component Variables



MPLE

Blueprint of your Data Exchange and Project Management Solution



You can find a million web-developers that know how to to this part

Linking to Your ERP or MIS System

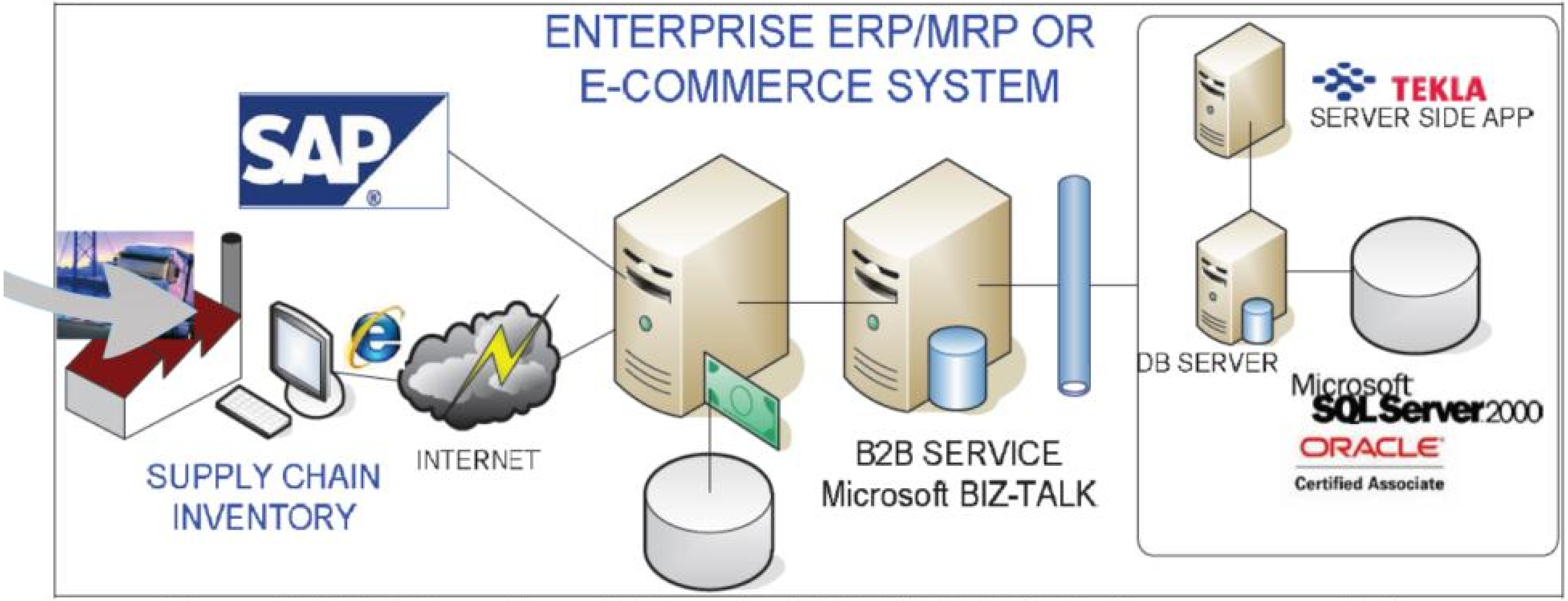
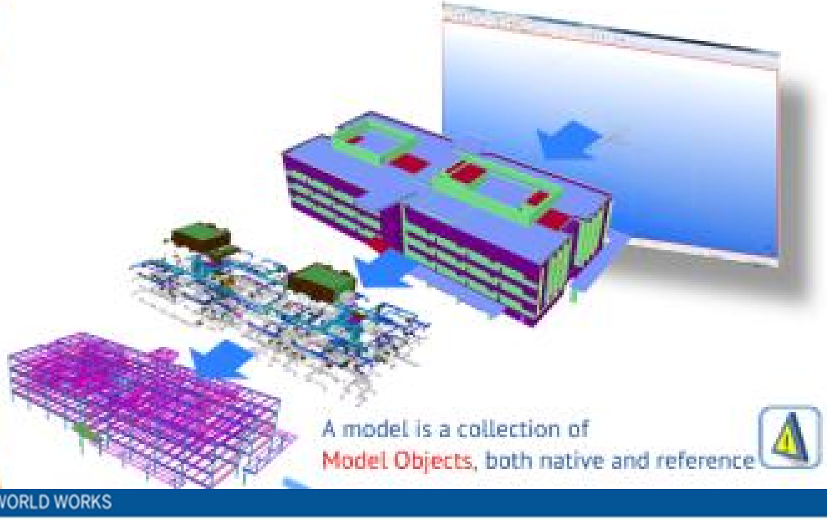


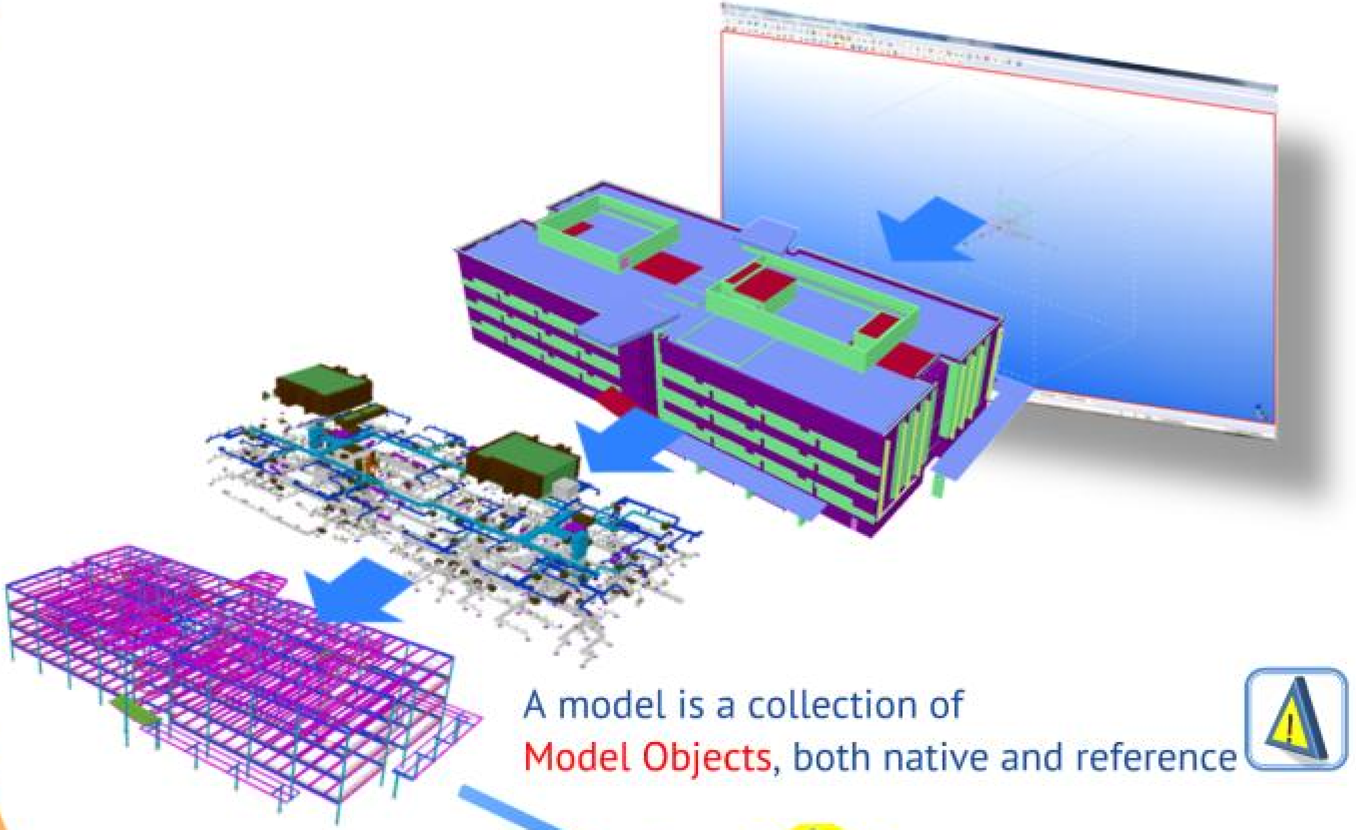
Figure 5 B2B integration platform for ERP, MRP, MIS & eCommerce solutions

Knowing the Concepts

> Simple data structure in Model API



A model is a collection of Model Objects, both native and reference



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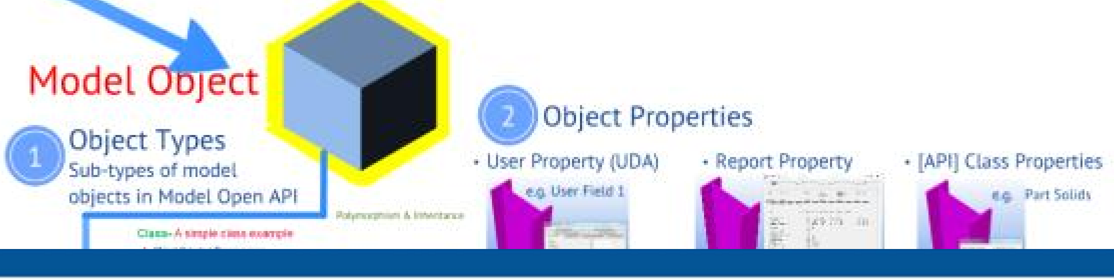

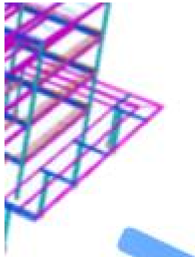

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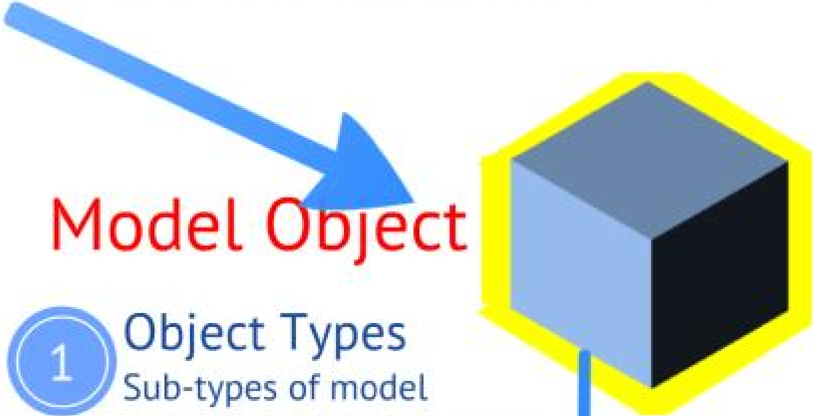
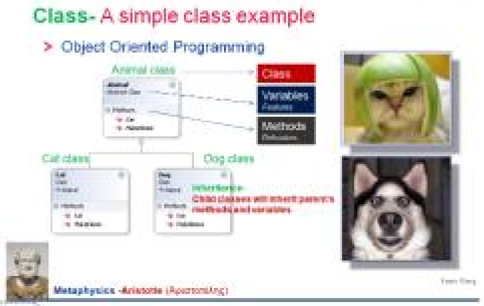


Model Object

1 Object Types

Sub-types of model objects in Model Open API

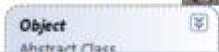


Class- A simple class example

> Object Oriented Programming

Animal class
Class
Variables
Methods
Cat class
Dog class
Inheritance
Child classes will inherit parent's methods and variables
Metaphysics -Aristotle (ApotonsAng)

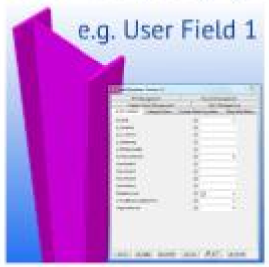
Polymorphism & Inheritance



Model Object is inherited from Microsoft .NET "Object" class

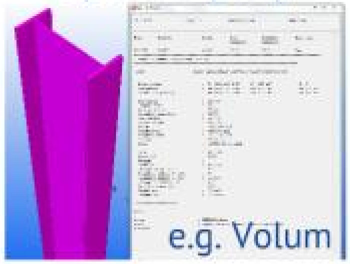
2 Object Properties

- User Property (UDA)



e.g. User Field 1

- Report Property

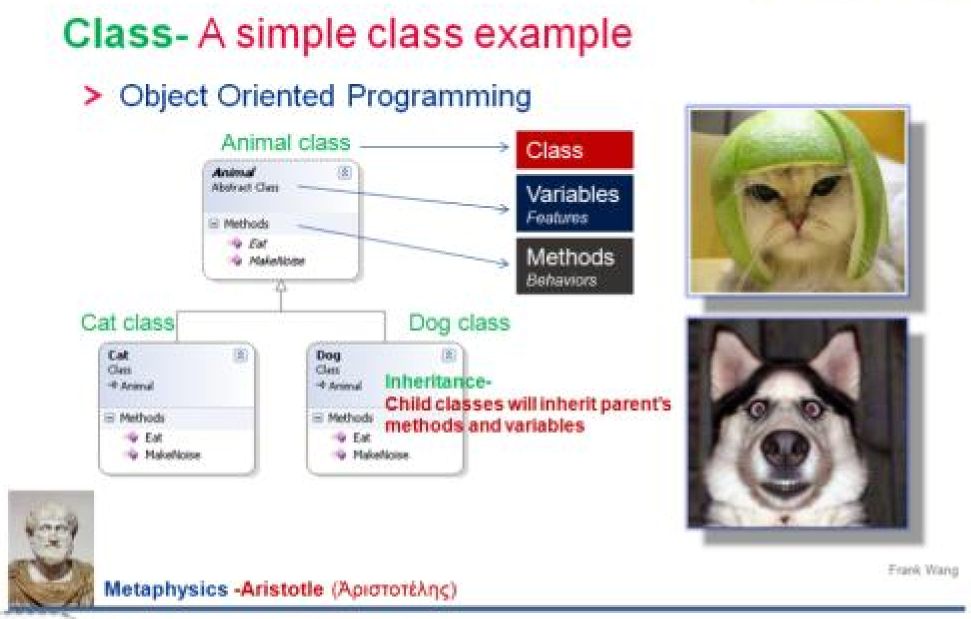


e.g. Volum

1 Object Types

Sub-types of model objects in Model Open API

Polymorphism & Inheritance



Class- A simple class example

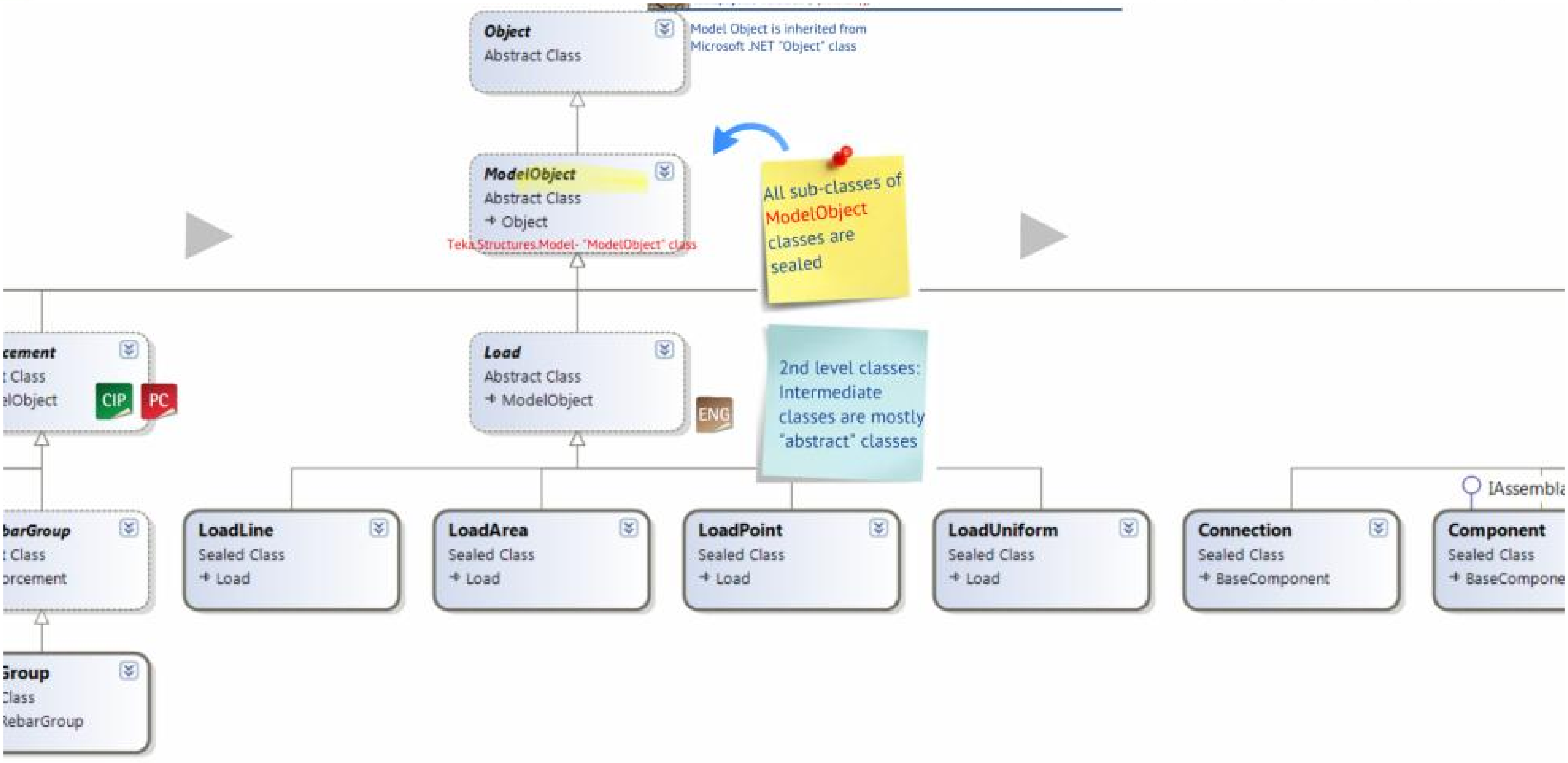
> Object Oriented Programming

Inheritance-
Child classes will inherit parent's methods and variables

Metaphysics -Aristotle (Ἀριστοτέλης)

Object
Abstract Class

Model Object is inherited from
Microsoft .NET "Object" class



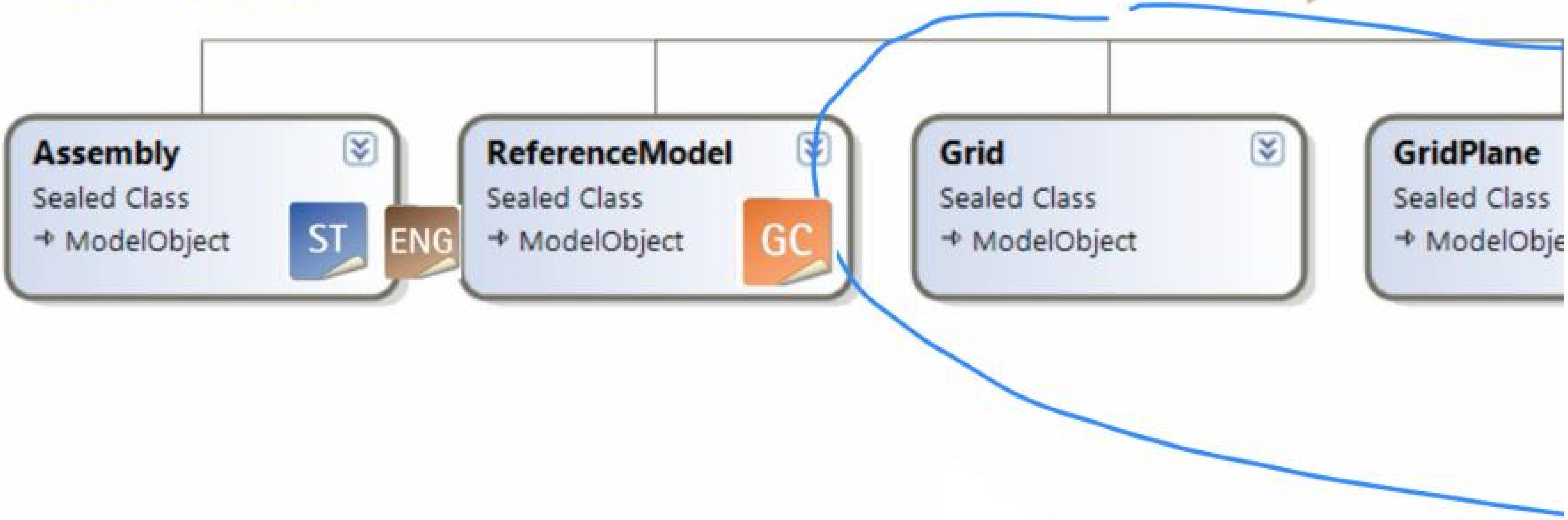
Model Object is inherited from Microsoft .NET "Object" class

Tekla.Structures.Model- "ModelObject" class

All sub-classes of ModelObject classes are sealed

2nd level classes: Intermediate classes are mostly "abstract" classes

Start here



Assembly
Sealed Class
→ ModelObject
ST
ENG

ReferenceModel
Sealed Class
→ ModelObject
GC

Grid
Sealed Class
→ ModelObject

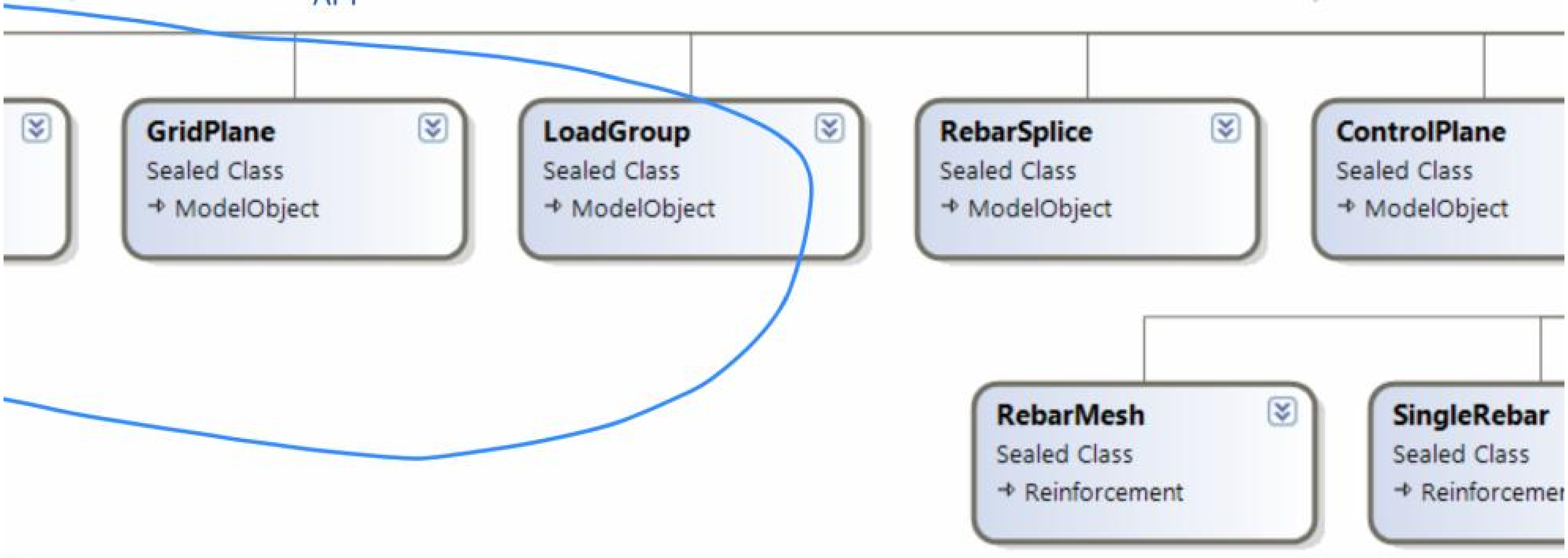
GridPlane
Sealed Class
→ ModelObje

Yes,

1) grid and grid plane,

2) load, load group

are all model objects that are accessible in Model API



GridPlane
Sealed Class
→ ModelObject

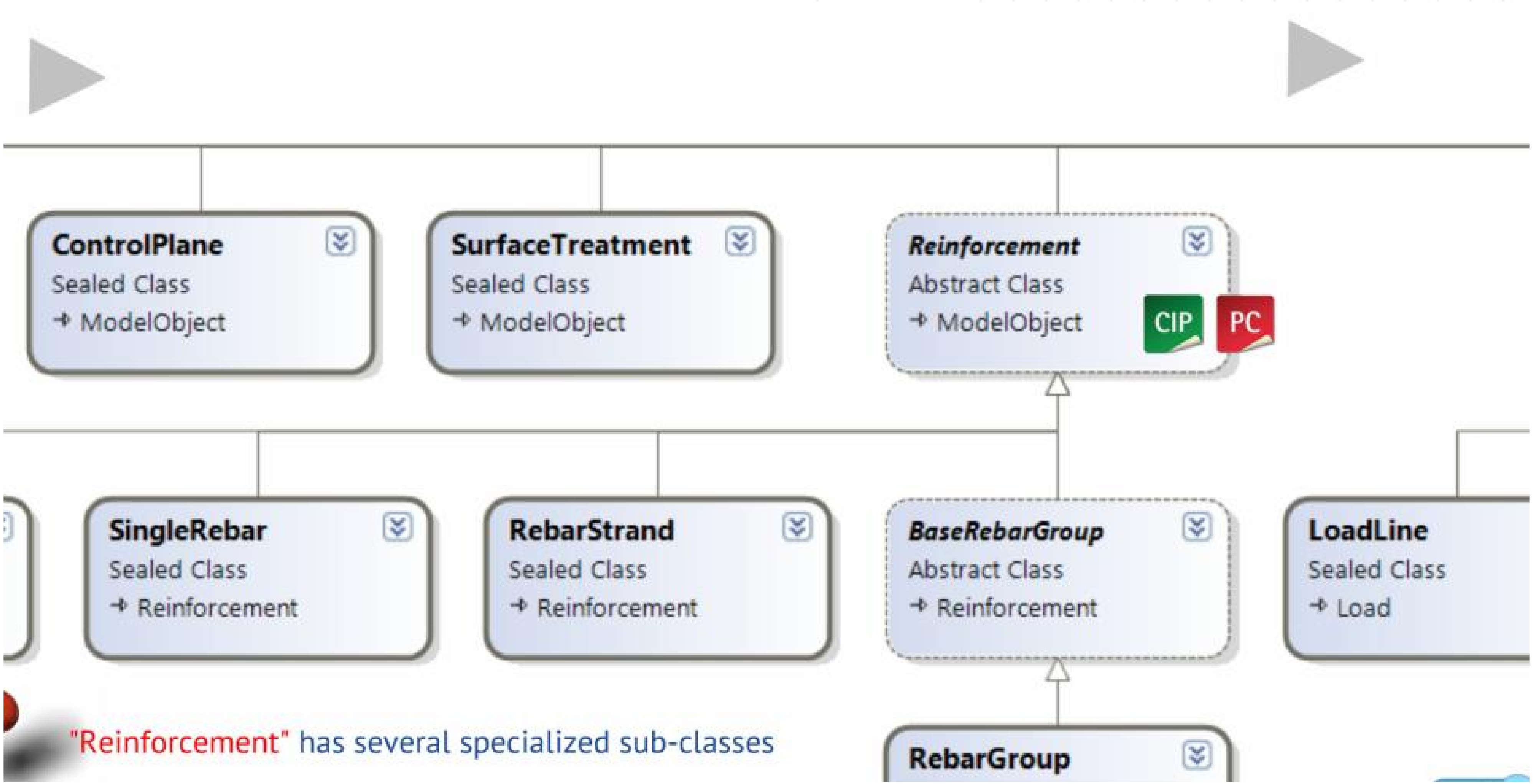
LoadGroup
Sealed Class
→ ModelObject

RebarSplice
Sealed Class
→ ModelObject

ControlPlane
Sealed Class
→ ModelObject

RebarMesh
Sealed Class
→ Reinforcement

SingleRebar
Sealed Class
→ Reinforcemer



ControlPlane
Sealed Class
→ ModelObject

SurfaceTreatment
Sealed Class
→ ModelObject

Reinforcement
Abstract Class
→ ModelObject

CIP PC

SingleRebar
Sealed Class
→ Reinforcement

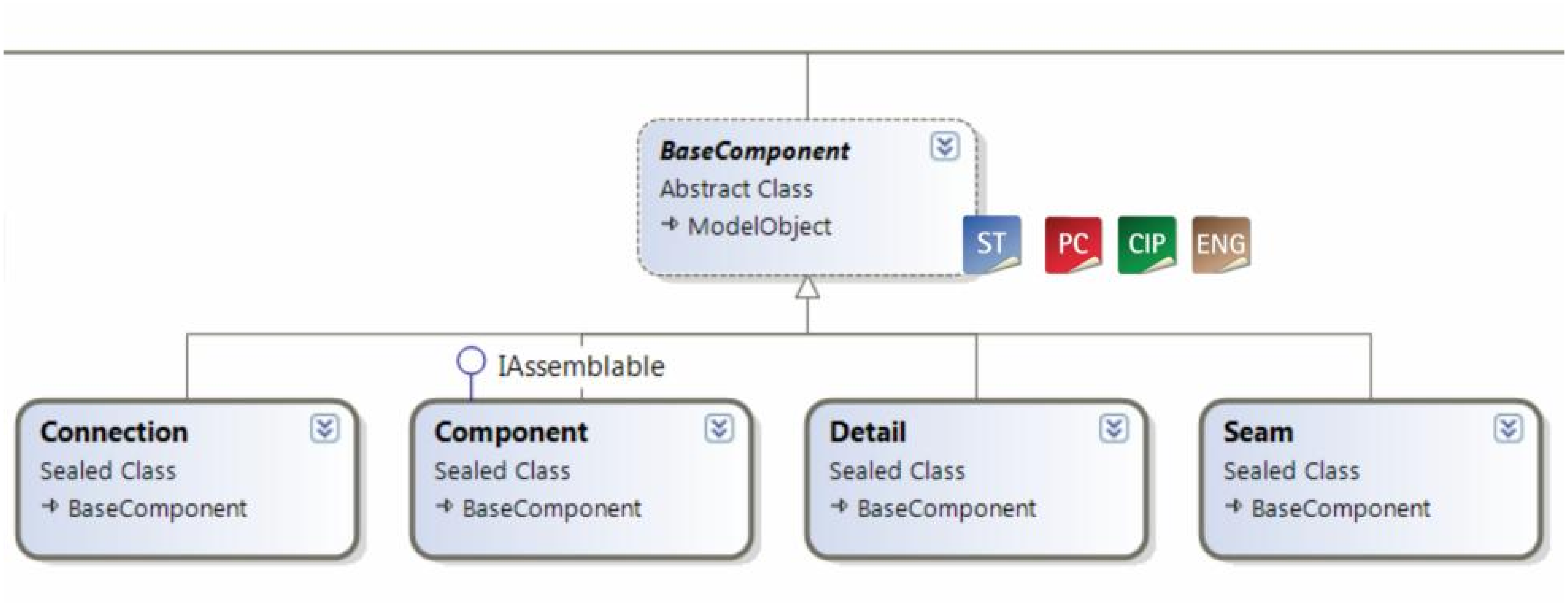
RebarStrand
Sealed Class
→ Reinforcement

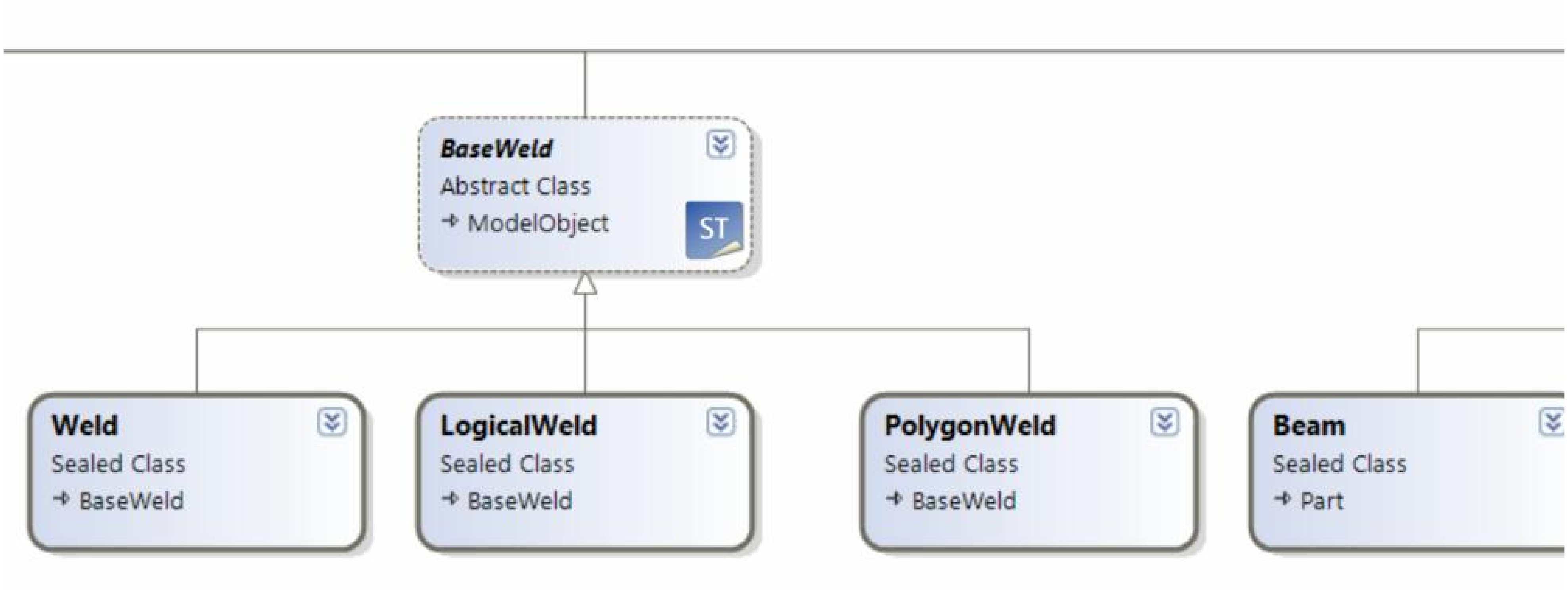
BaseRebarGroup
Abstract Class
→ Reinforcement

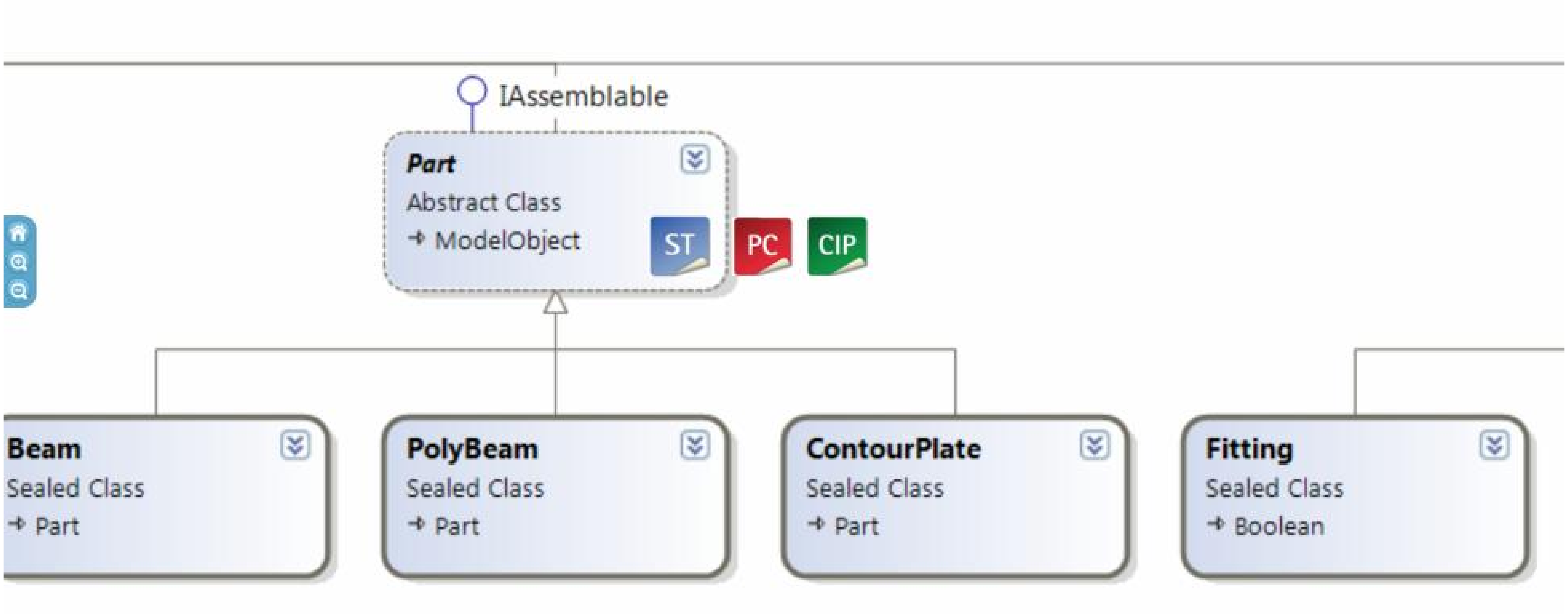
LoadLine
Sealed Class
→ Load

RebarGroup

"Reinforcement" has several specialized sub-classes


BaseComponent
Abstract Class
ModelObject
ST
PC
CIP
ENG
IAssemblable
Connection
Sealed Class
BaseComponent
Component
Sealed Class
BaseComponent
Detail
Sealed Class
BaseComponent
Seam
Sealed Class
BaseComponent


BaseWeld
Abstract Class
ModelObject
ST
Weld
Sealed Class
BaseWeld
LogicalWeld
Sealed Class
BaseWeld
PolygonWeld
Sealed Class
BaseWeld
Beam
Sealed Class
Part

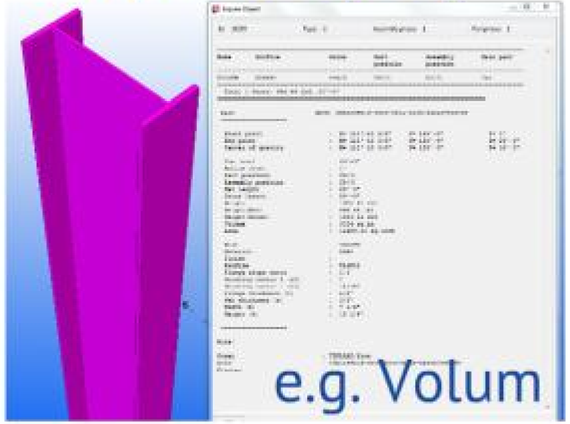

IAssemblable
Part
Abstract Class
ModelObject
ST
PC
CIP
Beam
Sealed Class
Part
PolyBeam
Sealed Class
Part
ContourPlate
Sealed Class
Part
Fitting
Sealed Class
Boolean

2 Object Properties

- User Property (UDA)

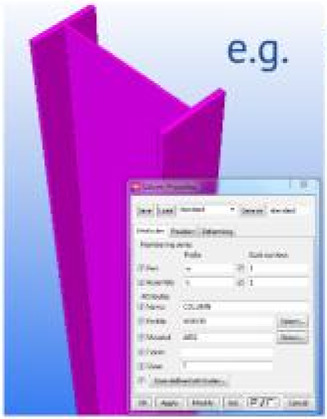
e.g. User Field 1

- Report Property

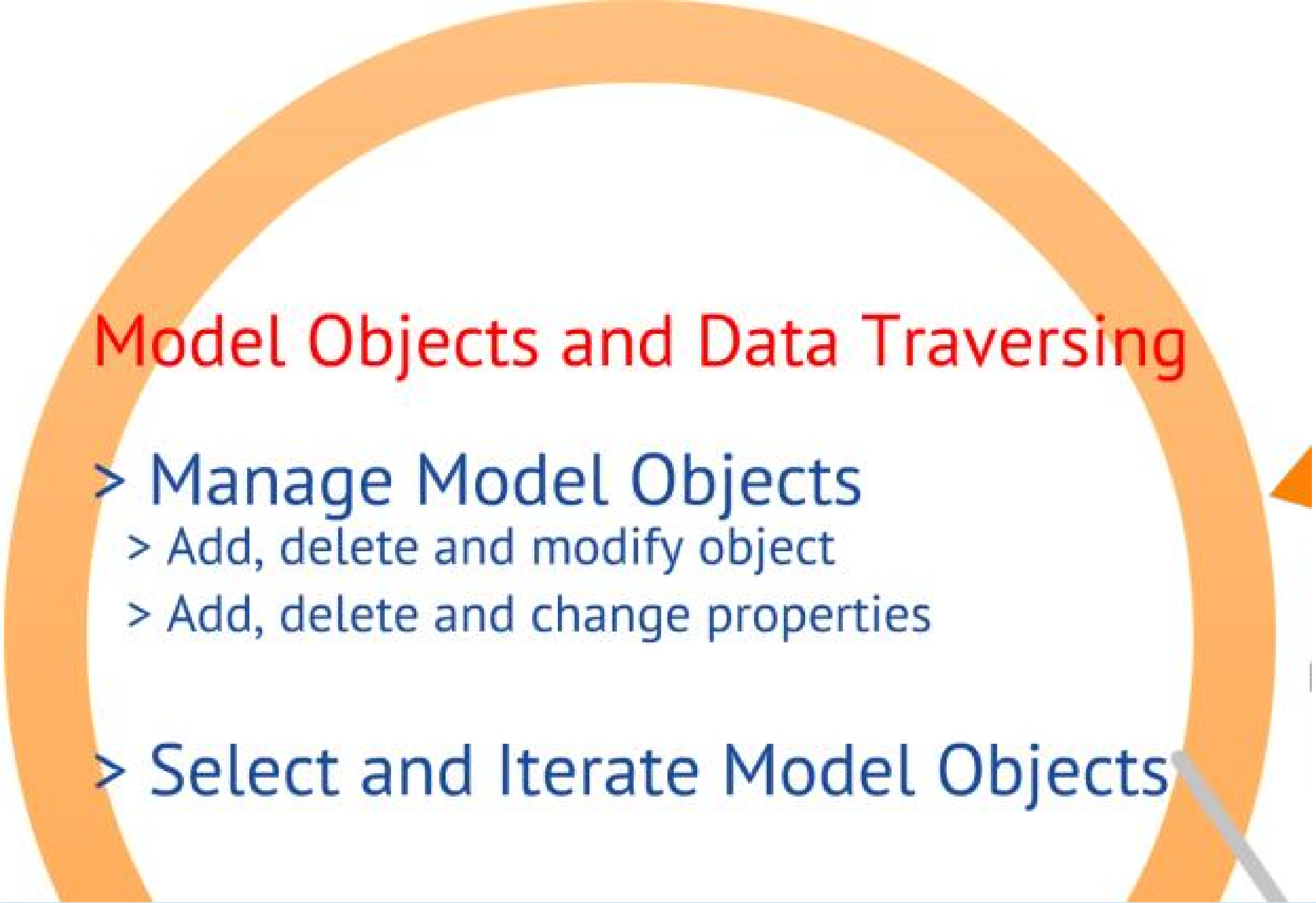


e.g. Volum

- [API] Class Properties



e.g. Part Solids



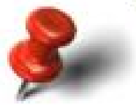
Model Objects and Data Traversing

- > Manage Model Objects
  - > Add, delete and modify object
  - > Add, delete and change properties
- > Select and Iterate Model Objects

Select and Iterate Model Objects

Model API provides consistent methods to:

- Select and gather objects
  - Using existing filter(s) or
  - Select by object type(s)
- Easy iteration method



Simple Instruction

- Create a selector
- Define the selector's behavior
- Iterate through returned objects

ModelObjectSelector Methods

[illegible]

Methods

See Also

Filters

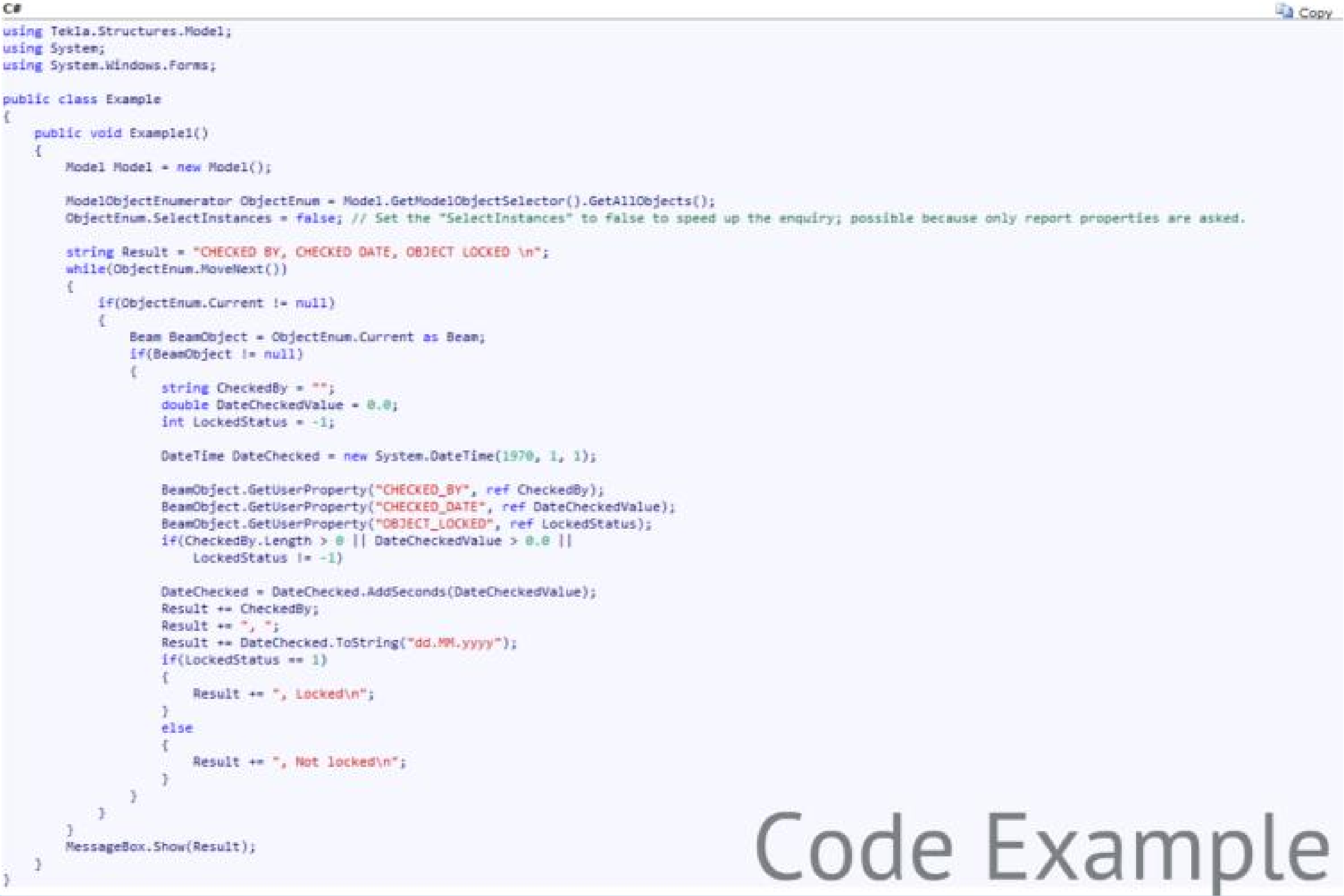
standard
Cip_All
Cip_Beam
Cip_Caisson
Cip_Column
Cip_Hardware
Cip_Joist
Cip_PadFooting
Cip_Pilecap
Cip_Retaining_Wall
Cip_Shear_Wall
Cip_Slab
Cip_StripFooting
Cip_Wall
Concrete_All
External_Assembly Code
External_Assembly Description
External_Fire Rating
External_Level
External_Load bearing
External_Material
External_Name
External_Object_type
External_Profile name
External_Reference

All

ModelObject Class

Code Example

Code Example



```
using Tekla.Structures.Model;
using System;
using System.Windows.Forms;

public class Example
{
    public void Example1()
    {
        Model Model = new Model();

        ModelObjectEnumerator ObjectEnum = Model.GetModelObjectSelector().GetAllObjects();
        ObjectEnum.SelectInstances = false; // Set the "SelectInstances" to false to speed up the enquiry; possible because only report properties are asked.

        string Result = "CHECKED BY, CHECKED DATE, OBJECT LOCKED \n";
        while(ObjectEnum.MoveNext())
        {
            if(ObjectEnum.Current != null)
            {
                Beam BeamObject = ObjectEnum.Current as Beam;
                if(BeamObject != null)
                {
                    string CheckedBy = "";
                    double DateCheckedValue = 0.0;
                    int LockedStatus = -1;

                    DateTime DateChecked = new System.DateTime(1970, 1, 1);

                    BeamObject.GetUserProperty("CHECKED_BY", ref CheckedBy);
                    BeamObject.GetUserProperty("CHECKED_DATE", ref DateCheckedValue);
                    BeamObject.GetUserProperty("OBJECT_LOCKED", ref LockedStatus);
                    if(CheckedBy.Length > 0 || DateCheckedValue > 0.0 ||
                        LockedStatus != -1)

                    DateChecked = DateChecked.AddSeconds(DateCheckedValue);
                    Result += CheckedBy;
                    Result += ", ";
                    Result += DateChecked.ToString("dd.MM.yyyy");
                    if(LockedStatus == 1)
                    {
                        Result += ", Locked\n";
                    }
                    else
                    {
                        Result += ", Not locked\n";
                    }
                }
            }
        }
        MessageBox.Show(Result);
    }
}
```

I am processing large amount of data, how can I improve the speed of my app?

How to deal with large models?

Optimization!

Tips for Beginners

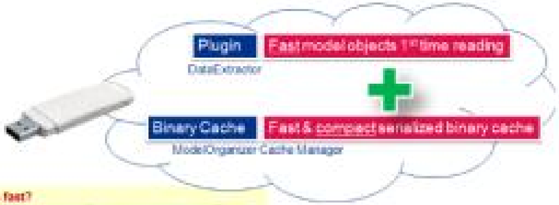
> Gether objects by types and filters
> Avoid explicilty "Select" object

- Use report/user property if aviable
- Set the "SelectInstance" to "false" as defulat

Tips for Advance Users

> Consider doing the heavy work in plugin
> Utilize caching/serialization

- Make your cache accessible by your apps



Plugin
Fast model objects 1st time reading
DataExtractor

Binary Cache
Fast & compact serialized binary cache
ModelOrganizer Cache Manager

Why plugin is fast?
Several MS .NET framework DLLs are embedded in TS core makes Plugin run 100 times faster then calling same .NET DLL through external apps

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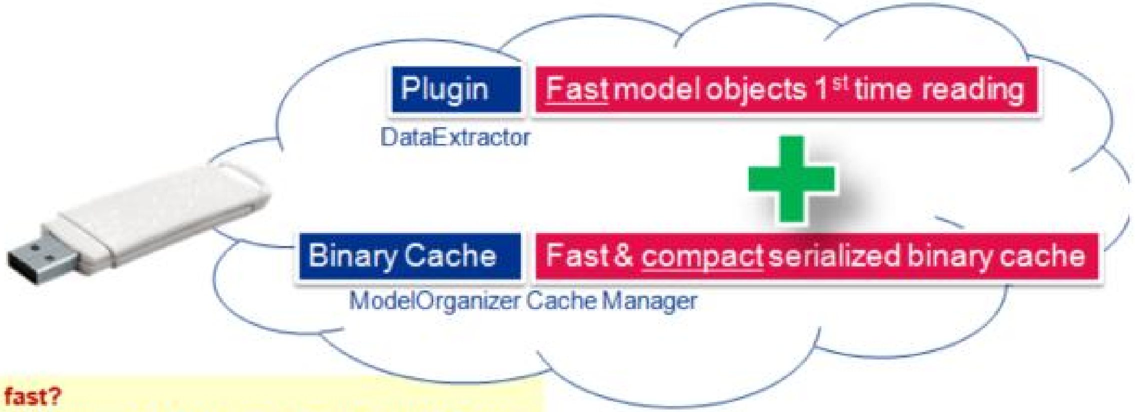

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DataExtractor

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Thank You