Bentley and LandXML
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About Bentley

Bentley's mission is to provide innovative software and services for the enterprises and professionals who design, build and operate the world's infrastructure—sustaining the global economy and environment, for improved quality of life.

About Bentley

Bentley Subscribers are the *ENR* Top Design Firms:

- **20 of the Top 20 in:**
  - General Building
  - Transportation
  - Power
  - Manufacturing
  - Water
  - Sewer/Waste

- **19 of the Top 20 in:**
  - Industrial Process/Petroleum
  - Telecommunications
  - Hazardous Waste

- **47 of the Top 50 Designers in International**

- **97 of the Top 100 Pure Design Firms**

Global Business:
- Nearly 3,000 colleagues in 45 countries
- $500 million in annual revenues

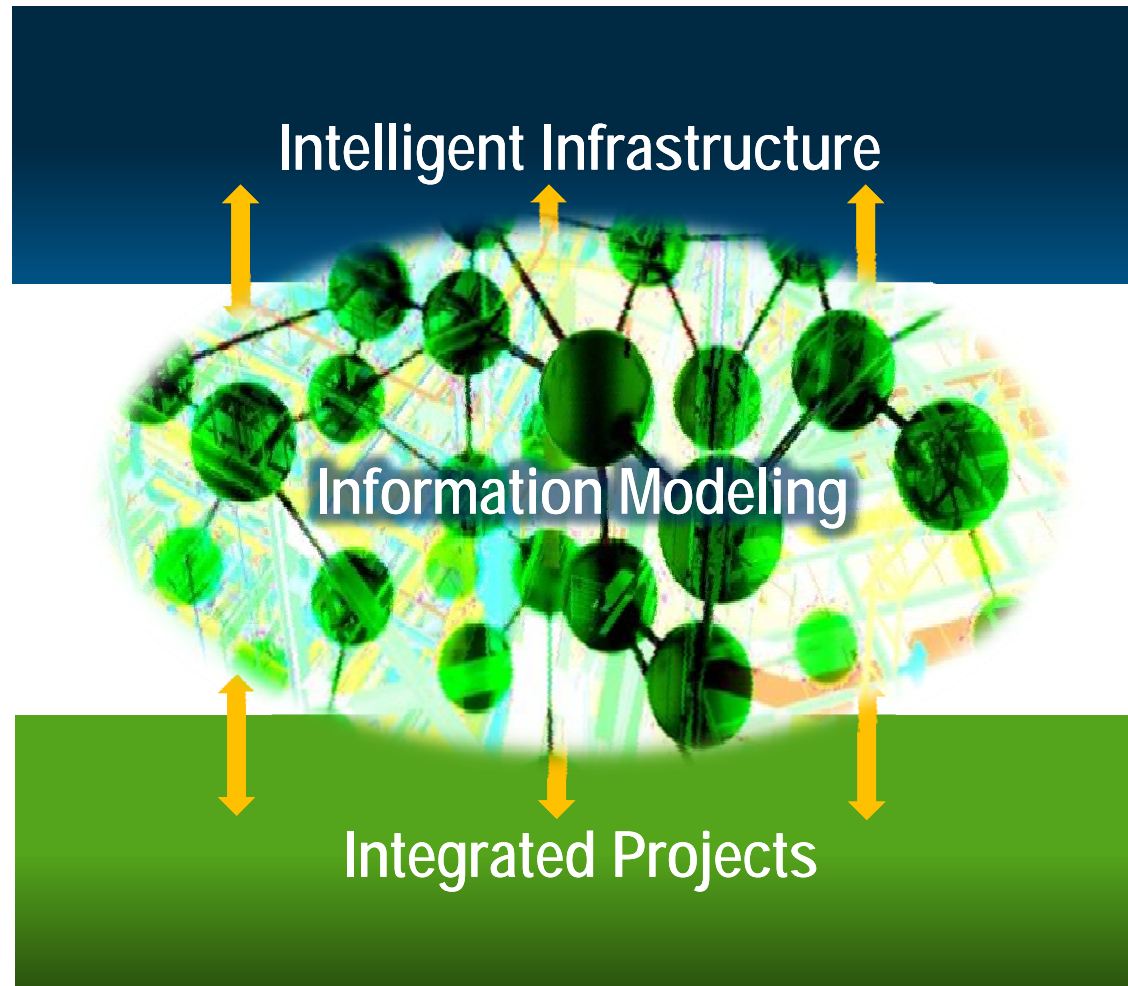### 47 out of 50 U.S. State DOTs use Bentley

Bentley is the Global Leader in:

- Road and Rail
- Bridges
- Water systems
- Structural analysis
- Process plant operations

- Generative design
- 3-D city GIS
- Construction simulation
- Energy modeling
- Infrastructure asset operations

  - Collaboration servers for project work-sharing

Bentley *Sustaining Infrastructure*

Intelligent Infrastructure

Intelligent Infrastructure

Information Modeling

Integrated Projects

Benefits of Information Modeling

- Better coordination during design and construction

- Earlier identification of conflicts

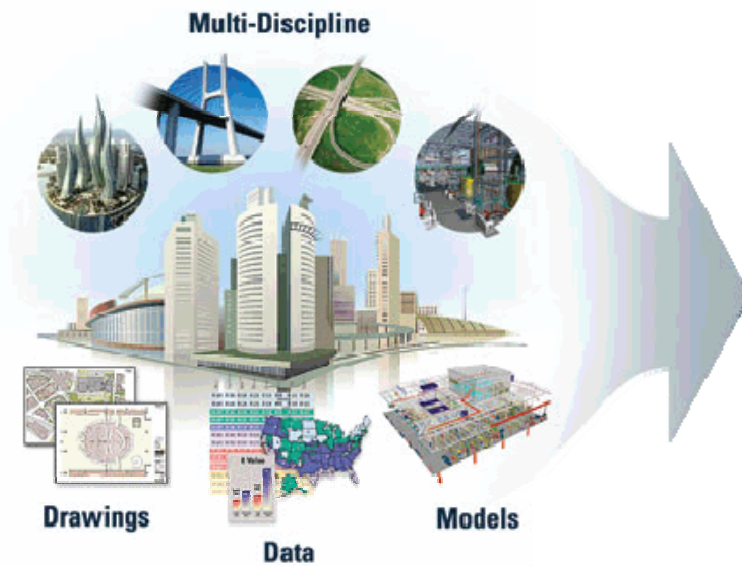- Lower costs and better performing assets
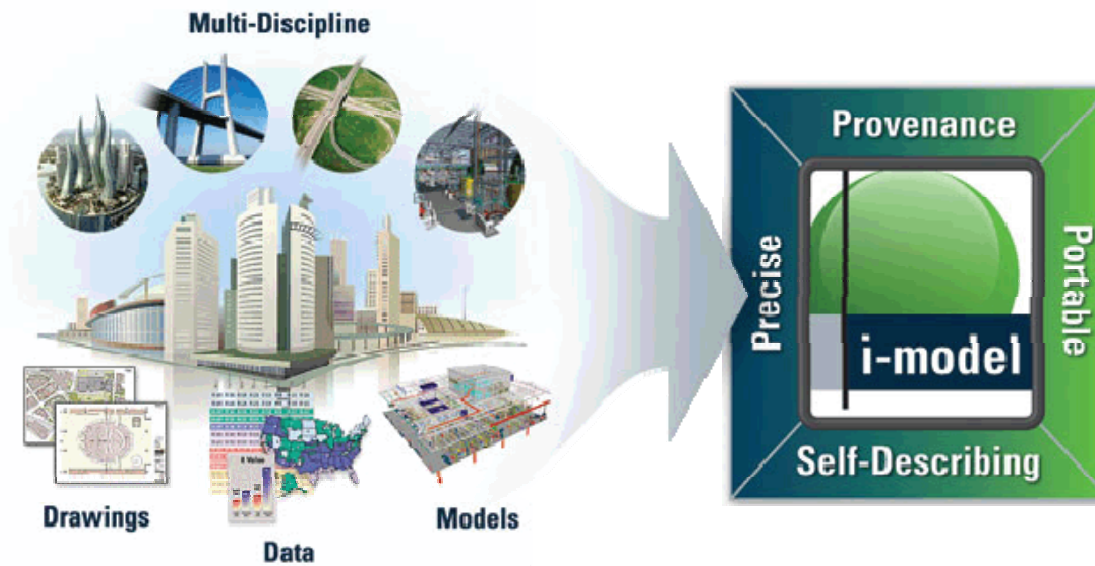
Intelligent Infrastructure

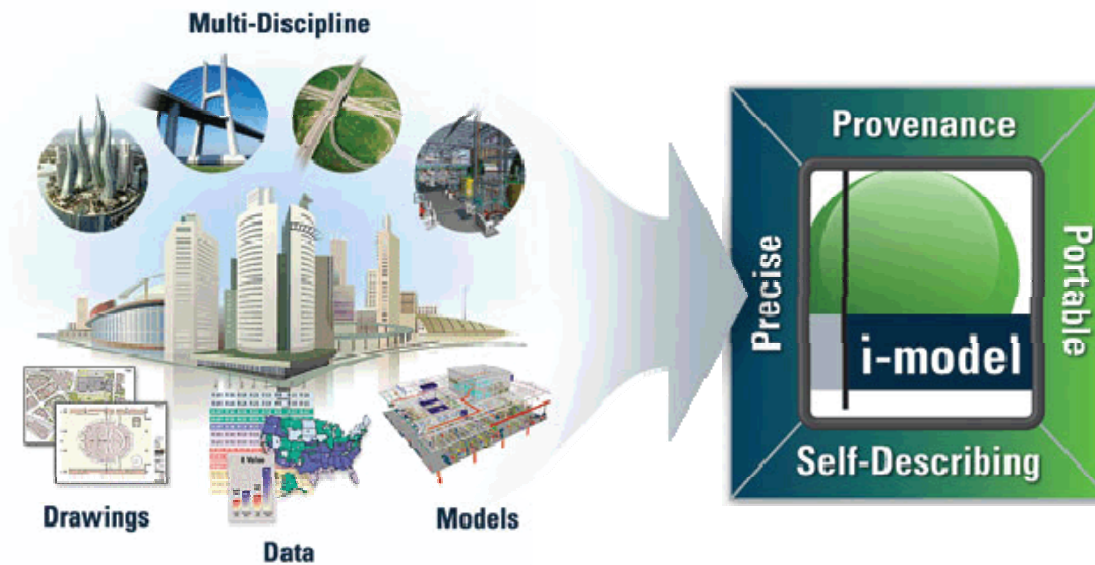- Single Re-usable Platform

- Federation

- i-models

i-model Container for Info Exchange

Multi-Discipline

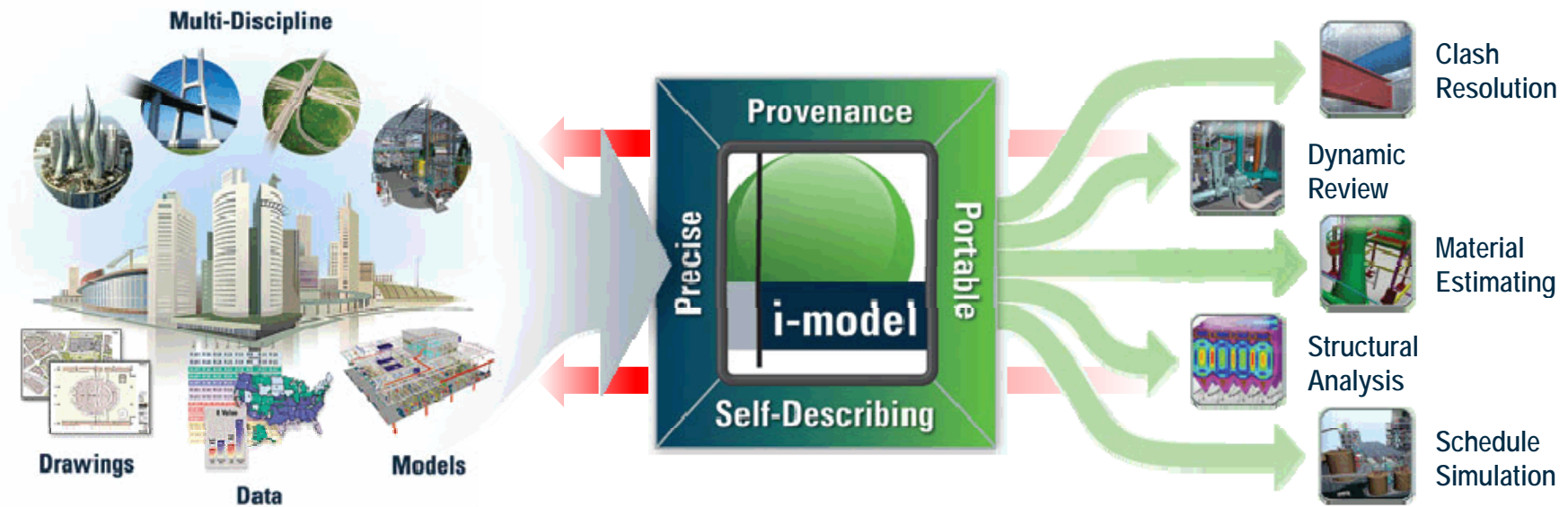Drawings   Data   Models

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i-model Container for Info Exchange

i-model Container for Info Exchange
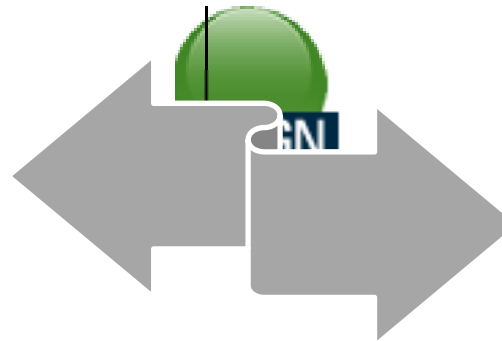

Precise → Provenance → Self-Describing

i-model Container for Info Exchange

Bentley-Autodesk Agreement

\+
APIs

\+ APIs

Bentley Systems and LandXML

How do we support LandXML now?
Few aspects and opportunities for improvement?

# LandXML support in Bentley products now

- Supported in all of our key civil design/construction applications
  - InRoads
  - PowerCivil for Sweden, PowerCivil for Denmark etc.
  - MX, Geopak
  - gINT geotechnical application

- Import/export of geometry, alignments and surfaces

- New: LandXML support in MicroStation or all industry disciplines without Bentley civil applications
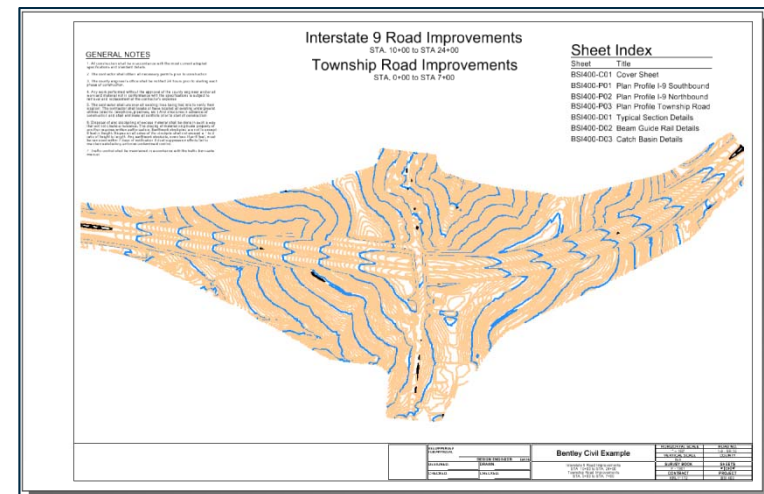
Civil Terrain Model and LAND xmL Support

Pain: Without civil applications, can not control appearance of DTM

Solution:

Easily annotate and visualize terrain models to meet project standards
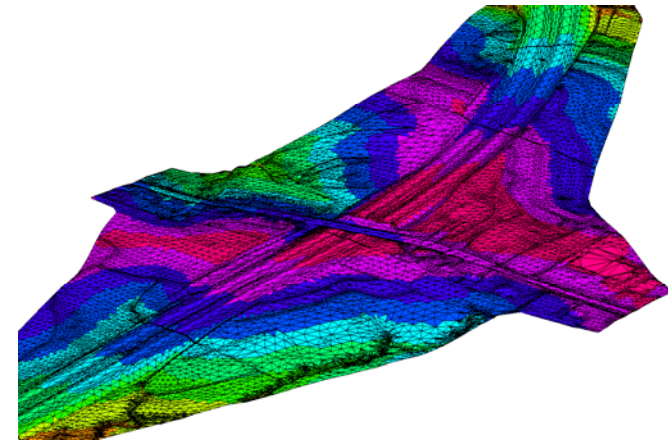
Use Cases:

- Draftsman annotating a terrain model
- Now you don't have to be a civil engineer to work with 3D terrain models

Positive Aspects of LandXML

- LandXML is a very comprehensive and flexible file format for storing and communicating civil design information

- It is widely used throughout the industry between designers, surveyors and constructors

- The XML format provides
  - machine independence
  - application software independence
  - human readability (sort of)

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Opportunities for Improvement

- LandXML flexibility comes at a cost: it cannot serve as a standard exchange format until the exchangers agree on how to implement it
  - Most fields are optional, allowing everyone to define elements with different parameters which hinders exchange and welcomes incompleteness

- Documentation needs improvement
  - An underlying (UML) Conceptual Model would improve comprehension and establish common vocabulary
  - Modularization would improve XML code readability
  - Clearer statement and description of required items would improve understanding
  - Better consistency in naming conventions would also help

Opportunities for Improvement

- Improve XML fundamentals
  - For example, improper use of choice constructor currently permits incomplete element specification

- Better compatibility / integration with other standards
  - opportunity to better align spatial data types, coordinate definition, spatial reference systems and feature definition with OGC / TC211 GIS standards

Opportunities for Improvement

- Extend limited geometric support to worldwide geometric standards (spirals, superelevation, etc.)

- Extend geometric support to include 3D solid geometry

- Current schema entails legacy practices should evolve. For example, a road contains proposed cross sections shouldn't these jus be a result of the true geometric model ?

Future Options

- TransXML
  - initial release worked on a LandXML UML conceptual model

- OGC
  - opportunity exists to move LandXML into the Open Geospatial Consortium (OGC) where GIS, UML and standards expertise can
    - help move LandXML closer to a true exchange format
    - improve documentation and proper XML usage
    - integrate LandXML with other (OGC and ISO TC211) GIS standards
    - enable further LandXML development

How can international software companies like Bentley contribute to national/regional standards?

Case KuntaGML - Finland

What is KuntaGML ("MunicipalGML")?

- In order to harmonize access to municipal geospatial data, group of Finnish municipalities started (early 2000's) to do specifications and plans for a Municipal Geospatial Service ("Kuntien paikkatietopalvelu") based on standard OGC/ISO service interfaces.

- The project was later expanded and named as KuntaGML-project with more than 100 municipalities participating.

- Largely funded by TEKES (Finnish Funding Agency for Technology and Innovation), funding directly from TEKES to solution vendors, based on acceptance by the municipalities

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KuntaGML goals

- To have a vendor /software independent format enabling flexible data sharing inside the <u>industry</u> between municipalities, contractors and engineering companies

- To achieve better <u>internal</u> sharing of geospatial data inside municipalities, which may have several GIS, CAD and engineering systems (in different departments)

- To have a common format for data exchange across the whole <u>governmental</u> sector

Standards used with KuntaGML

- ISO 19136 Geography Markup Language
- ISO 19109 Rules for Application Schema
- ISO 19142 Web Feature Service
- ISO 19143 Filter Encoding
- ISO 19128 Web Map Service Interface

- WMS Web Map Service, version 1.1.1
- WFS Web Feature Service, version 1.0.0
- GML Geography Markup Language, version 3.1.1

What were the results of KuntaGML?

- KuntaGML standard <u>schema</u> within our geospatial products

- KuntaGML <u>import / export</u> functionality

- WMS / WFS / other OGC standard based data <u>services</u>

And …

- Valuable input to Bentley software development and changes /improvement to the standard COTS products

- Maybe also input from software vendors to the standardization team

Thank you.

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