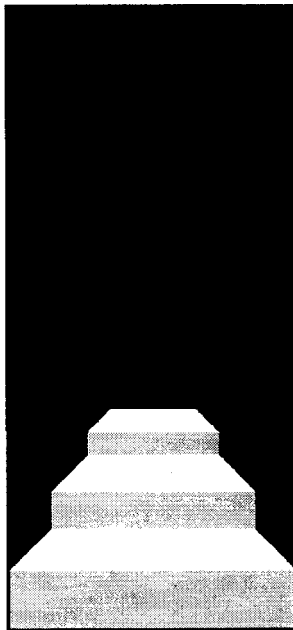


CALS/EC Korea '98

Product Model Exchange and Worldwide Manufacturing

*Dr. Martin Hardwick
Professor of Computer Science and President STEP Tools, Inc.
Rensselaer Polytechnic Institute
1223 Peoples Avenue
Troy, NY 12180
Phone +518 276-2848 FAX:+518 276-8471
Email: hardwick@steptools.com*

Slide 1



**STEP Software for
World Wide Manufacturing**

**Martin Hardwick
President, STEP Tools, Inc.
Professor of Computer Science, RPI**

**STEP Tools, Inc..
Rensselaer Technology Park
Troy, New York 12180**

**(518) 276-2848 (518) 276-8471 fax
info@steptools.com <http://www.steptools.com>**

- **STEP is an International Standard (ISO 10303)**
 - that defines the methodology to create computer interpretable product data models.
- **STEP Implementation**
 - allows exchange and sharing of product data while retaining semantics throughout the product life cycle.

Slide 3

- **Lockheed Martin reports the following savings**
 - 10% improvement in reliability of data exchange
 - 10% process savings for non composite parts
 - 50% process savings for composite parts
 - projected 27% savings for tool design using CAD/CAM systems
 - projected 38% savings for NC CAM systems due to elimination of data entry

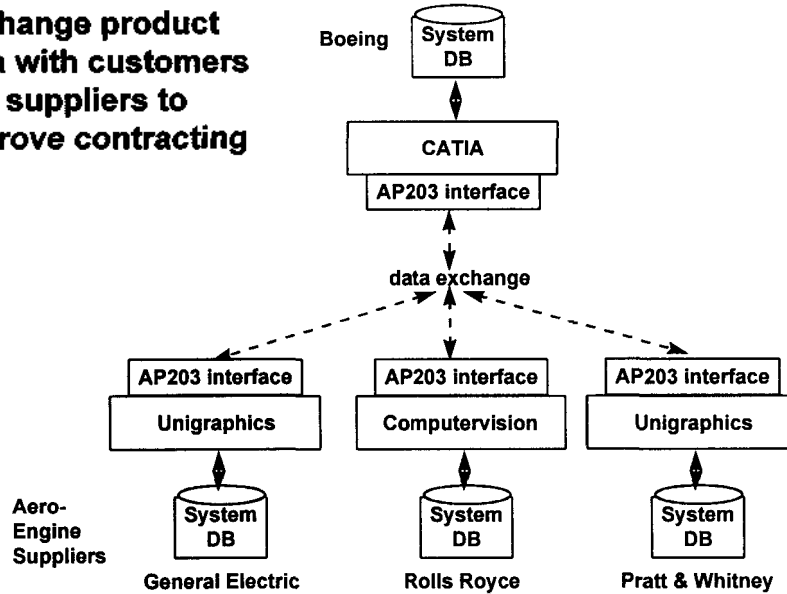
Lockheed Martin Press Release Thursday, March 12, 1998

Slide 4

Opportunity 1 - Data Exchange

STEP Tools, Inc.

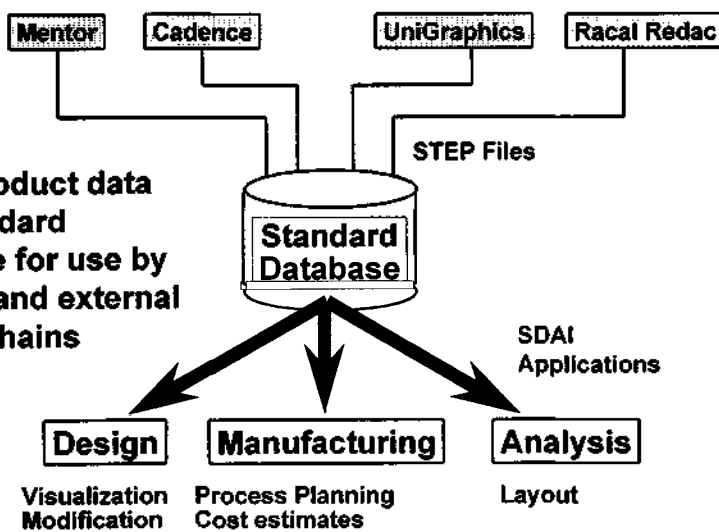
Exchange product data with customers and suppliers to improve contracting



Opportunity 2 - Shared Databases

STEP Tools, Inc.

Store product data in a standard database for use by internal and external supply chains



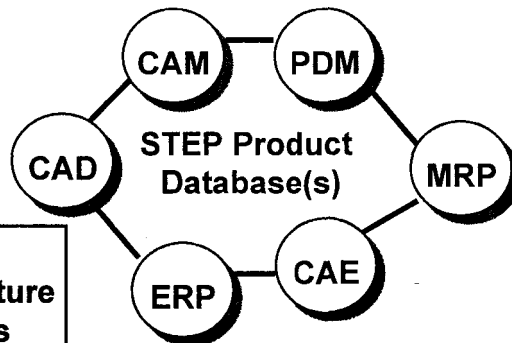
- **An Application Protocol defines the usage (semantics) of STEP product data for a given application context.**
- **An Application Protocol represents a measurable and shareable subset of STEP capability that is expressed in an industry's or discipline's terminology.**

Side 7

- **Structure of Data**
 - **Within a Part**
 - » geometry, topology, tolerances, features etc.
 - **About the Part**
 - » part name, number, security classification, revision, approval, life cycle
 - **About a Product (Group of Parts)**
 - » assemblies, relationships, configurations, effectivities
- **Meaning of Data (Semantics/Context)**
 - AP-203 context - design of mechanical assemblies
 - AP-217 context - design of ship piping
 - AP-224 context - design of manufacturing features
 - etc

Side 8

- Data sharing through different life cycle applications
- STEP allows access to all types of data across the life cycle



How?
Infrastructure
Resources
Protocols

Slide 8

- **EXPRESS is an information modeling language**
 - Transparent to user
 - Used to create and define data models in STEP
 - Well defined structure
- **Enabling Intelligent Data**
 - Engineering drawing title block contains inserted text strings; EXPRESS has intelligence in product data models to interpret this data
- **And EXPRESS driven Implementation Methods**
 - Part 21 file format
 - Part 22 Standard Data Access Interface (SDAI)
 - » C binding
 - » C++ binding
 - » Java binding

Slide 10

- **The Integrated Resources are a library of definitions for product data**
- **Integrated Generic Resources (Part 41...)**
 - Part 41 - Fundamentals of product description and support
 - Part 42 - Geometric and topological representation
 - Part 43 - Representation structures
 - Part 44 - Product structure configuration
 - Part 45 - Materials
 - Part 46 - Visual presentation
 - Part 47 - Shape variation tolerances
 - Part 49 - Process structure and properties
- **Integrated Application Resources (Part 101...)**
 - Take the definitions from the 40-series and refine them somewhat for a particular industry. Simplifies creation of multiple AP's with the same subject area.

Slide 11

- **Part 41 forms the basis for the product descriptions understood by STEP**
- **Product, Product Definition**
 - A product version is called a product definition formation
- **Dates and Time**
- **Approvals**
- **Effectivities**
- **People and Organizations**
- **Many types of relationships**
- **Very basic definitions, AP's often refine these definitions to match their notion of a product, but in a controlled way**
 - A product could be a building.
 - A product could be a bolt.

Slide 12

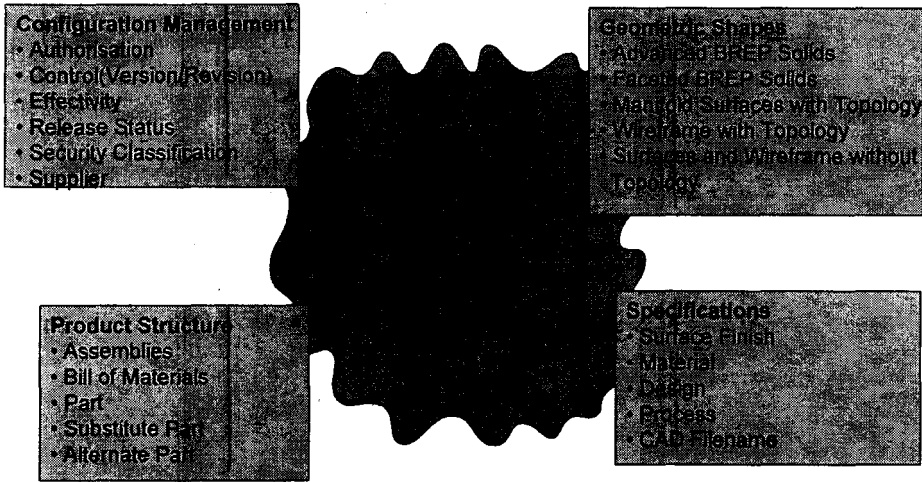
- **Part 42 describes the geometry and topology understood by STEP**
- **Mathematically very precise, AP's use these definitions without change.**
- **Curve and Surface Geometry**
- **Topology**
- **CSG Solids**
- **B-Rep Solids**
- **Surface Models**
 - Does not necessarily form complete boundary of a solid
 - collection of shells or faces
- **Wireframe Models**
 - no surface information
 - contains information on intersections of surfaces
- **Geometric Sets**

Slide 13

- **AP-203**
 - Configuration controlled design
- **AP-202**
 - Associative Draughting
- **AP-224**
 - NC Form features for process plans
- **AP-213**
 - Process routing sheet data
- **ISO 14649**
 - NC working steps for material removal (milling, ...)
- **20+ other protocols for other domains including**
 - Ship building, Automotive, Aerospace, Process Plants
 - Printed circuit boards, Cabling, Piping, building structures
 - Casting, Composites, NC Features, NC Plans

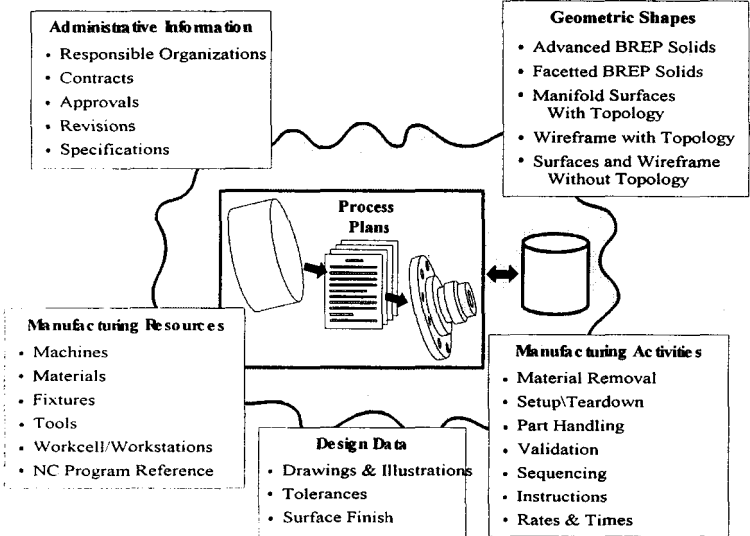
Slide 14

AP 203: Configuration Controlled 3D Designs of Mechanical Parts and Assemblies



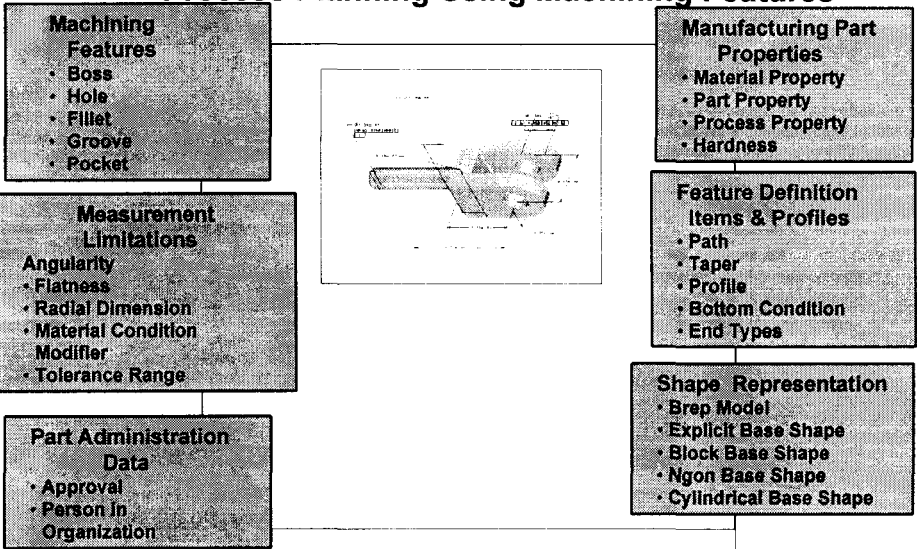
Slide 16

AP 213: Numerical Control (NC) Process Plans for Machined Parts



Slide 16

AP224 Mechanical Product Definition for Process Planning Using Machining Features

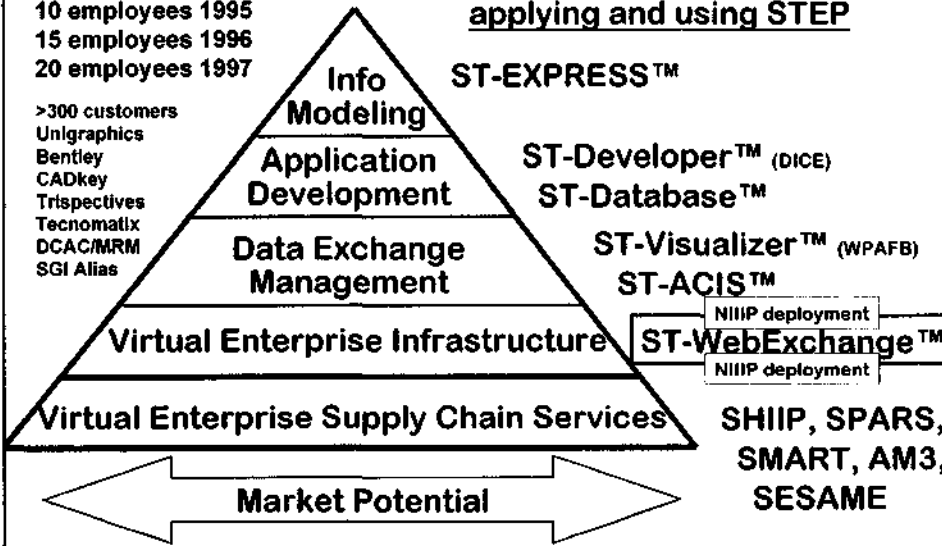


Slide 17

STEP Tools, Inc. founded 1991
 10 employees 1995
 15 employees 1996
 20 employees 1997

>300 customers
 Unigraphics
 Bentley
 CADkey
 Trispectives
 Tecnomatix
 DCAC/MRM
 SGI Alias

Products for defining, applying and using STEP



Slide 18

- **CAD Vendors**
 - SGI Alias*, AUTOCAD, Bentley*, CATIA, Pro/Engineer, SDRC, Unigraphics*, CADKey*
 - Strong, well tested implementations
 - 98% reliability in some deployments
 - Interoperability now key component of vendor growth strategies
- **CAE Vendors**
 - MSC NASTRAN, Tecnomatix*, Deneb*
 - More recent, some waiting for AP209 to become a standard
- **PDM vendors**
 - IMAN*, Metaphase, Sherpa*
 - STEP will put PDM on the Internet
- **CAM vendors**
 - Bridgeport Controls , Lycomb (Alpha CAM)

*Vendors in red are STEP Tools, Inc. customers

Slide 19

- **STEP for the supply chain (Virtual Enterprises)**
- **Between enterprises**
 - Protocols for safe, efficient data sharing
 - NIIP project (next slide)
- **Between disciplines**
 - Design to manufacturing
 - Product model databases with all information needed for an activity (not just geometry)

Slide 20

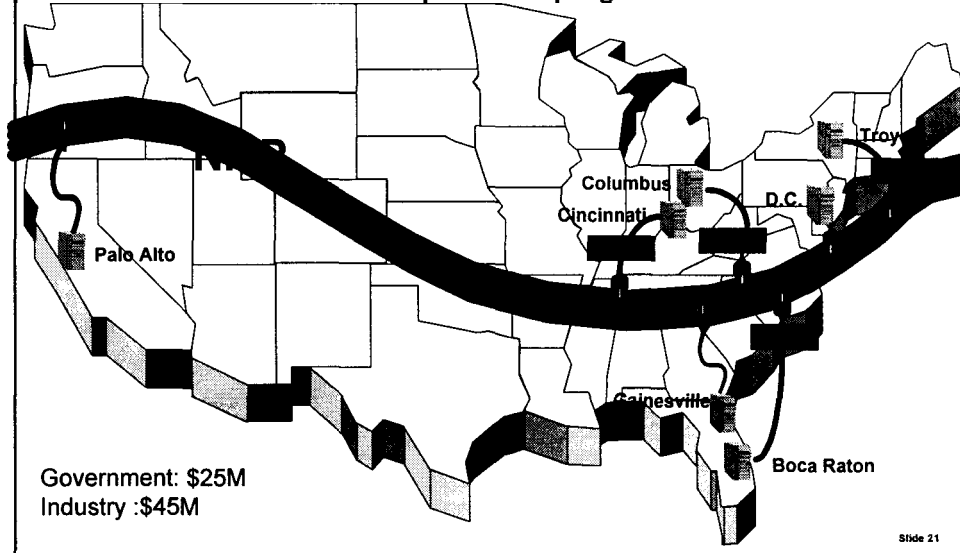
Protocols for virtual enterprises

STEP Tools, Inc.

Research Phase: 1994-1997
 Deployment Phase 1997-2000

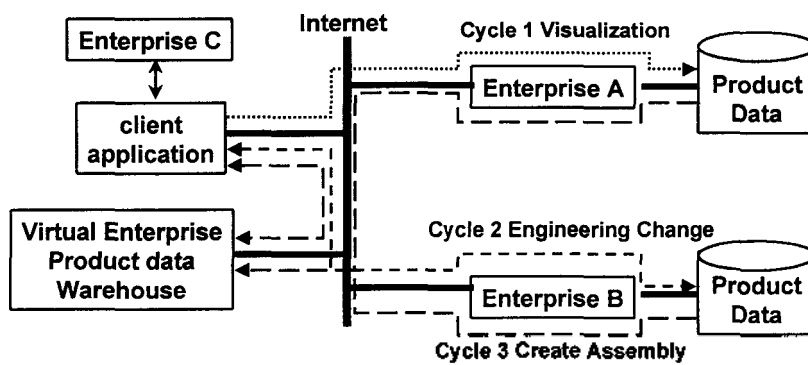
Lessons learned:
<http://www.steptools.com>
<http://www.niip.org>

Winning Technologies:
 SDAI Java/XML
 EXPRESS-X



NIIP Test Cases

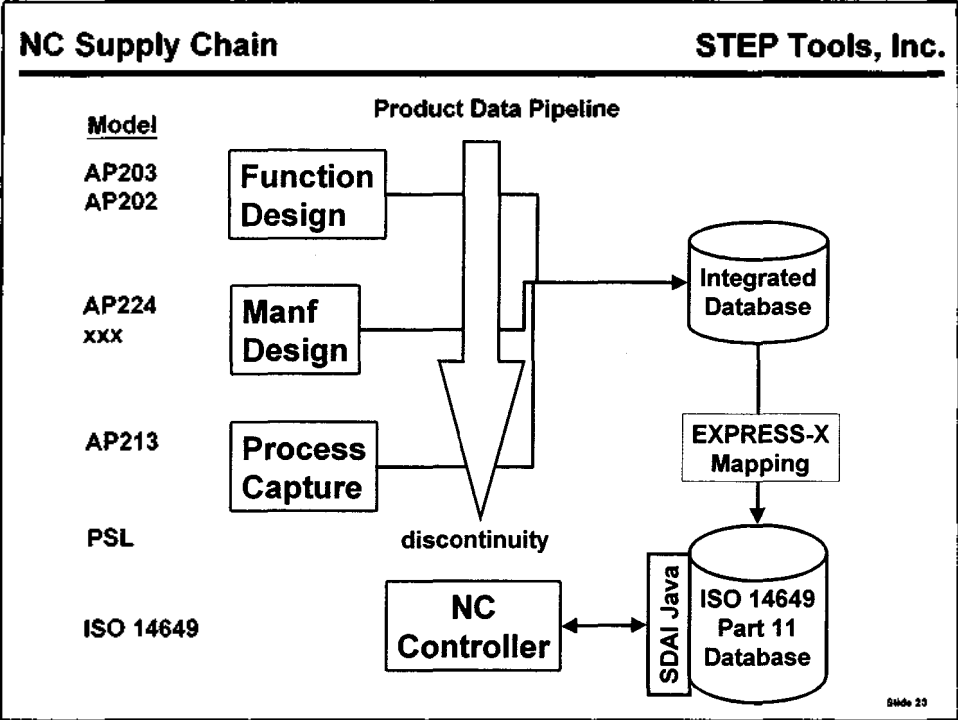
STEP Tools, Inc.



National Industrial Information Infrastructure Protocols

- Cycle 1 => EXPRESS-X Data mapping protocol
- Cycle 2 => SDAI Java Data transport protocol
- Cycle 3 => Data integration protocols (unfinished)

Slide 22



- Conclusion** **STEP Tools, Inc.**
-
- **STEP is in deployment**
 - PDM data exchange at Boeing and others
 - Geometry data exchange at GM and others
 - **The STEP community overcomes obstacles**
 - “They will never finish the standard” (done 1994)
 - “They will never be able to transfer solids” (done 1995)
 - “They will never make solids transfer reliable” (done 1997)
 - “They will never implement all those Application Protocols” (TBD)
- Slide 24