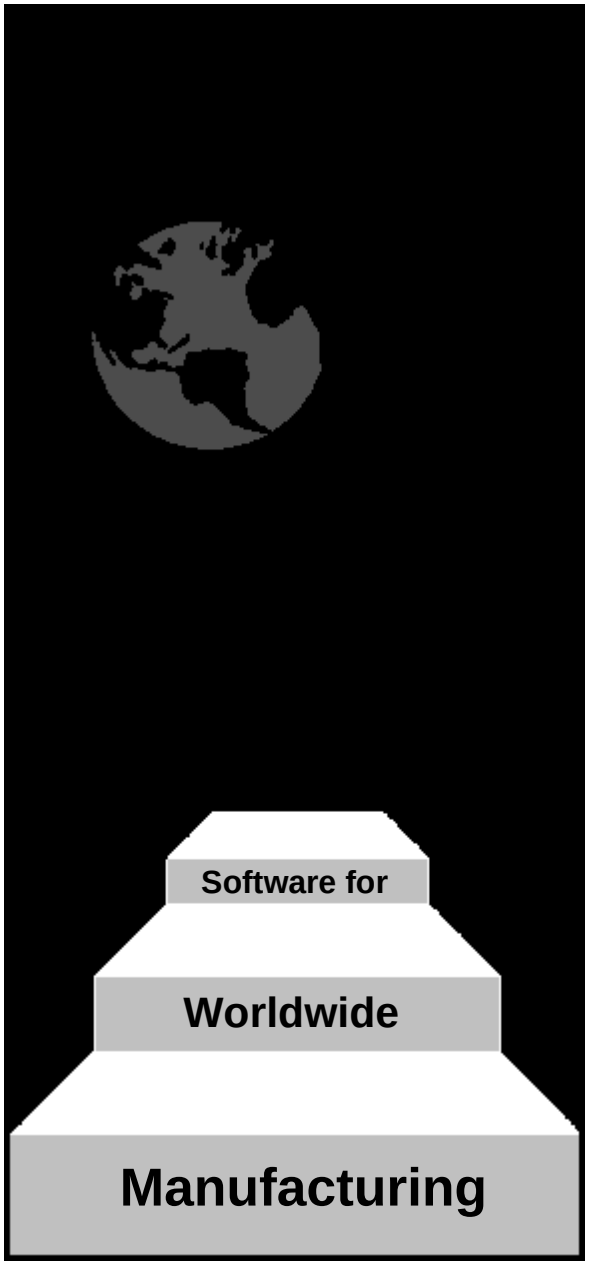

Manufacturing Applications of STEP

Martin Hardwick, Ph.D.
President

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Troy, New York 12180

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Goals

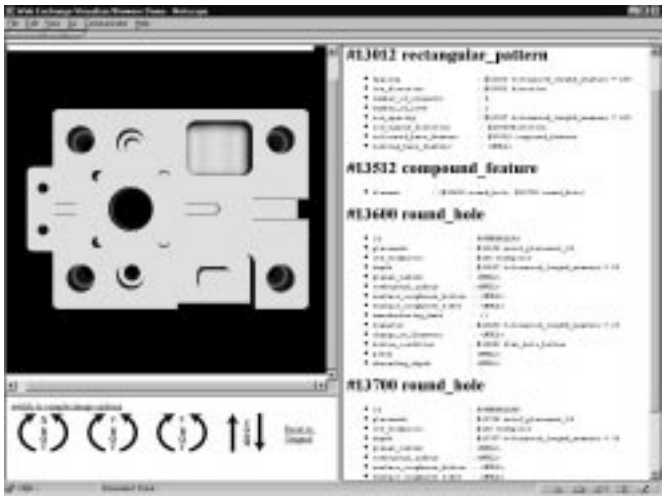
- **Model Driven e-Manufacturing**
  - Direct control of machine tools from 3D data
  - Using STEP-NC specification under development in Europe and Far East for 3 years
    - » Milling, Turning, Grinding, Bending, Cutting
    - » Extensions for Robotics and Assembly anticipated
  - Process planning and manufacturing control savings of between 35% and 75%

Project Organization

- **Industrial Review Board**
  - GE Fanuc
  - CNC Data (MASTERCAM)
  - CADKEY
  - Alibre
  - Boeing
  - General Electric
  - General Motors
  - Gibbs and Associates
  - Hurco Machine Tool Products
  - Lockheed Martin
  - IBM
  - Monarch Machine Tools
  - NASA (GSFC)
  - NCMS
  - Unigraphics Solutions
  - Suppliers

- **Subcontractors**
  - Allied Signal
  - Bridgeport Controls
  - Liberty Consulting
  - RPI

- **Pilot Projects**
  - GD Tank Automotive
  - Lawrence Livermore
  - NIST Intelligent Systems

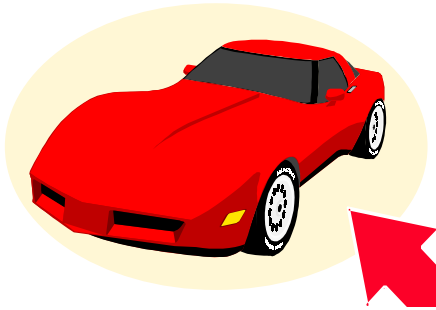


Key personnel

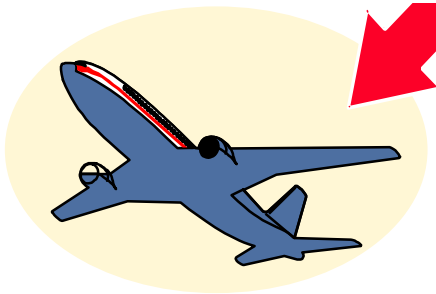
- **Martin Hardwick, Ph.D**
  - President
  - 20 years experience
  - STEP expert (50+ papers)

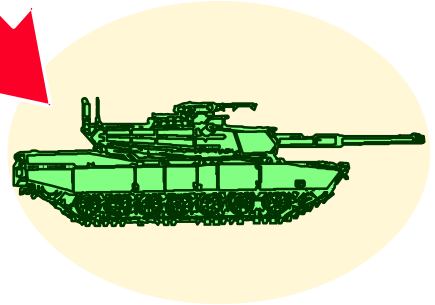
- **Mike Kutcher**
  - Marketing Consultant
  - 45 years experience
  - manufacturing expert
- **David Loffredo, Ph.D**
  - VP Programming Tools
  - 10 year experience
  - programming expert
- **Blair Downie, MS**
  - VP Desktop Tools
  - 12 years experience
  - geometry expert
- **John Valois, Ph.D**
  - 5 years experience
  - EXPRESS expert
- **10 programmers**

“Ownership” of Parts 14, 21 and 24 of STEP
“Ownership” of Parts 3 and 51 of STEP-NC



There are now more than one million STEP enabled CAD stations in the world





With CAM and CAE systems following

Why do manufacturers seek ISO certification?

Quality processes need quality data!

STEP will be "ISO 10,000"

And More Opportunity

The supplier creates the production process from a 3D product model instead of paper drawings*

		Without STEP				With STEP	Saving
		Max	Min	Average			
Time to make a process plan		100	4	16		12	25%
Time to replan a process plan		20	1	4		3	25%
Number of iterations				3		2	33%
Total Hours				28		18	36%
Number of plans per Year				1000		1000	
Burdened cost per hour				$50		$50	
Total Cost				$1,400,000		$900,000	36%

***Numbers are for a "typical" machine shop**

Example - Raytheon

STEP is used to automatically prepare visuals for process plans.

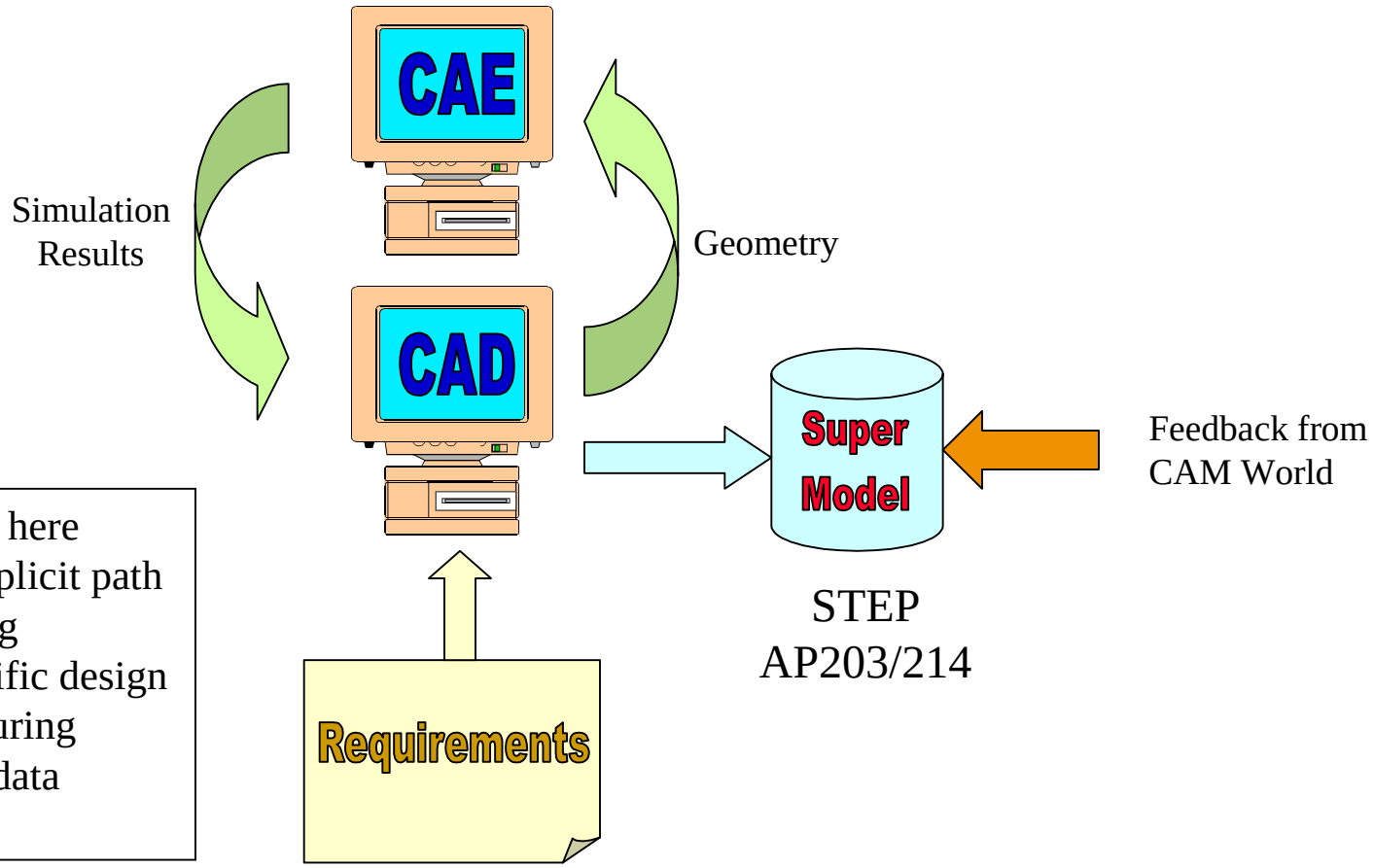
GOAL: Reduce manufacturing costs

- **50% of total process plan effort is composing visuals.**
- **STEP-based system using to produce process plan visuals.**
- **Projected 75% reduction in man hours spent in visuals preparation (25 hours vs. 100 hours).**

Other stories at Boeing, Lockheed Martin the German Automotive industry and more

DESIGN

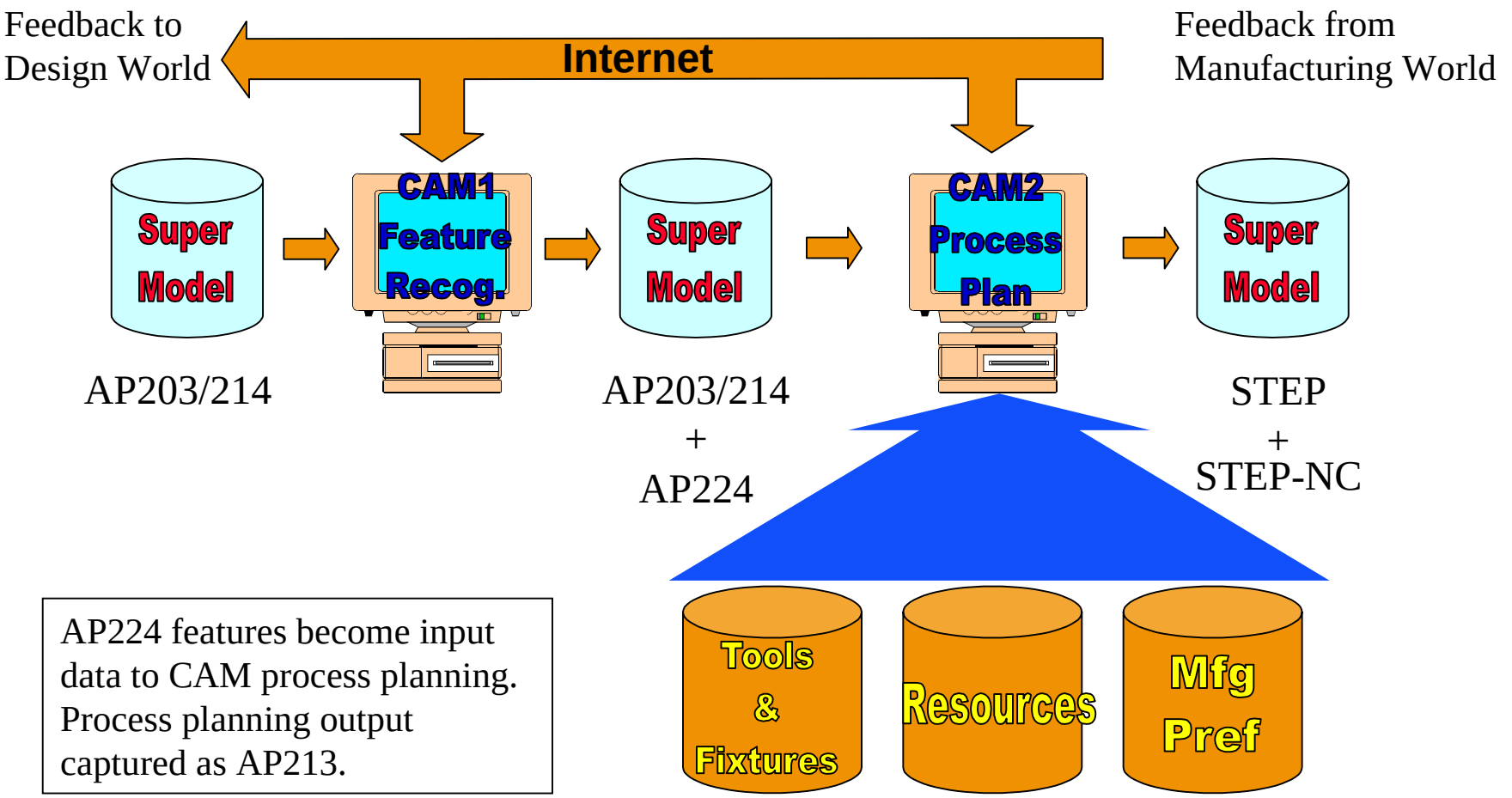
The Design World (To-Be)



Nothing changes here except for the explicit path for manufacturing feedback to specific design and/or manufacturing features and the data format

Manufacturing Process Planning

The CAM World (To-Be)

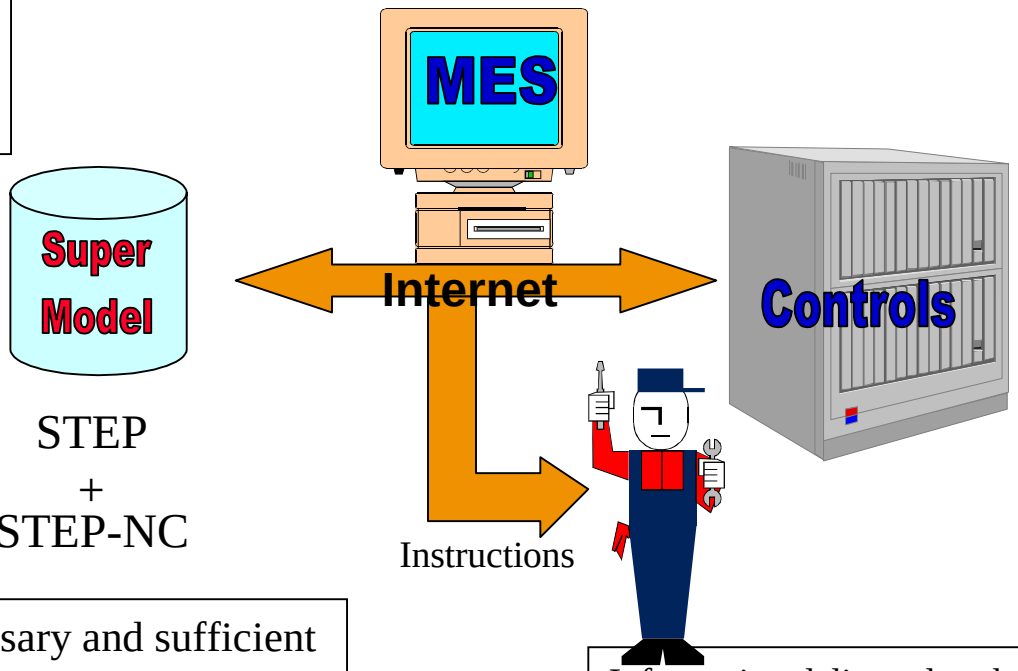


AP224 features become input data to CAM process planning. Process planning output captured as AP213.

Manufacturing Execution

The Manufacturing World (To-Be)

Eliminate hundreds of files with one DB in a format that is good for 25+ years



STEP
+
STEP-NC

One necessary and sufficient database containing all the information required to unambiguously manufacture the product.

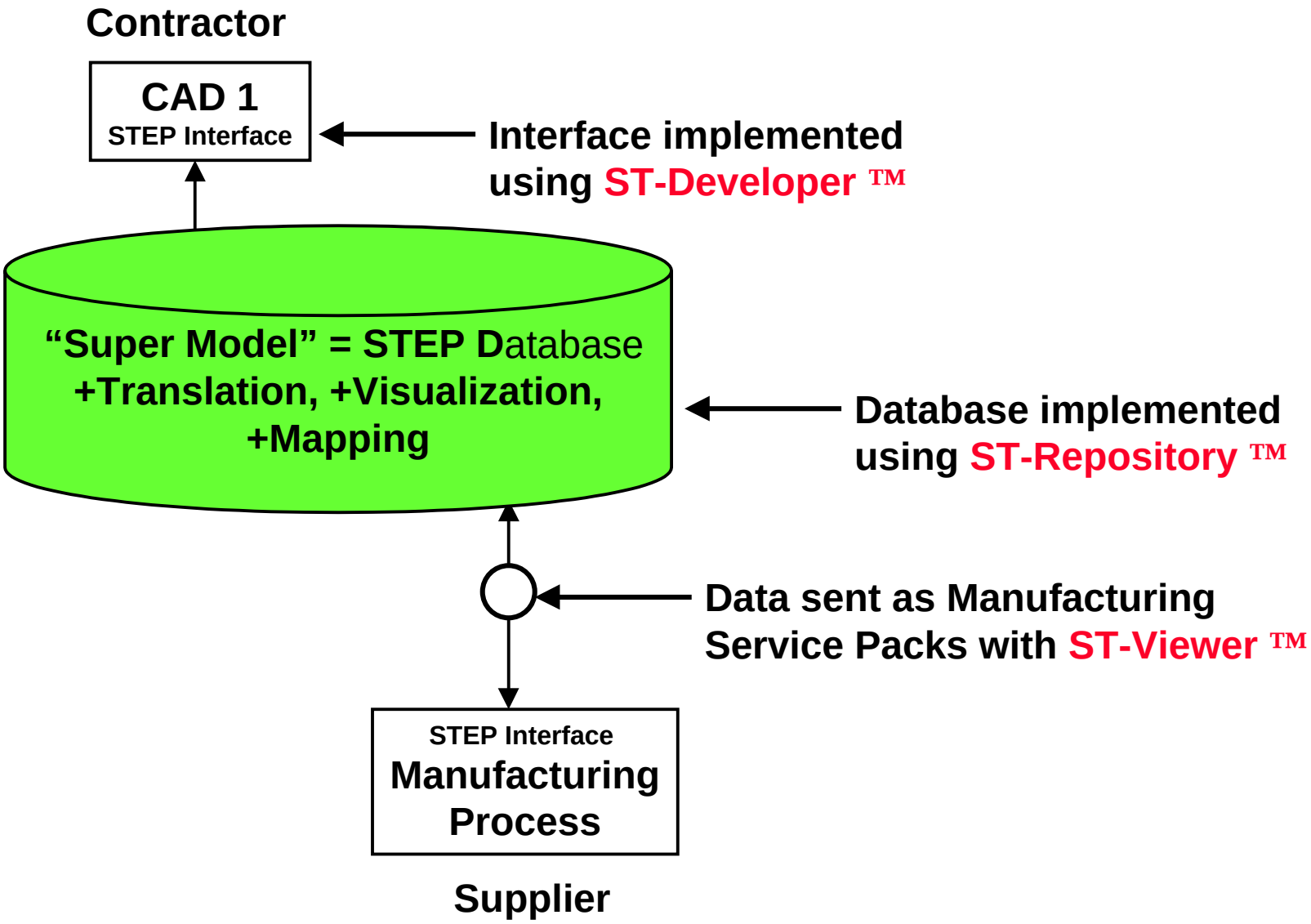
Information delivered to the shop floor in service packs for

Milling

Turning, etc.

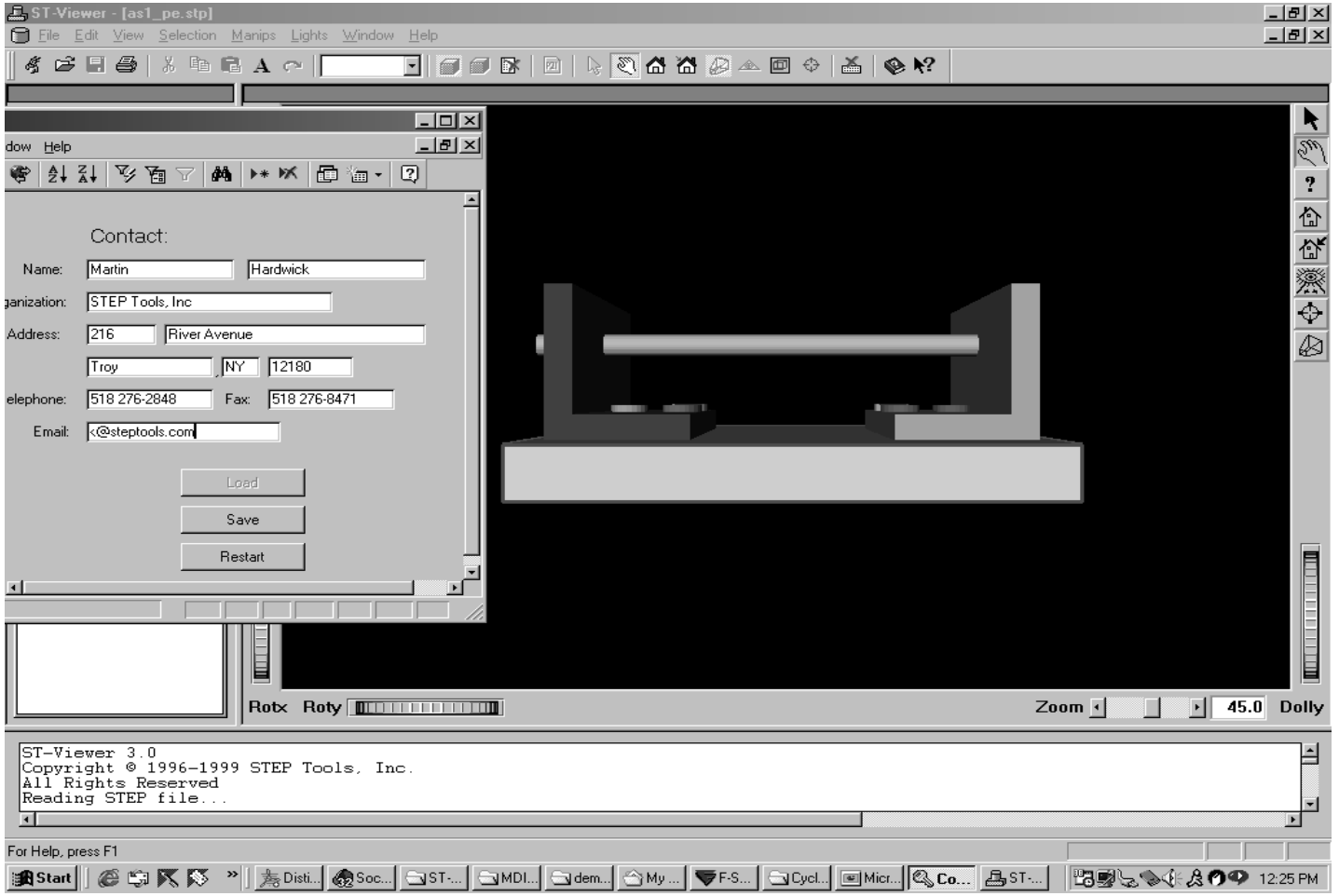
Implementing the "Super Model" solution

STEP Tools, Inc.



Example - set manufacturing contact

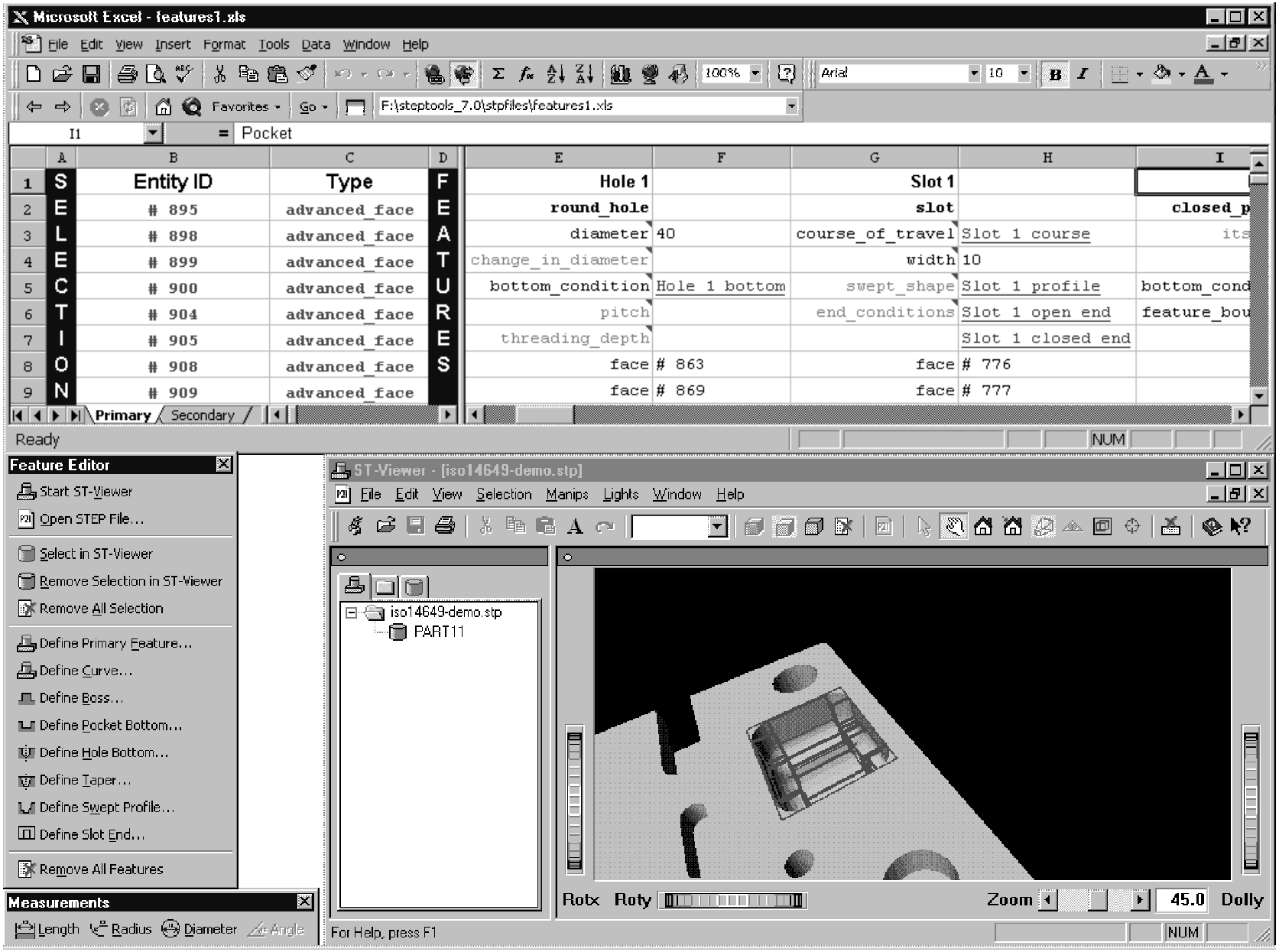
- **Microsoft Access database of people and addresses**
  - **XML data sent to MS Access by ST-Repository ™**
  - **Visual Basic OLE/COM interface to ST-Viewer ™**



Feature Manufacturing Service Pack

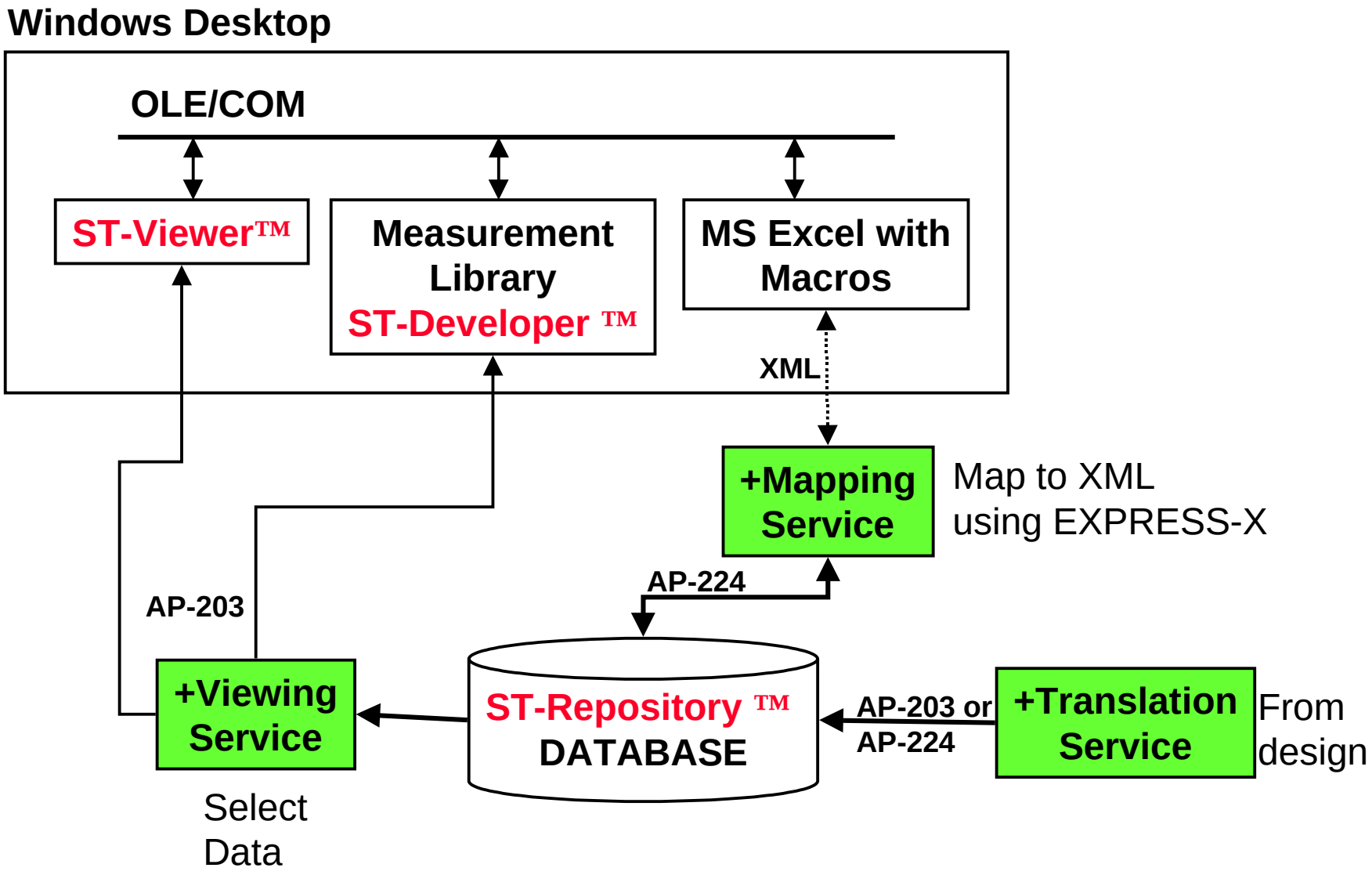
STEP Tools, Inc.

MS Excel

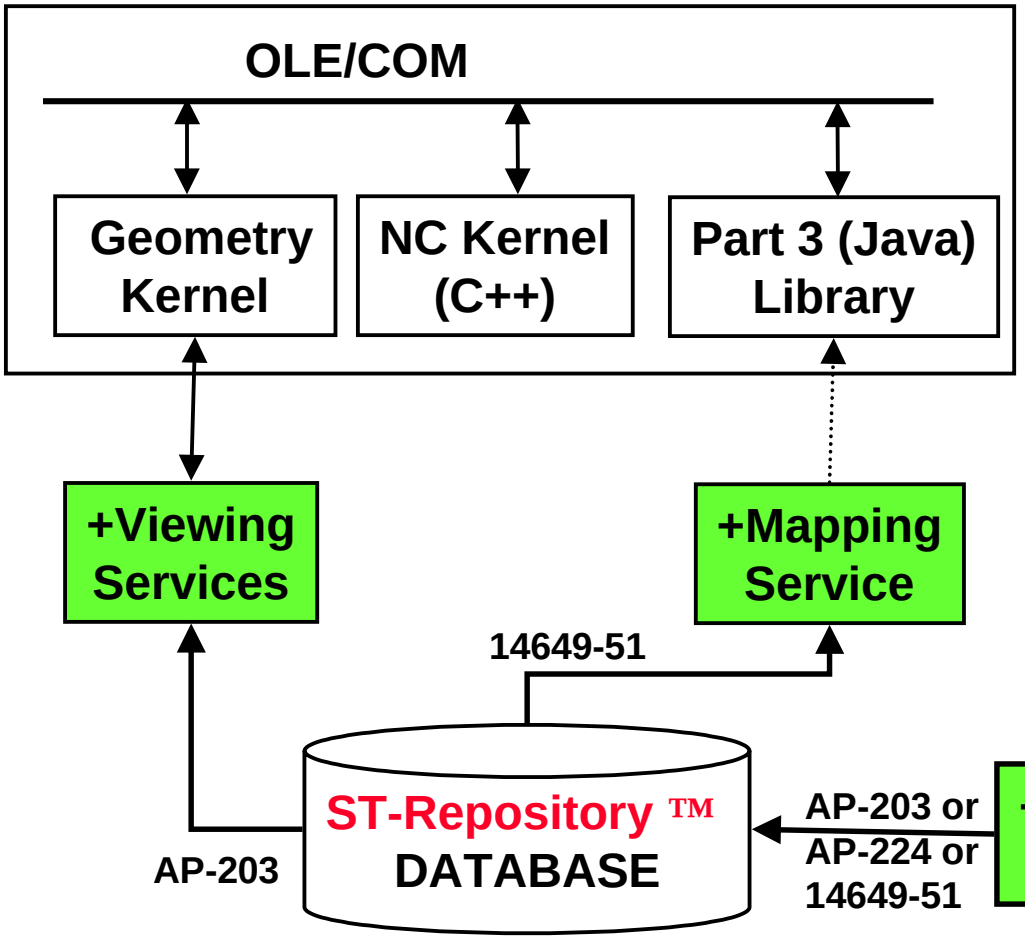


Operation of Feature Service Pack

STEP Tools, Inc.



CNC Milling Service Pack

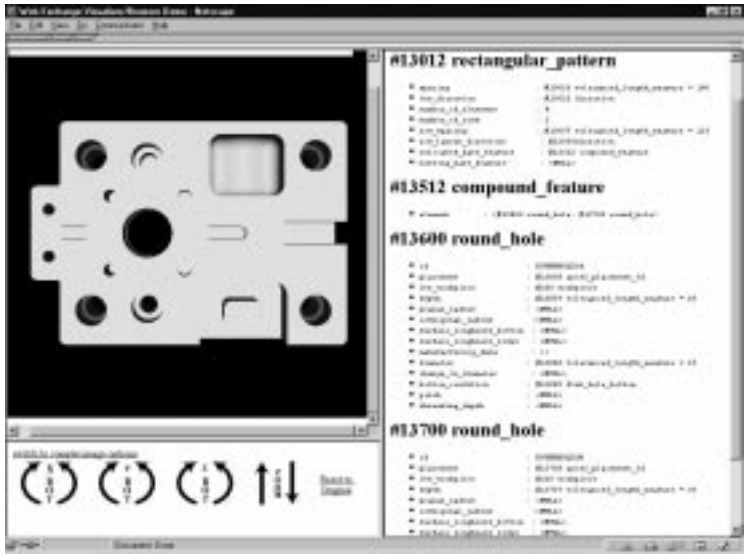


Project Schedule

Year 1 - Partial milling model

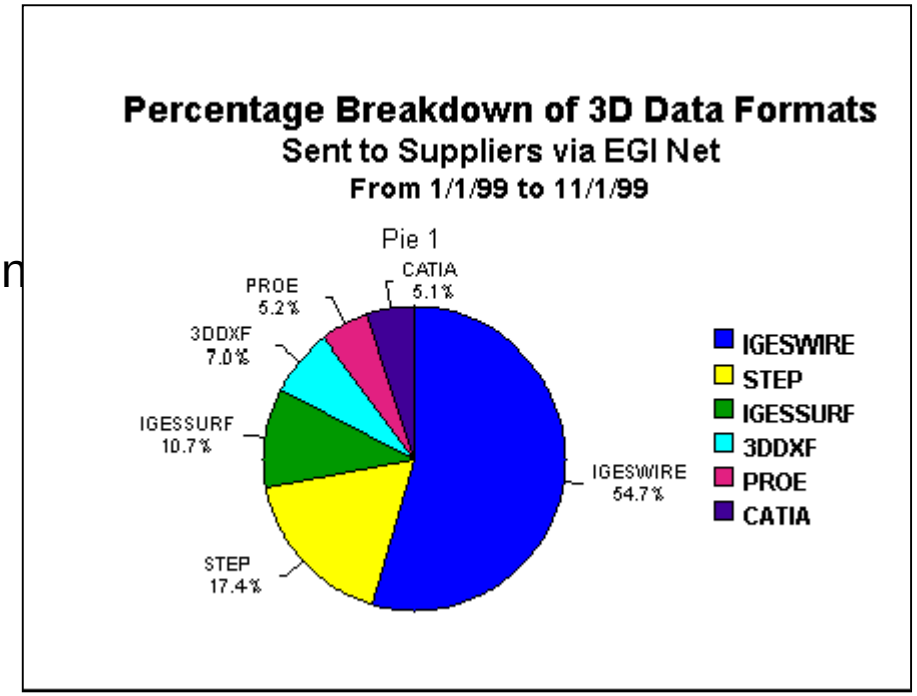
Year 2 - Whole milling model

Year 3 - Turning, Grinding or EDM



Summary

- **STEP is for manufacturing**
- **“Super Model” database =**
  - STEP Integrated Resources
  - +Translation, +Visualization, +Mappin
  - Data for all the manufacturing tools
- **We are implementing using**
  - ST-Repository ™ database
  - ST-Viewer ™ desktop checker
  - ST-Developer ™ programming
- **Benefits are significant**
  - 35% cost reduction for Process planning
  - 75% cost reduction for Manufacturing control
  - Replace hundreds of files with a Master Model on the Internet



IBM supply chain

Reasons to get started

- **Aerospace**
  - 70% of a wing is machined using CNC machine tools
- **Automotive**
  - Time to produce a new Power Train needs to be reduced from four years to two years
- **Ships**
  - Production costs must be reduced by further automation
- **Action**
  - Join Industrial Review Board
  - Start a pilot project