Engineer-to-Order Automation for Centrifugal Compressors:

Automation from Configuration thru Detailed Part Design

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Sean Sullivan
Vice President Engineering
Design Automation Associates, Inc
www.DAASolutions.com

Premium Partners:

DRESSER-RAND

- A leader in energy conversion technology, with field-proven centrifugal and reciprocating compressors, steam turbines, gas turbine packages, expanders, and control systems.

Design Automation Associates, Inc

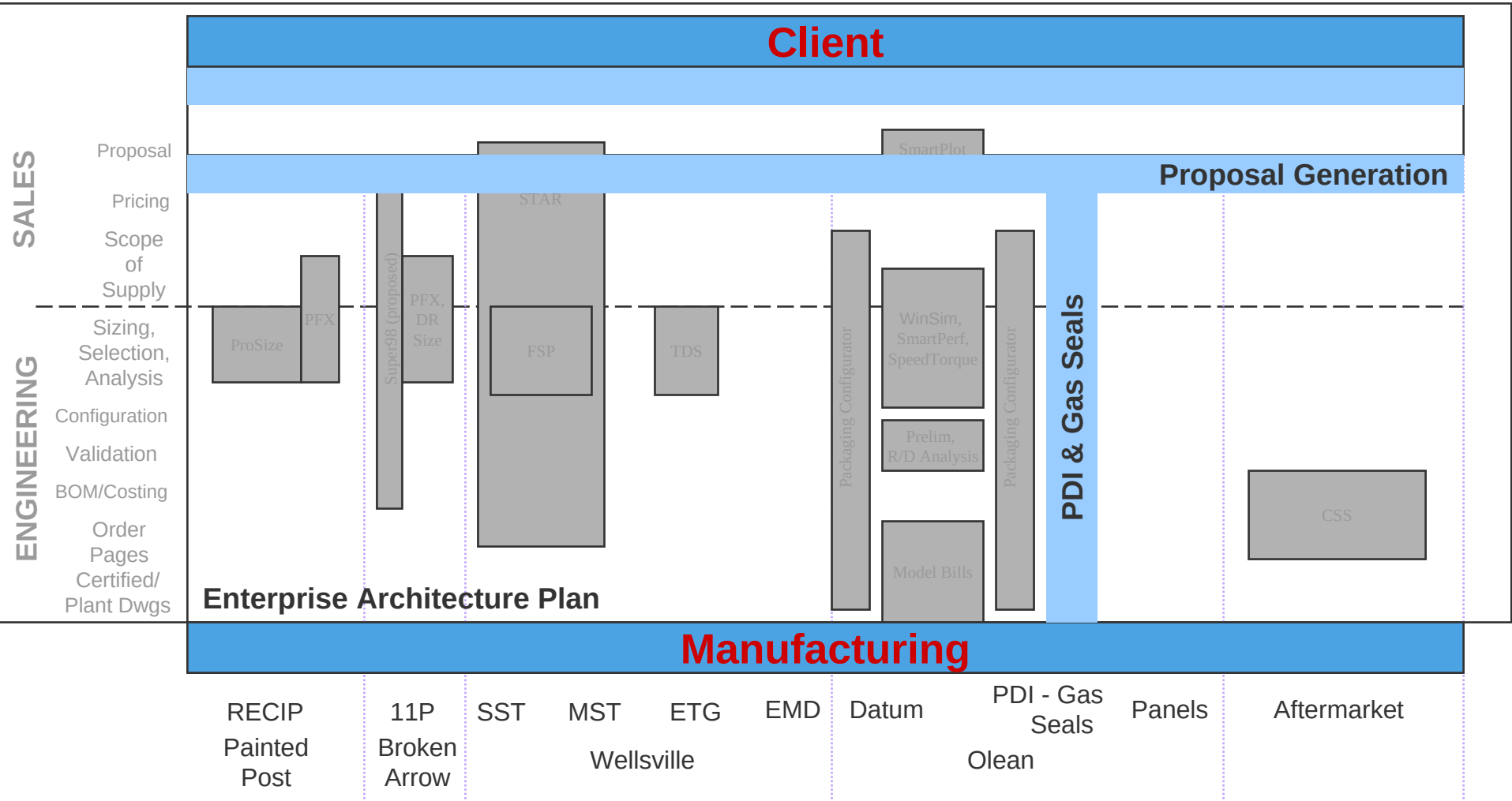
- The leader provider of NX/Knowledge Fusion Automation Systems in North America for Sales/Engineering/Manufacturing Automation and Engineering Services.
- DAA serves the aerospace, automotive, oil & gas, industrial & commercial sectors.

Development of Pele-Sol Engineered Solutions

DRESSER-RAND in 1995

- Business Processes were not optimized
- Recognized an opportunity for improvement

Typical Enterprise Architecture Issues



Development of Pele-Sol Engineered Solutions

Results of inefficient Business Processes

- Non-Integrated systems and operations
- Delays in delivery of product
- Opportunities for miscommunication
- Costly re-work
- Long cycle times
- Engineering team could not always produce what the selling team sold

Goals of Business Process Automation Project

- Integrate proposal generation, engineering, and manufacturing systems
- Facilitate collaboration in engineering from anywhere in the world
- Improve speed and accuracy of information company-wide from proposal to delivery

Goals of Business Process Automation Project

- Reduce engineering and production cycle times
- Create consistent output company-wide
- Reduce project delays and costly rework

Finding a Solution

Dresser-Rand analyzed existing software and consulting firms

- Tried unsuccessfully to implement systems from a major software company
- Concluded that they must develop a solution in-house

What a Difference!

Engineering Cycle Time

	1995 *	2001
Proposal Engineering Cycle Time	3 Weeks	3 - 5 Days
Initial Approval (Review) Drawings & Diagrams	12 weeks ARO	@ Proposal via Configurator
Final Issue of all Drawings & Diagrams	26 weeks ARO	10 weeks ARO (including client review cycle)

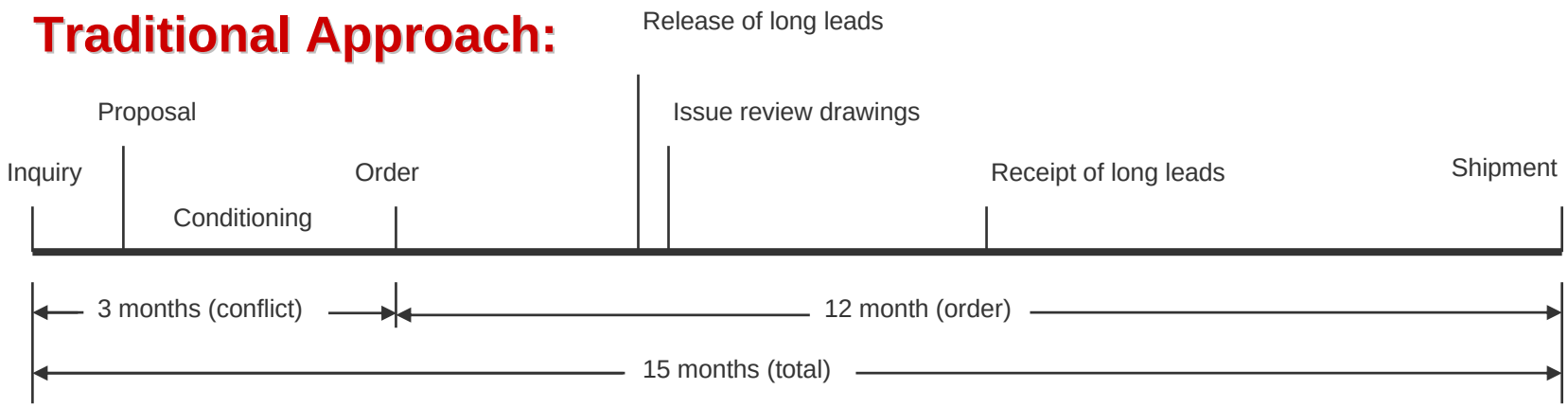
* still today's industry standard!

“The Pele-System is one of the best we have seen that addresses the ETO (Engineer-to-order) market.”

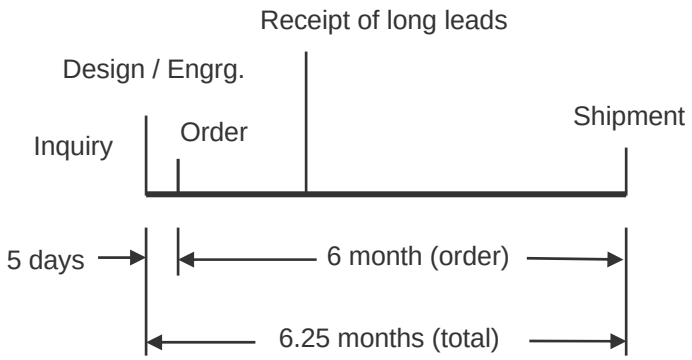
Aseem Mital, Tavant Technologies

Traditional vs. New Approach

Traditional Approach:



New Approach:

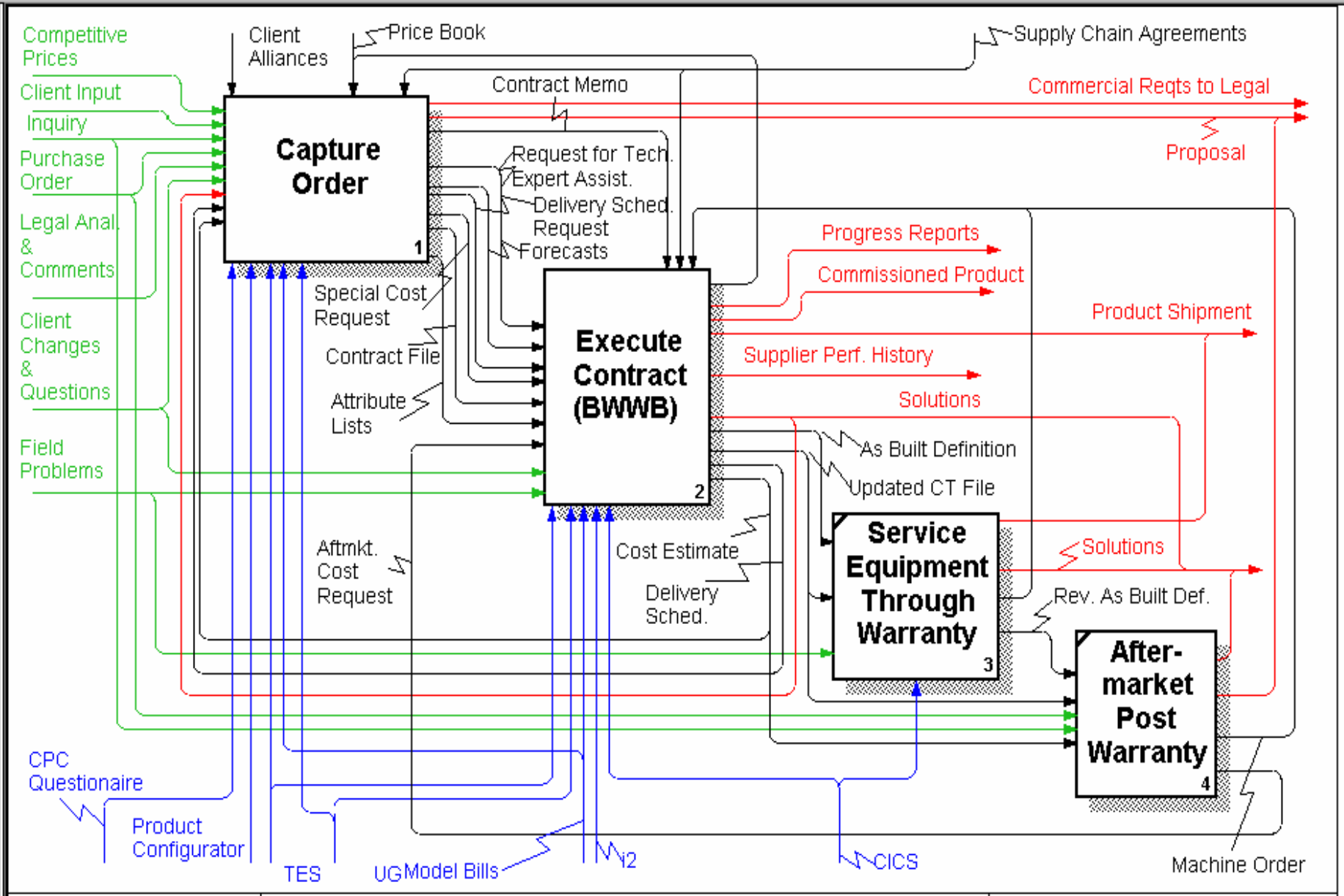


Configure with Confidence

- Creates custom configurations within hours or days
- Allows collaborative engineering from multiple geographic locations
- Accurately defines the product
- Proposal engineering is value added
- Minimizes hand off issues and miscommunication
- Creates budget configurations within 1 hour

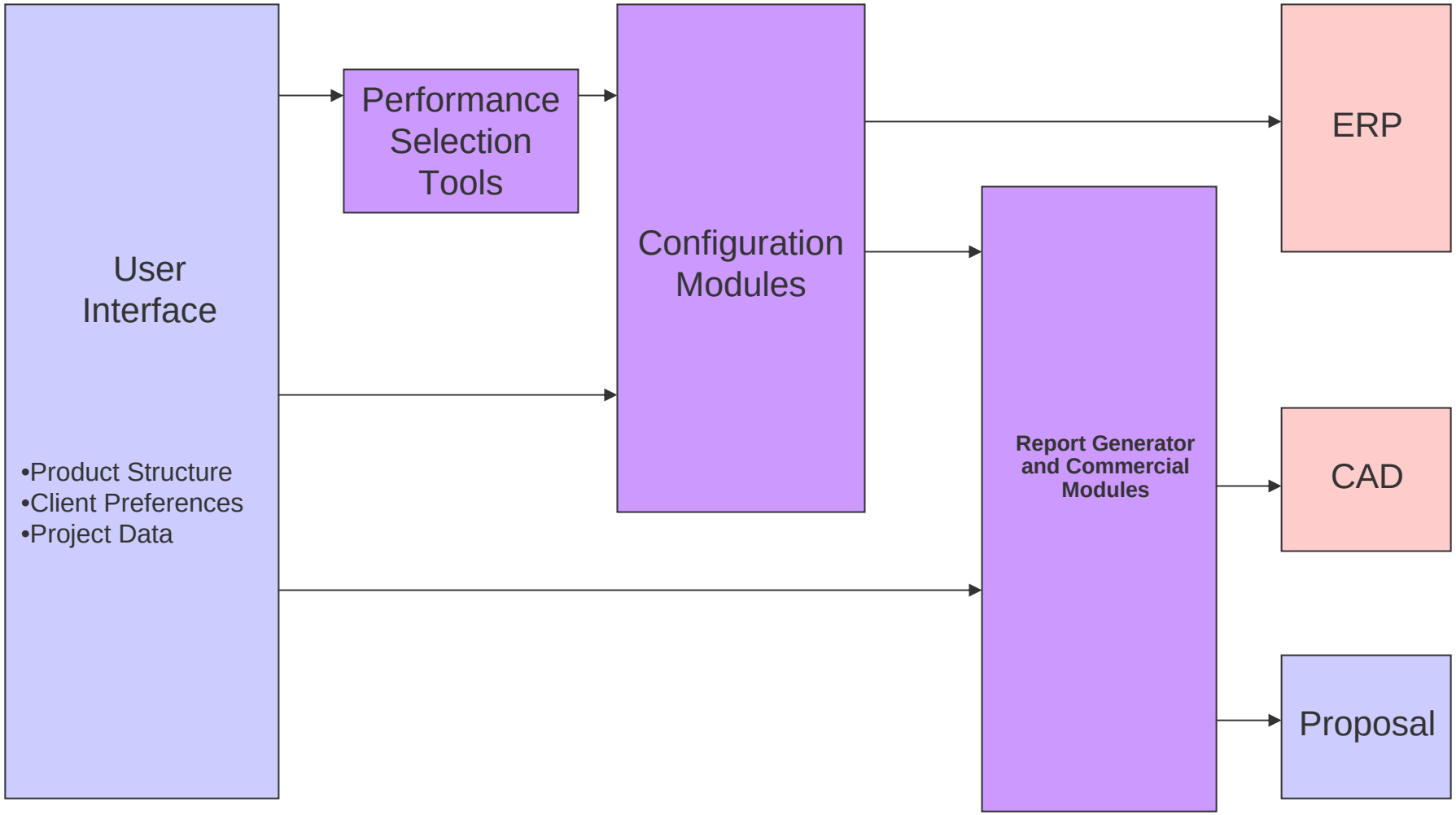
BPwin - [(A0) Supply Industry with Energy Conversion Solutions - DR Business Model [Busmodelrev1.BP1]]

File ModelMart Edit View Insert Report Tools Window Help

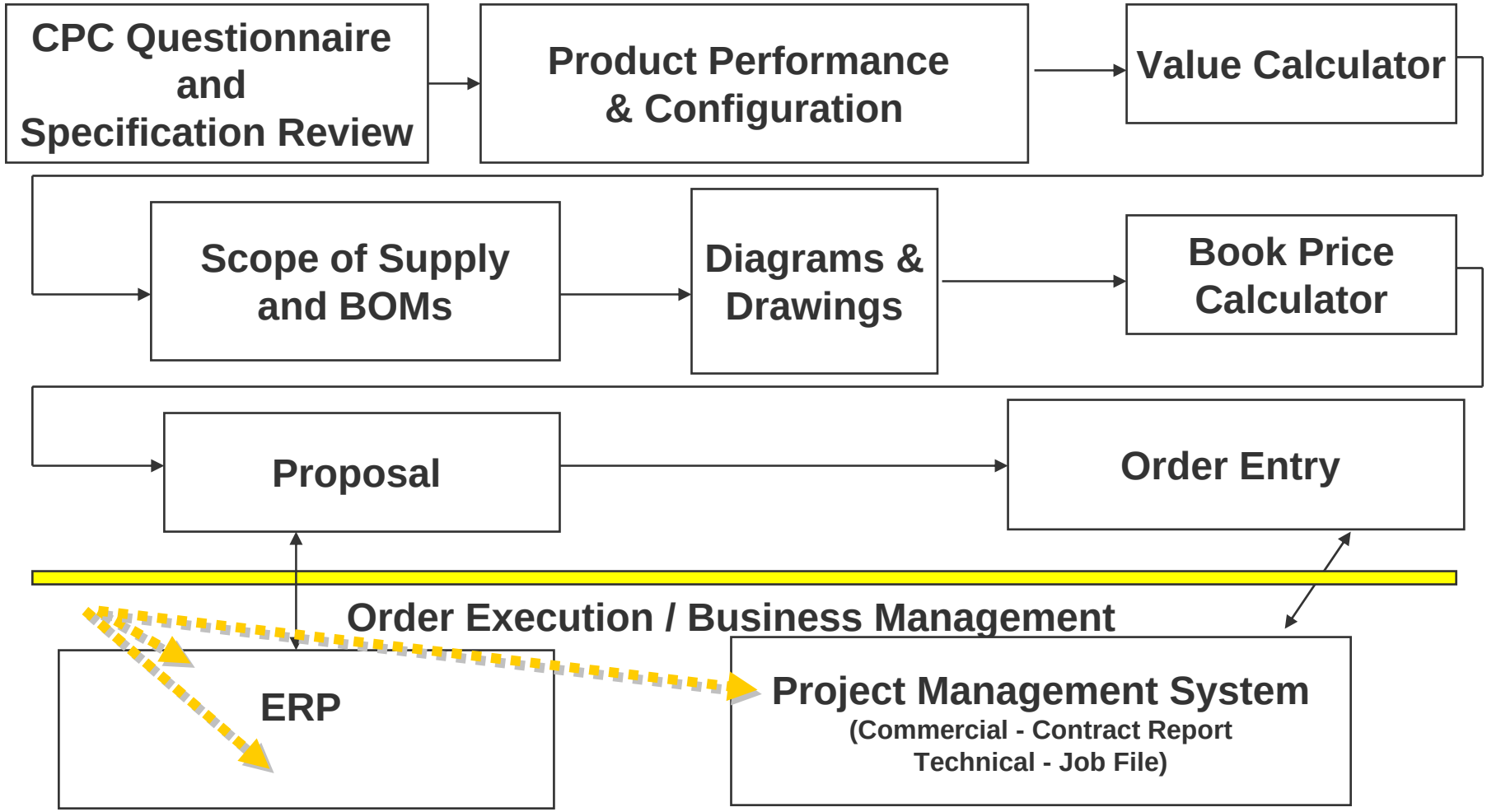


NODE:	TITLE:	NUMBER:
A0	Supply Industry with Energy Conversion Solutions	

Pele-System Architecture



Pele-System Module Integration



Rules Based Product Selection Provides Consistency Throughout the Enterprise

"The Pele-System is unparalleled in its ability to store and leverage a huge knowledge base and thereby streamline the ETO process."

Aseem Mital, Tavant Technologies

Pele-System

Automatically generates diagrams, bills of material, and client-requested data sheets

"The Pele-System is capable of building years of engineering knowledge into the collaborative process and thereby shaving significant time from the order cycle."

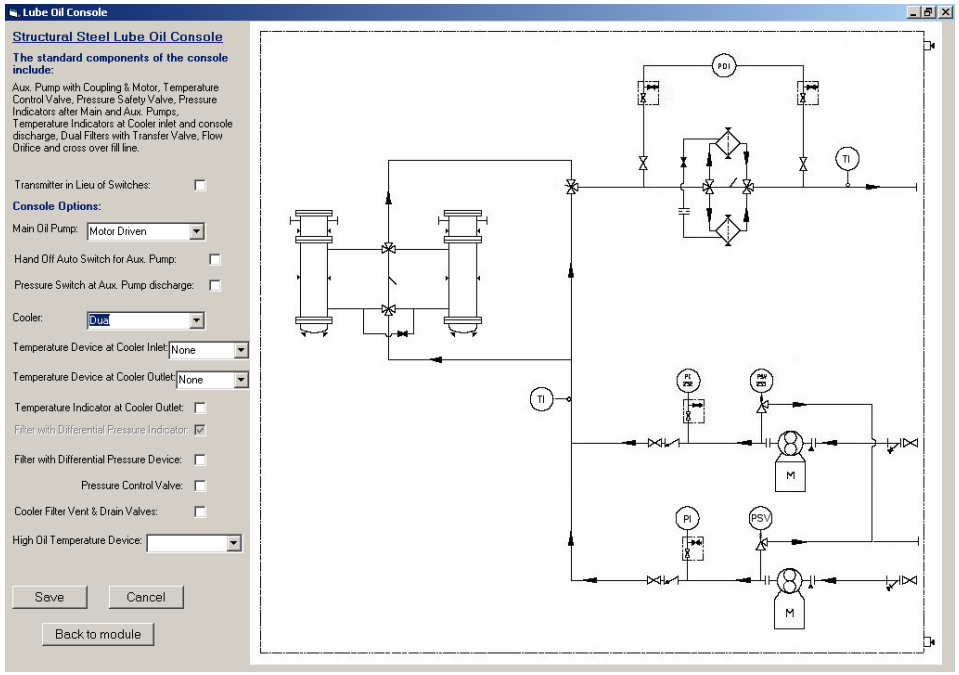
Aseem Mital, Tavant Technologies

Case Study - P&ID Visualization

Automated Diagram Geometry Generation

Financial Benefit

8 hours -> 10 minutes

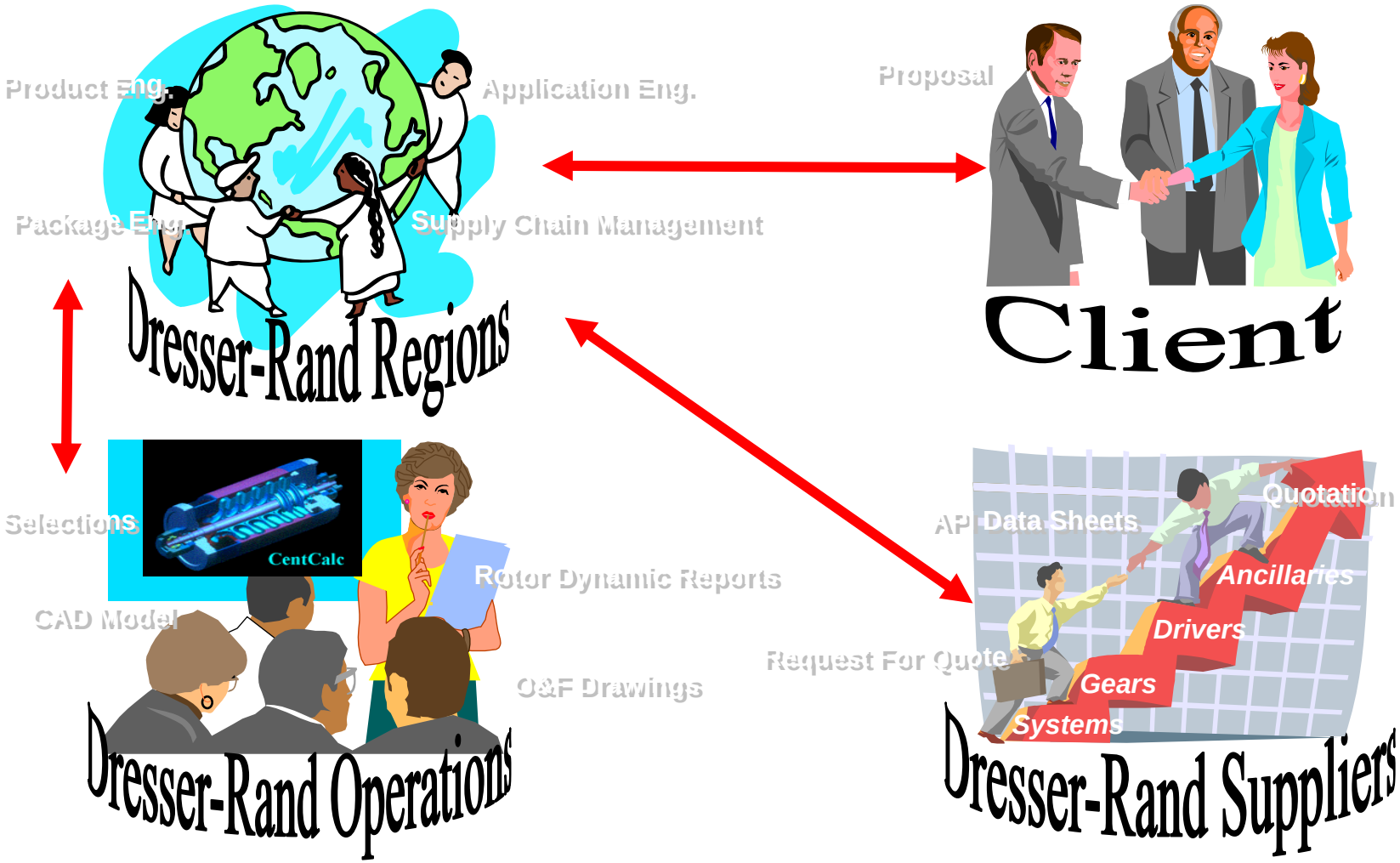


Opportunity

Multiple users from around the globe can use one software tool on one hardware system

- **creates consistency**
- **improves accuracy**
- **improves communication and coordination**
- **reduces cycle time**

Project Knowledge Transfer



Dresser Rand *Energy Solutions* Configurator

(Version 1.1.8)

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DRESSER-RAND

Commitment to excellence

User Name: gjacobik

Password: ****

Ok | Cancel

CPC Revision Date: 10/01/2000

Users : akidd All users

Opportunity Type N

Date 02/22/2000

Region/Location OL

CPC Master File Name N00L1027

CPC Questionnaire File Name

Siebel Opportunity ID

Configurator File Name OL1027007

Sales File Number

Contract Number N00L1027

Make Contract

SmartPerf File Name D12R8S_DR61

SmartPlot File Name

Smart Rotor File Name

ProSize File Name

Star File Name

DRSize File Name

SteamPerf File Name

Config File Comments

File for
Scope: DR-61/Gear/DATUM
Design Standard: North American
Procurement Source: Olean

Owner : Allan H. Kidd

New | Save | Delete | Exit | Cancel | Open | SaveAs | Export | Import | CpcQuest

This is the File Manager Screen. It is used to align Sales and Contract activity with a particular Client project

Implementation

This is a Proven Technology based on a Sophisticated ETO application

- **Fact NOT Theory**
- **Appropriate for Divisional or Enterprise-Wide Application**
- **Development Team is Available to Expedite Implementation**

Case History: Packaging Multiple $MM Favorable Impact in 1998

Package Business Process Redesign

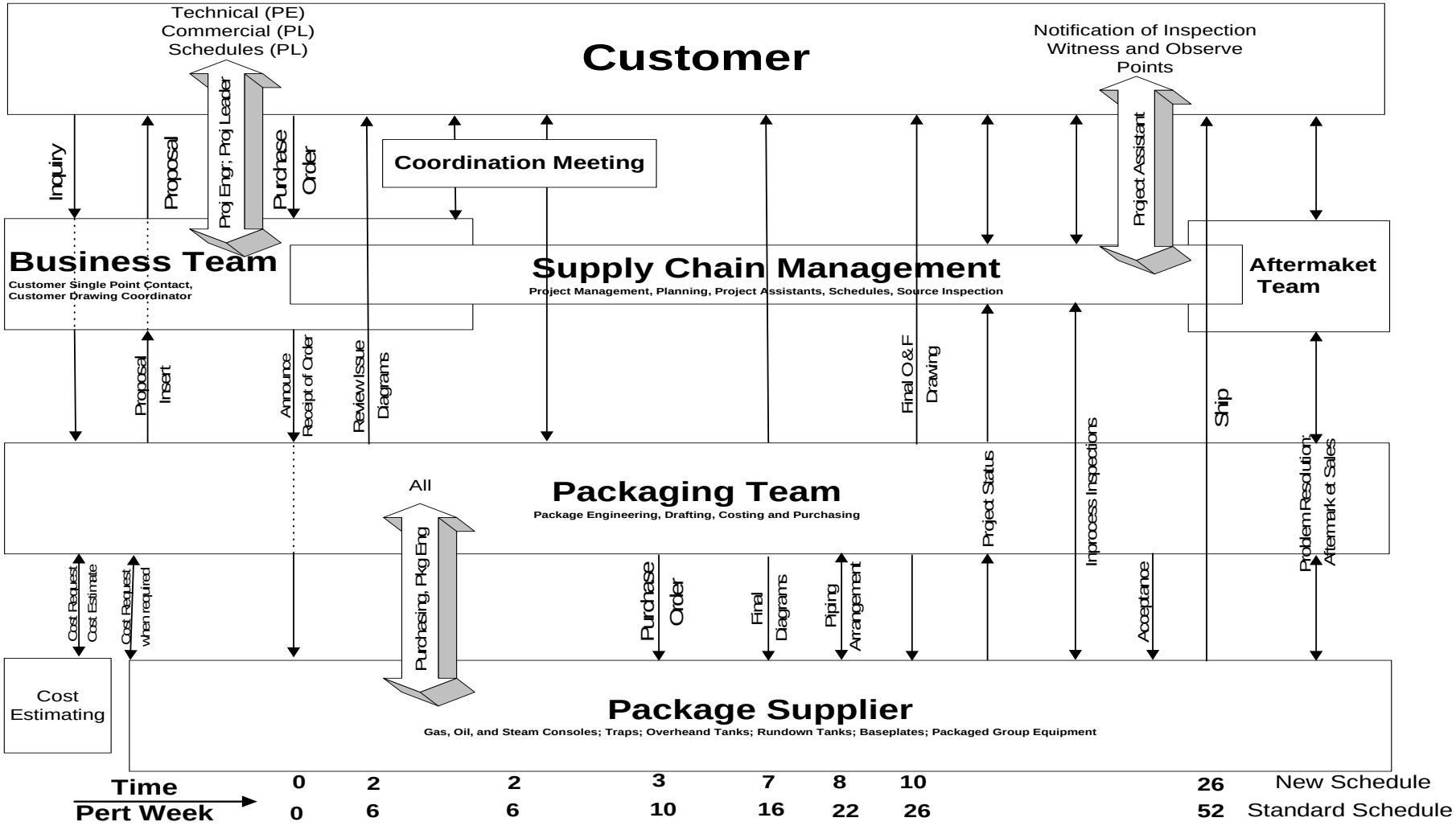
Implemented November 1997

Package Cell: Manufacturing & Procurement

Package Team: Engineering, Drafting, SCM

Packaging Interfaces - A Value Added Process

Dresser-Rand Co. Confidential



Pele-Sol Engineered Solutions
DESIGN AUTOMATION ASSOCIATES INC
DRESSER-RAND

Business Process System

- Automated Proposals
- Engineered BOMs for Manufacturing
- Automated Link to Model Bills
- Product Performance
- Engineering Data
- Pricing Analysis
- All Client Documentation
- Automated Order Entry
- CAD Interface

CAD Interface: Case Study - Bolted Diaphragm

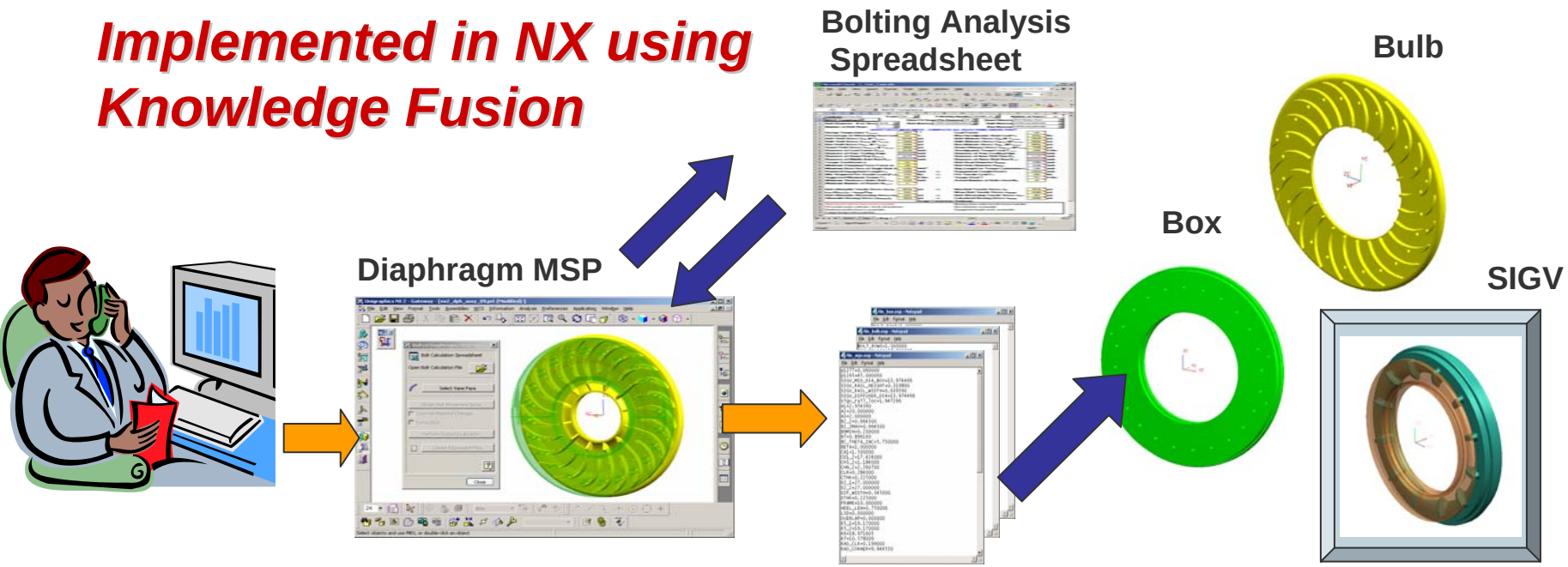
Automated Calculation of Part Bolting

bolts
bolt size
bolt location

Financial Benefit

16 hours →10 minutes

Implemented in NX using Knowledge Fusion



CAD Interface: Case Study - Flared Impeller

Automated Design of Impeller Flare

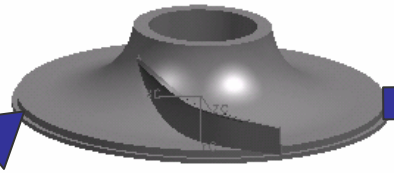
Geometry Generation

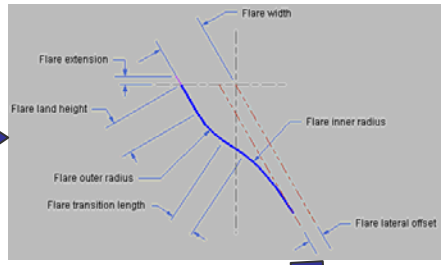
NC Tool Path Generation

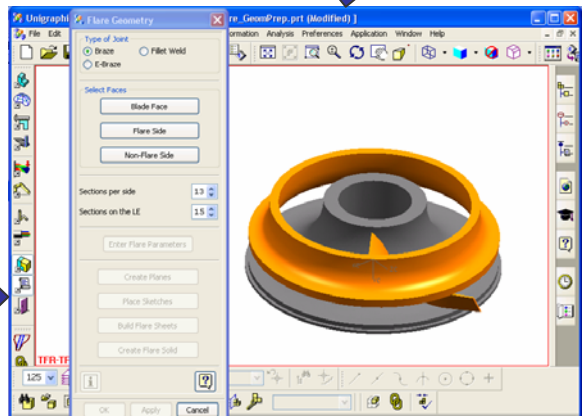
Financial Benefit

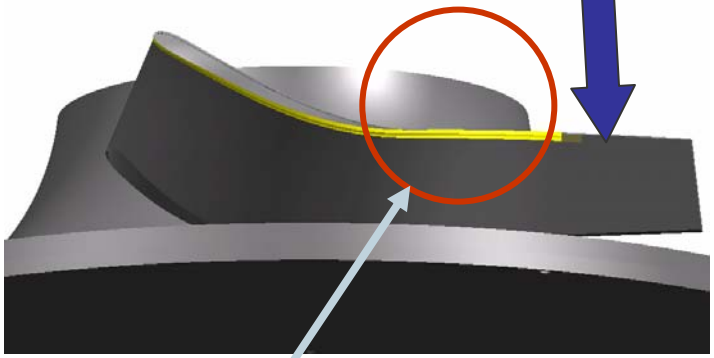
24 hours savings

Implemented in NX using Knowledge Fusion









Flare Solid

Bolted Diaphragm Design

Product: Bolted Diaphragm

- ☑ Analysis Automation
- ☑ Design Automation
- ☑ Manufacturing Automation

Highlights:

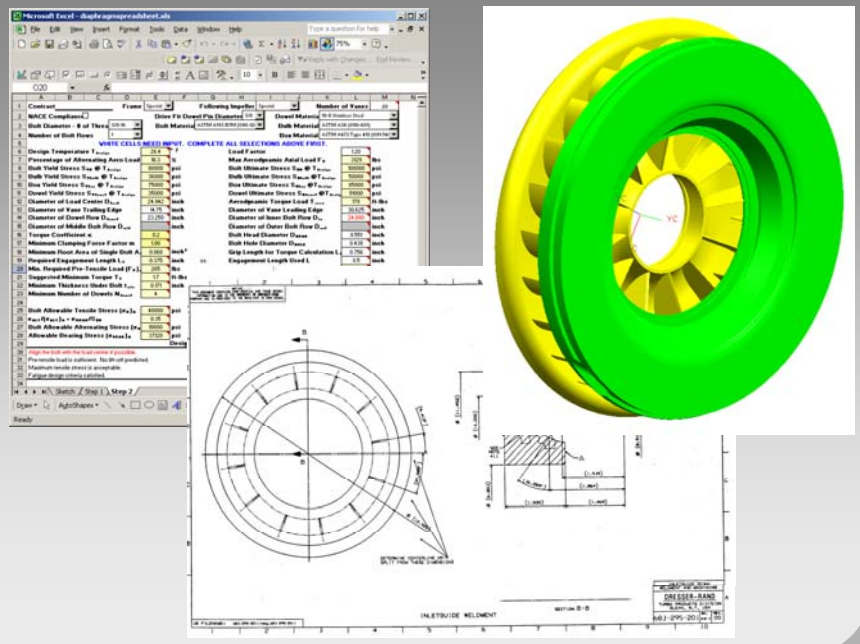
- 3D Solids
- Manufacturing Drawings
- Bolt Hole Positioning Optimization
- Bolted Analysis
- Linked to Excel Spread Sheet

Complexity (1-10): 5

Deployment: Client Based

Current Status:

- In Production Since December 2004



Results:

- Design Time Reduced 18 Hours down to 30 minutes
- Elimination Manual iteration of Bolt Location & Analysis

Impeller Design (Centrifugal Compressors)

Product: **Impeller Design**

- ☑ Design Automation
- ☑ Manufacturing Automation

Highlights:

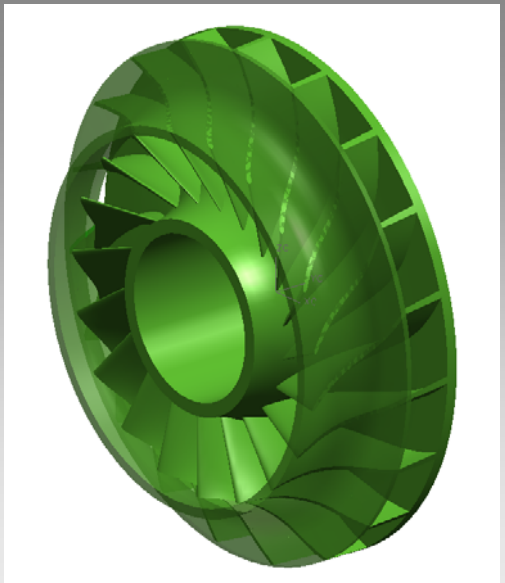
- 3D Solids
- Manufacturing Drawings
- Complex 3D Geometry Automation

Complexity (1-10): 5

Deployment: Client Based

Current Status:

- In Production Since 11/05



Results:

- Design Time Reduced 30 Hours down to 60 minutes

Flexible Diaphragm Design (Centrifugal Compressors)

Product: Flexible Diaphragms

- ☑ Analysis Automation
- ☑ Design Automation
- ☑ Manufacturing Automation

Highlights:

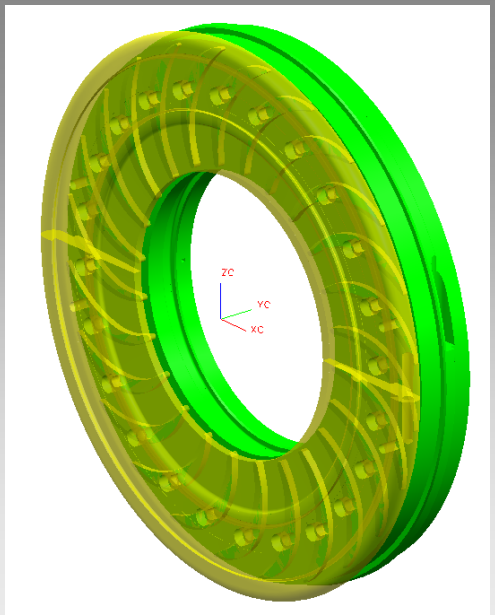
- 3D Solids
- Manufacturing Drawings
- Complex 3D Geometry Automation

Complexity (1-10): 5

Deployment: Client Based

Current Status:

- In Production Since 11/05



Results:

- Design Time Reduced 18 Hours down to 30 minutes
- Elimination Manual iteration of Bolt Location & Analysis

Stator Stages & Blades (Steam Turbines)

Product: Bolted Diaphragm

- ✔ Analysis Automation
- ✔ Design Automation
- ✔ Manufacturing Automation

Highlights:

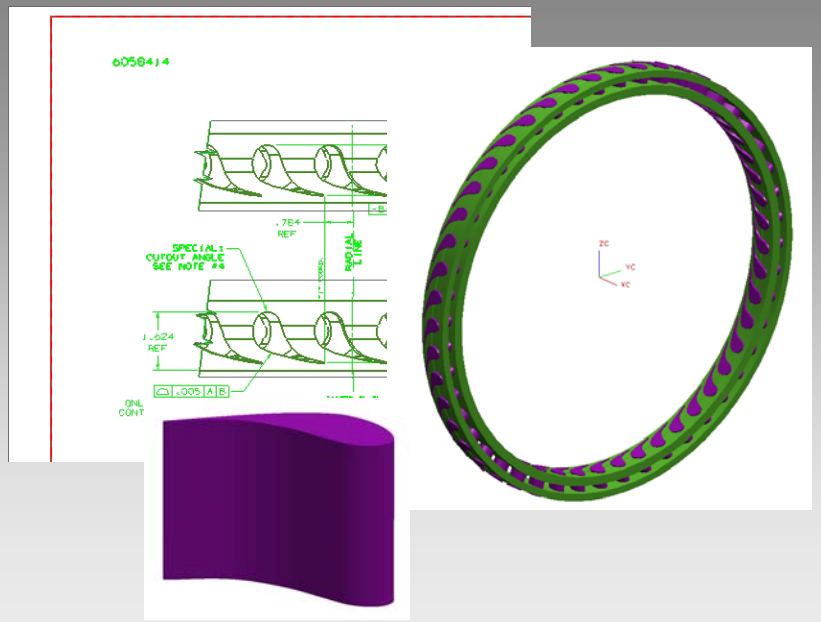
- 3D Solids
- Manufacturing Drawings
- Complex 3D Geometry Automation

Complexity (1-10): 4

Deployment: Client Based

Current Status:

- Targeted for Production in 6/06



Results:

- Design Time Reduced 40 Hours down to 5 hours
- Elimination of Extensive Mfg. Waste.

Piston Driven Compressors (Oil & Gas)

Product: Piston Design Automation

- ☑ Design Automation
- ☑ Manufacturing Automation

Highlights:

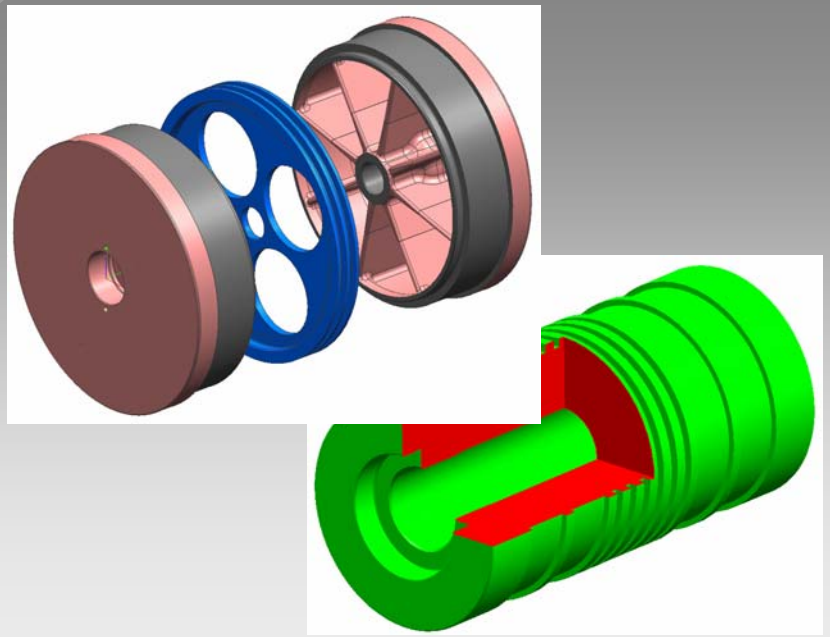
- 3D Solids
- Manufacturing Drawings

Complexity (1-10): 5

Deployment: Client Based

Current Status:

- Targeted for production in 2006.



Results:

- Design Time & NC Programming Reduced from 60 Hours down to 2 hours.
- Elimination of extensive Mfg. waste.

Sample Solutions #1

Proposal and Engineering Automation System Investment Analysis

Business Assumptions #1

Business Revenue	$ 100 MM / Yr
Average Gross Margin (SVM)	30 %
Sales Growth per year	2 %
Average # proposals / year	150
Average # Man hours / Proposal	60
Avg. Cost / Engineer Man hour	$ 60
Net Present Value Discount Rate	20 %

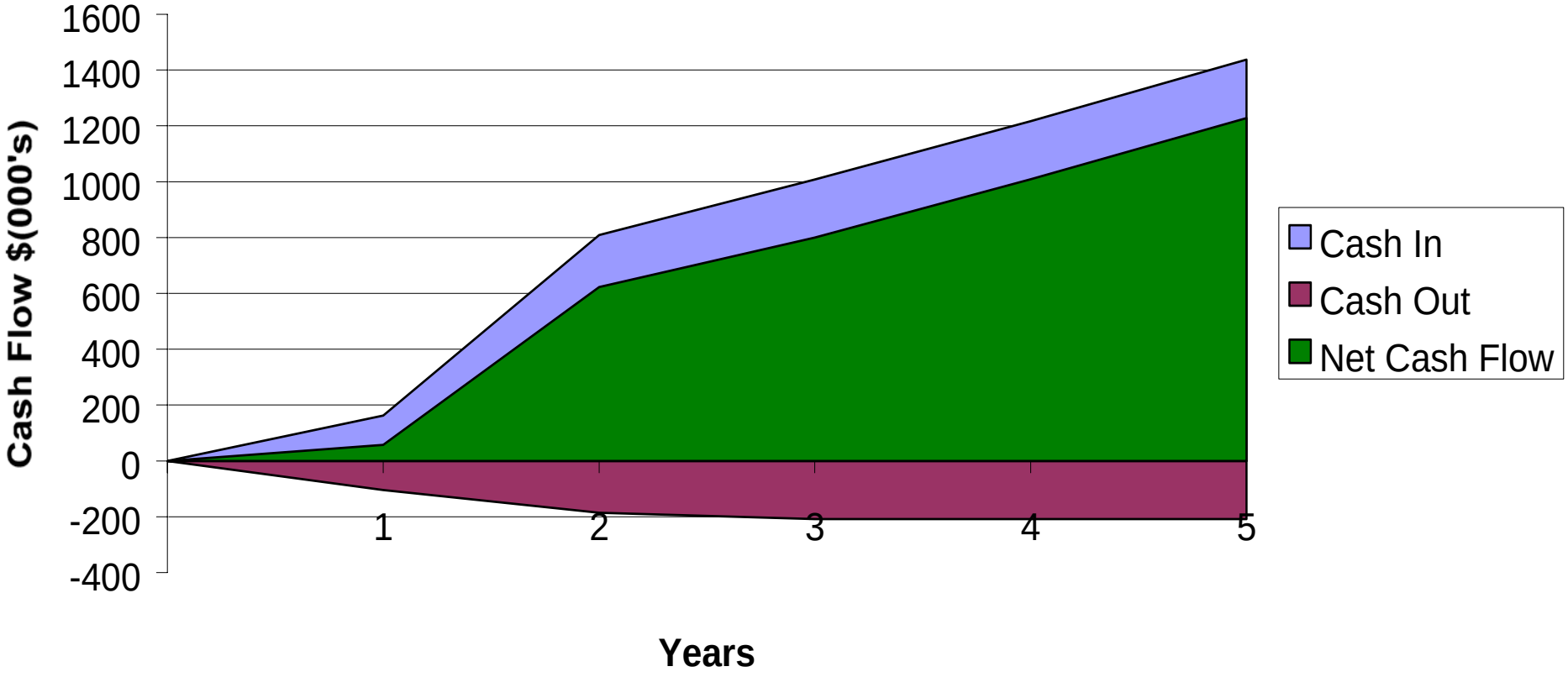
Pele-Sol Impact Assumptions #1

Proposal Savings, Man-hours / Year	**50 %**
(30% in first year of implementation)	
Proposal Growth Factor:	
> # proposals / Year	**10 %**
# Pele-System Users	**20**
Margin Increase	**+0.5 %**
(Impacts year two and beyond)	
Revenue Increase / Year	**+0.5 %**
(Impacts year two and beyond)	

Return on Investment #1

First Year	41 %
5 Years	766 %
Net Present Value-Cash Flows	$ 1,882MM
Internal Rate of Return	432 %

Pele-System Cash Flow Analysis with Lease



End of Presentation

For questions please contact:

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