Powertrain Component Commonality and Reuse

A Solution Approach using Classification Management with Controlled Workflow

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Evolution of the Ford Product Creation Process

1985
- CTC (Concept to Customer)
- MBJ#1: 72 MBJ#1

1992
- WCT (World Class Timing)
- MBJ#1: 68 MBJ#1

1993
- WCP (World Class Process)
- MBJ#1: 65 MBJ#1

Since 1996
- FPDS (Ford Product Development System)
- MBJ#1: 43 MBJ #1

2005+
- GPDS
- Global Product Development System
  - An Enterprise-wide process built from Global Best Practices

* <KO> equivalent timing for S4/P4 program

For Joint Programs
Key Business Drivers – Commonality
(Before C3PNG)

Requirements:
• Common PDM
• Common Product Structure
• Common CAD

Current Situation:
• Different PDM
• Different Product Structure
• Different CAD

Our current Methods/Tools/Data environment inhibits cross brand programs
C3P-Next Generation (Ford PLM Initiative)

- **C3P-NG (CAD/CAE/CAM/PIM)**
- CATIA V5 (excluding PT), IDEAS Teamcenter Engineering (TCe) & Teamcenter Manufacturing (TCm) AVBOM, Vismock, Tecnomatics, etc…. 

![Diagram showing integration of C3P Today and Strategic C3P NG]
The Business Need/Challenge

- Fierce competitive environment for time to market in large production system, and in particular Automotive Industries
- Major requirements from the customers are Quality and Economy
- Complexity of automotive product development and manufacturing with variants product configuration has been always challenging to maximize the quality, cost and time equation
- Disciplined approach of knowledge base re-use across all product development & manufacturing activities requires proven supporting tools and methods
- Keeping track of all components and making it available in the entire enterprise with managed BOM has been always challenging
The Competitive Environment

Time, Cost, and Quality equation is no longer sufficient

Globalization
Design anywhere
Build anywhere
Maintain anywhere at any time

Product Complexity
Increased part counts
Use of standard parts
Build-to-order and mass customization

Improved product quality

Reduced time

Lowered costs

Competition
Increasing globally
The need to differentiate
Consolidation while focusing on core competencies
Need to innovate product and processes

Innovation

Pricing Pressure
Demand for global pricing
Price it right the first time
You must know your costs
Decreased product margins

Extracted from CIM Data Research Report
Traditionally, the knowledge of the organization is the sum of that which is held by its people.

Intellectual Assets (Incorporate Principles)

Context

Knowledge (Patterns)

Information (Relationships)

Understanding

Data (Items)
The Foundation: Applications and Business Solutions

Data Vault & Document Management

Data Authoring (CAx)

Workflow & Process Mgmt.

Structure Management

Program & Project Management

Classification Management

Fasteners
- Screws
- Round
- Flat
- Hex

- Bolts, etc.
- Bolts
- Nuts
- Washers

Key for Part Commonality Implementation

New Product Development Project
Classification Management?

A controlled disciplined processes of classifying, managing and reusing the knowledge base throughout the enterprise with controlled reuse workflow.

Are You Re-Inventing the Wheel?
"Up to 80% of the work done in an engineering department is identical or very similar to work done previously" from research by: Arthur D. Little
Benefits

- Increase reuse of existing components, processes and resources
- Limit part number proliferation by commonizing purchased parts and consolidate suppliers
- Improve product quality by reducing variation and noise in the process
- By product - Part/process standardization for PD PD
- Configuration management with maximize variety and minimize number of parts
Current PT Solution

- **Standard Component Library (SCL):** A system developed in PT Engineering-IT to facilitate PT engineers and designers in reusing powertrain standard components and features.
- The tool is being deployed in product and design groups.
- The system is deployed as a web portal and can be accessed by engineers and designers through thin web client.
- The system is populated with preferred components for engine programs reuse.
- The system has browse and attribute based search capabilities.
Current System - Key Features

- Lightweight web portal interface for both PC and UNIX platforms
- Attribute based search for components and features
- Component relationship based on key attribute match
- CAD model availability through Metaphase location information and web download of Ideas program files and universal files
- Session management for program assumptions for selecting standard components
Classification Groups – Reuse Potential

**Engineered Components**

**Custom Design/Low Reuse**
The Engineered Components will be based on individual PT program requirements to meet powertrain performance and fuel economy specification.

Low level of reuse expected/desired. But after reuse, the engineered components will migrate to Bookshelf components.

Population will increase as new programs will introduce and new components will be classified in this category.

**Reuse in Similar Application**
The functional specification and application will have the high chance of fulfilling the requirements across similar Power packs (i.e. Utility Components).

Medium level of reuse expected/desired.

Population will increase as new Engineered Components will move in this category.

**Bookshelf Components**

**Standard Components**

**Global Reuse**
The functional specification and application fulfills the requirements across many Power packs (examples include fasteners, valves, filters, connectors, etc.).

High level of reuse expected/desired.

Seldom update is required throughout the life cycle; limited revisions.

Allow highly detailed characteristics to facilitate attribute based-searching.

Population will increase as Bookshelf Components will move in to this category.
Future Trends in Part Proliferation
(After Part Commonization Deployment with Controlled Workflow)

- Engineered Components
- Bookshelf Components
- Standard Components

Current Practice

With Controlled Process and Tool

Future State

1st Year
2nd Year
3rd Year
4th Year

# of Released Components
Standard Components – An example

Hierarchy

- Fastener
  - Threaded Fastener
    - Bolt
    - Screw
    - Stud
  - Nut
  - Rivet
  - Spacer
  - ...

Characteristics/Attributes

- **Fastener**
  - Name
  - Type
  - Weight
  - Cost*
  - Supplier
  - Unit of Measure
  - CAD Master
  - Extra Description

- **Bolt**
  - Subtype
  - Thread Length
  - Diameter
  - Thread Pitch
  - Length
  - Head Dia
  - Head Type
  - ...

- **Rivet**
  - ...

- **Nut**
  - Subtype
  - Torque Range
  - Diameter
  - Thread Pitch
  - Height
  - ...

- **Spacer**
  - ...

Common/Inherited Attributes
Product Classification Process

Classify?

Manufacturing

Design

Product

Reuse Approval
SME Signoff
Attribute Def.

Component

- Part Number
- Description
- Maturity Status
- Tool Owner
- Plant Code
- Program Used By

Engineered Components
- Power Pack
  ---- Engine
  ------- Power Transmission
  ******** Crankshaft...

Bookshelf Components
- Idle Bypass Valve
  ---- Inlet area = ...
  ---- Opening shape = ...
  ---- Flow rate = ...

Standard Components
- Fastener
  ---- Threaded Fastener
  ------- Bolt
  ******** Length = ...
  ******** Diameter = ...
  ******** Thread Pitch = ...

EBOM

3D

NC

Bookshelf Components

Engineered Components

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EBOM

3D

NC
Product Classification – Guidelines

- All forward, current and past model, aftermarket, and manufacturing in-process part will be considered for classification
- All potential components will be reviewed by respective SME’s
- The classification levels (depth) will be created based on commodities. For ease of search, the number of levels will limit to maximum 4
- A workflow will be in placed for managing the classification and will be enforced in the entire life cycle of the development
- The product classification hierarchy will not intend to duplicate the eBOM structure or Referencer; instead, it will be used to group components with similar set of characteristics
- Classification attributes will be chosen based on product functional requirements and application
- The classification scheme will not uniquely define the component. It will facilitate search to a finite number of desired components
Classification Creator – A snapshot
(A tool to create/manage/integrate classification structures)
Classification Structure – Example in Teamcenter
Classification – Structure Creation Process

Classification Process Usage in Individual CBGs

- Std. Components
- Std. Resources
- Process Templates
- ...

Classification Creator

plmxml
plmxml
plmxml
plmxml

Classification Creator

Consolidated plmxml (CBG)
Classification – Structure Integration Process

Global Classification Consolidation Process

- plmxml (PT)
- plmxml (VO)
- plmxml (BODY)
- plmxml (Other CBGs)

Consolidation/Validation

- Regenerate Ids (if required)
- Sort Classification Structures
- Consolidate Structure
- Validate Name/Numbering
- Merge Dictionaries/LOVs
- Validate References

Global plmxml

Teamcenter
Powertrain Component Commonality and Reuse

Q & A