



new!

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PTC Product Focus

Introducing MPMLink (Manufacturing Process Management)

Manufacturing Process Management (MPM) is the process of defining and managing the manufacturing processes used to make parts, assemble final products, and perform inspections.

PTC's Manufacturing Process Management Solution, Windchill MPMLink, enables the manufacturing engineer to associatively transform the engineering BOM (eBOM) to the manufacturing BOM (mBOM), to manage libraries of manufacturing resources and standardized manufacturing capabilities, to define digital definitions of process plans with associative links to the mBOMs and manufacturing resources and to dynamically generate work instructions for the shop floor.

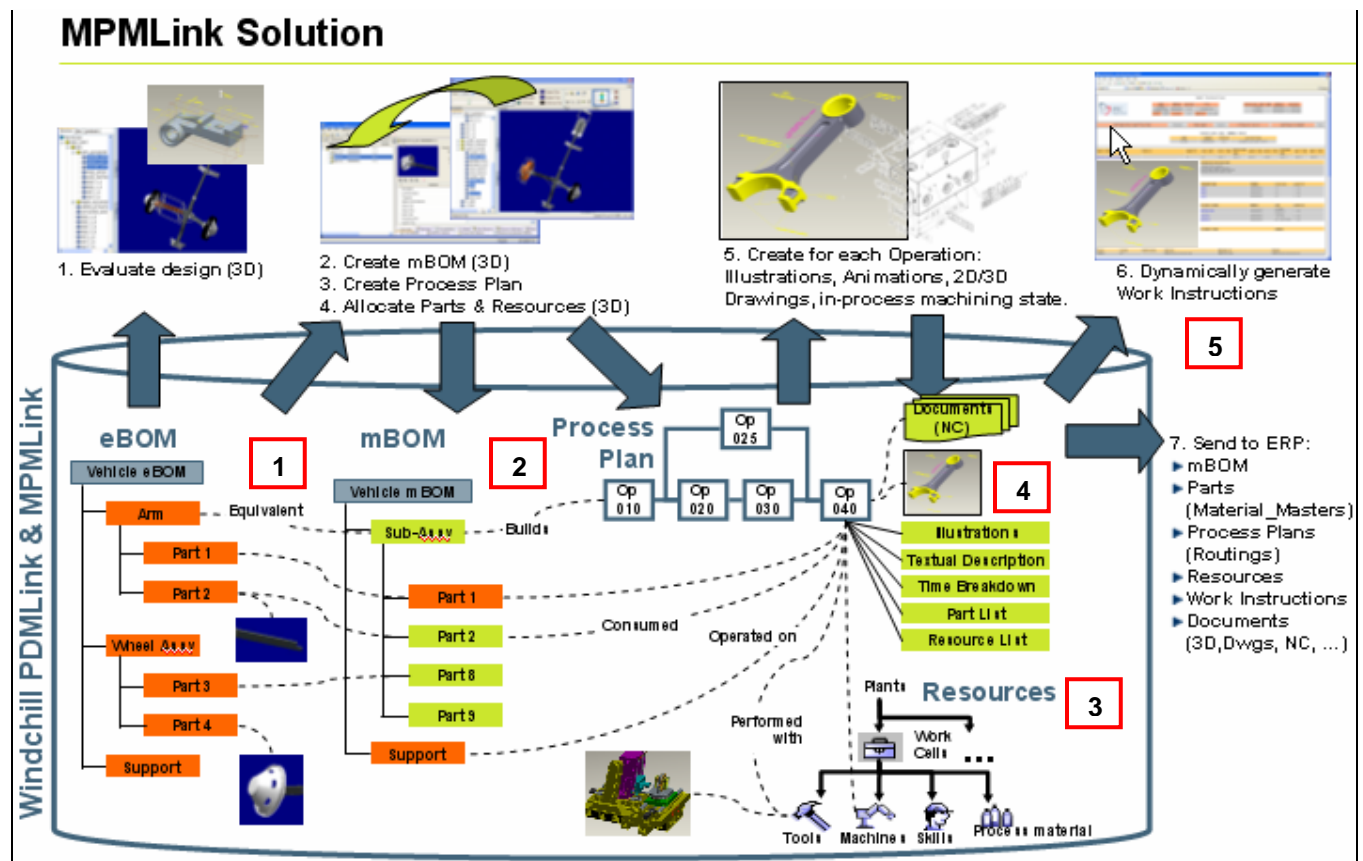
Keys Benefits of MPMLink

- Reduce time-to-market by enabling concurrent product and manufacturing process definition
- Enhance efficiency of manufacturing engineers by allowing them to digitally author and manage manufacturing process plans and the associated resources
- Lower the cost of changes by streamlining change impact identification and propagation as well as reducing the number of expensive late-stage changes
- Improve production ramp-up and productivity by using Windchill MPMLink to efficiently optimize manufacturing processes and dynamically generate 2D and 3D work instructions

- Improve product quality by reducing scrap and rework
- Lower Total Cost of Ownership by eliminating multiple legacy and MS Office-based solutions

MPMLink is an integral Windchill module and actually it's reusing some PDMLink functionality and it is reusing also the ProductView framework in Windchill, the key Windchill services like change management, document management, access control as well as ESI for integration to other systems.

The diagram below outlines a number of key concepts for MPMLink and a representative flow of manufacturing data to support an assembly manufacturing process. The key MPMLink concepts are highlighted with the diagram and are described in more detail in the following sections.



- 1** eBOM to mBOM Transformation
- 2** Manufacturing Process Plans
- 3** Manufacturing Resources
- 4** Manufacturing Capabilities and Documentation
- 5** Dynamically Generated Work Instructions

1 Associative eBOM-mBOM

MPMLink can associatively link mBOMs to the source engineering design information (eBOM), so that mBOMs always reflect engineering's current design. An eBOM can easily be transformed into multiple mBOMs while maintaining associativity using traceability links.

A number of visual indicators and visualization is used to validate part allocations, consumptions, engineering designs, mBOMs, eBOMs, and dynamically generated 3D models.

The screenshot displays the Product Structure Explorer interface. The main window shows a tree view of the mBOM for a Golf Cart. A red box highlights the mBOM structure, which includes the following items:

Name	Number	Version	Downstream...
mBOM Golf Cart	221	A.1 (Manufacturing)	✗
LEFT Wheel and Arm Assembly	225	A.1 (Manufacturing)	✓
Wheel and Axle Assembly	220	A.1 (Manufacturing)	⚠
AXLE_SLEEVE	GC000034	A.1 (Design)	✓
BEARING_AXLE	GC000033	A.1 (Manufacturing)	✓
HUB_CAP	GC000037	A.1 (Manufacturing)	✓
MFG ONLY PART	218	A.1 (Manufacturing)	✗
MFG ONLY WHEEL_AXLE	2005	A.1 (Manufacturing)	✓
TIRE	GC000036	A.1 (Manufacturing)	✓
WHEEL_HUB	GC000035	A.1 (Manufacturing)	✓

The right-hand pane shows the details for the selected 'Wheel and Axle Assembly' (Number 220). It displays a table of associated process plans:

Name	Number	Status	Version
Alternate WHEEL AND ARM ASSEMBLY	3122008	Work in progress	A.2
Alternate WHEEL AND ARM ASSEMBLY	3122008	Checked out	A.2
WHEEL AND ARM ASSEMBLY	312	Checked in	A.4

Red boxes highlight the mBOM table and the 'Associated Process Plans' table. The text 'Manufacturing Bill-of-Material' is overlaid on the mBOM table, and 'Associated Process Plans' is overlaid on the process plans table.

Manufacturing Bill – of - Material

2 Manufacturing Process Plans

A process plan is the detailed description of what needs to be done on the shop floor in order to produce, inspect, assemble, repair or maintain a given part or assembly.

Process plans contain the operations to be performed, the standard processes used to perform these operations, the sequence in which they must be done, the parts related to the operation, and the physical and human resources required to complete the operation. Included in a process plan are any document references or descriptions that could aid the worker, and a process plan can be used to evaluate time and cost requirements.

The screenshot displays the 'Process Plan Explorer' application. The main window shows the details of an alternate process plan for 'WHEEL AND ARM ASSEMBLY, 3122008 A.2'. The interface is divided into several sections:

- Left Panel:** A tree view showing the process plan structure. The root is 'Alternate WHEEL AND ARM ASSEMBLY, 3122008'. It contains five sub-operations: '10 ASSEMBLE WHEELS', '15 ASSEMBLE AXLE', '20 ASSEMBLE ARMS', '50 FINAL INSPECTION', and '80 Assemble new components'.
- Operations Table:** A table with columns: Operation Label, name, description, number, Version, State, Work Center, Process, Setup Time, and Labor Time. The data is as follows:

Operation Label	name	description	number	Version	State	Work Center	Process	Setup Time	Labor Time
10	ASSEMBLE WHEELS	Assemble Wheels	0000000126	A	In Work	Station 01	M2001	5.0 s	10.0 s
15	ASSEMBLE AXLE	Assemble Axle	0000000125	A	In Work	Station 01	M2001	10.0 s	20.0 s
20	ASSEMBLE ARMS	Assemble Arms	0000000127	A	In Work	Station 01	M2001	5.0 s	12.0 s
50	FINAL INSPECTION	Perform Final inspection	0000000128	A	In Work	Inspection Work Ce...	Visual Inspection Pro...	5.0 s	13.0 s
80	Assemble new comp...	Assemble new components	0000000129	A	In Work	Welding Work Center	P1001	10.0 s	
- Sequences Table:** A table with columns: Name, Number, Version, State, Type, Context Name, Operations Holder, Branching Operation, Branching Constraint, Br. Lag, and Return C. This table is currently empty.
- Bottom Panel:** A navigation bar with tabs for Information, Uses, Documentation, Related, Part Allocations, Resource Allocations, and Plant.

Red annotations highlight the 'Process Plan' label in the left panel and the 'Process Plan Operations' table.

Manufacturing Process Plan with Operations

3 Manufacturing Resources

Resources are the entities, such as personnel or equipment, which perform production activities. Manufacturing Resources are the resources needed on the shop floor during the production, maintenance, inspection or repair of parts. They normally have cost, time or technical constraints associated to them. Resources may be physical (work centers, tooling, and process materials) or human (skill).

- **Work Centers** are the physical or logical production areas used as a unit for scheduling and routing operations. There is only one work center per operation. Types of work center include line, cell, workstations, work units.
- **Tooling** represents the tools, fixtures and other physical devices required in addition to a work center to perform a production run. Tooling can be designed or purchased. Tooling may be consumed during operations or remain available for a certain number of production runs. Tooling does not appear in the product bill of material and is not part of the final product. However, it can be a product by itself and be required to be delivered as an end item within a contract, program or project.
- **Process Materials** are orderable items, composed of a given material, which are required to perform a given operation. Process materials do not appear in the BOM for the end item, and are typically consumed during the manufacturing process. Typical examples are paint, glue, grease, etc.
- **Skills** represent the ability of a human to perform a certain task up to a certain level of complexity

Manufacturing Resource Explorer [1] : Edit

File Edit View Selected Help

Edit :

Name	Number	Version
PlantB - Boston	111111115	A.1 (Manufacturing)
Process Material	111111116	A.2 (Manufacturing)
Cleaner	111111122	A.1 (Manufacturing)
Coolant2	111111120	A.2 (Manufacturing)
Welding_gas	111111121	A.3 (Manufacturing)
Sector 01 - Final Assembly	111111118	A.4 (Manufacturing)
Line 01	111111142	A.2 (Manufacturing)
Line B	111111143	A.1 (Manufacturing)
Line C	111111144	A.2 (Manufacturing)
Station 01	111111145	A.3 (Manufacturing)
Station 02	111111146	A.1 (Manufacturing)
Station 03	111111147	A.1 (Manufacturing)
Station 04	111111148	A.1 (Manufacturing)
Station 05	111111149	A.1 (Manufacturing)
Sector 02 - Assembly	111111119	A.2 (Manufacturing)
Alternate Welding Work Ce...	111111182	A.3 (Manufacturing)
Tooling	111111127	A.2 (Manufacturing)
Fixture	111111129	A.3 (Manufacturing)
Jig	111111128	A.2 (Manufacturing)
Tool	111111131	A.1 (Manufacturing)
Welding Gun	111111130	A.1 (Manufacturing)
Welding Cell	111111101	A.2 (Manufacturing)
Welding Work Center	111111139	A.5 (Manufacturing)
Work Center 1	111111140	B.2 (Manufacturing)
Work Center 2	111111141	A.1 (Manufacturing)
Sector 03 - Fabrication	111111110	A.2 (Manufacturing)
Skills	111111117	A.2 (Manufacturing)
Assembly Junior	111111133	A.2 (Manufacturing)
Assembly Senior	111111134	A.1 (Manufacturing)

Process Materials

Work Centers

Tooling

Skills

Details of

Context Name: GOLF_CART

Name: Welding Work Center
 Number: 111111139
 Version: A.5 (Manufacturing)
 State: In Work
 Status: Checked in
 Category: Work Unit

Attribute	Value
Description	Welding Work Center
*External?	False
Usage	All
Precision	
Working Volume X	
Working Volume Y	
Working Volume Z	
Dimension X	
Dimension Y	
Dimension Z	

Information Uses Documentation Compatibility Equivalence Links View Plant

Java Applet Window

4 Standard Manufacturing Capabilities

A *manufacturing capability* is a description of what a manufacturing company is able to produce, along with the documents and standard procedures that can be used in production to achieve that capability. Manufacturing capabilities list standardized and approved ways of producing a specific result with varied technical means and facilitate the re-use of process planning information.

The screenshot shows the 'Manufacturing Standards Explorer' application. The left pane displays a tree view of manufacturing capabilities. A red box highlights a section of the tree, and the text 'Standard Manufacturing Process' is overlaid in red. The right pane shows the details for process P2003, including a 'Related Process Table' with one entry.

Name	Number	Version
Boston Mfg Capabilities	0000000001	A.1
Drilling Processes	0000000023	A.1
Inspection	0000000026	A.1
Inspection with Gages	0000000027	A.1
Visual Inspection	0000000025	A.1
X-Ray	0000000028	A.1
Manual Assembly	0000000024	A.1
Milling Processes	0000000022	A.1
P1001	0000000001	A.2
P1002	0000000002	A.2
Welding Processes	0000000021	A.3
P1001	0000000001	A.2
P1002	0000000002	A.2
P2003	0000000024	A.3
STD_PP for Welding Assemblies	103	A.2
Clean Components	0000000049	A.2
Inspect Components	0000000047	A.2
Inspect welded assembly	0000000050	A.2
Position Components in Jig and ...	0000000048	A.2

name	number
STD Welding Process Plan	310

Manufacturing Capabilities

5 Dynamically Generated Work Instructions

A work instruction is a dynamically generated HTML document that combines process plans information (sequences, operation, part allocation, resource allocation, time, etc.) and all related documents such as drawings, images and 3D sessions with annotations.

The work instruction is the main reference document for the production operator to understand what exactly needs to be done in production. It usually shows the information for one operation at a time.

Process plans are composed of sequences of operations

Work Instructions are dynamically generated documents

ASSEMBLY PROCESS SHEET
WORK INSTRUCTION: Operation 035
OPERATION NUMBER : 035 STATUS : IN WORK PRODUCTS : M80M Challenger 650

WORK CENTER		TIME BREAKDOWN	
WORK CENTER	DESCRIPTION	SETUP TIME	REACT TIME

VISUAL REPRESENTATION

PART LIST

ITEM NO.	DESCRIPTION	QTY	UNIT
17549	A. HOSE, HYDRAULIC	1	L
17672	A. BELT, V	1	L
20045	A. SHEAVE, DRIVE	1	L
30375	A. HOSE, HYDRAULIC	1	L
31362	A. SUPPORT, MOTOR	1	L
44624	A. PLATE, FLAT	1	L
49440	A. 3/8-16 x 1 1/2A HFS GRD	1	L
44175	A. 1/2-20 HW GR2	1	L
40627	A. 3/8-16 NYLON GRUS	1	L
44443	A. 6/32-18 NYLON	1	L
44262	A. 1/2 HARDENED FLASH WASHER	1	L
44315	A. WASHER, 3/8 HARDENED FLASH	1	L

RESOURCE LIST

RES ID	DESCRIPTION	UNIT

CHANGE MANAGEMENT HISTORY

NO.	CREATOR	CREATION DATE	ALL. BY	PRINTED DATE
001	PTC	05-10-02		05-10-18

Dynamically Generated Work Instructions

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Tips of the Month

Datum Graphs and Sketcher Relations

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Tips of the Month

Creating & Managing Manufacturing Process Plans

A *process plan* is the detailed description of what needs to be done on the shop floor in order to produce, inspect, assemble, repair or maintain a given part or assembly.

Process plans contain the operations to be performed, the standard processes used to perform these operations, the sequence in which they must be done, the parts related to the operation, and the physical and human resources required to complete the operation. Included in a process plan are any document references or descriptions that could aid the worker, and a process plan can be used to evaluate time and cost requirements.

There are three ways to create a process plan:

- Using the **Manufacturing Product Structure Explorer**, open up a part and create a process plan that is automatically associated with it.
- Using the **Process Plan Explorer**, create a standalone process plan that is not linked to any part. Parts can then be linked to this process plan at later dates.
- Duplicate an existing process plan.

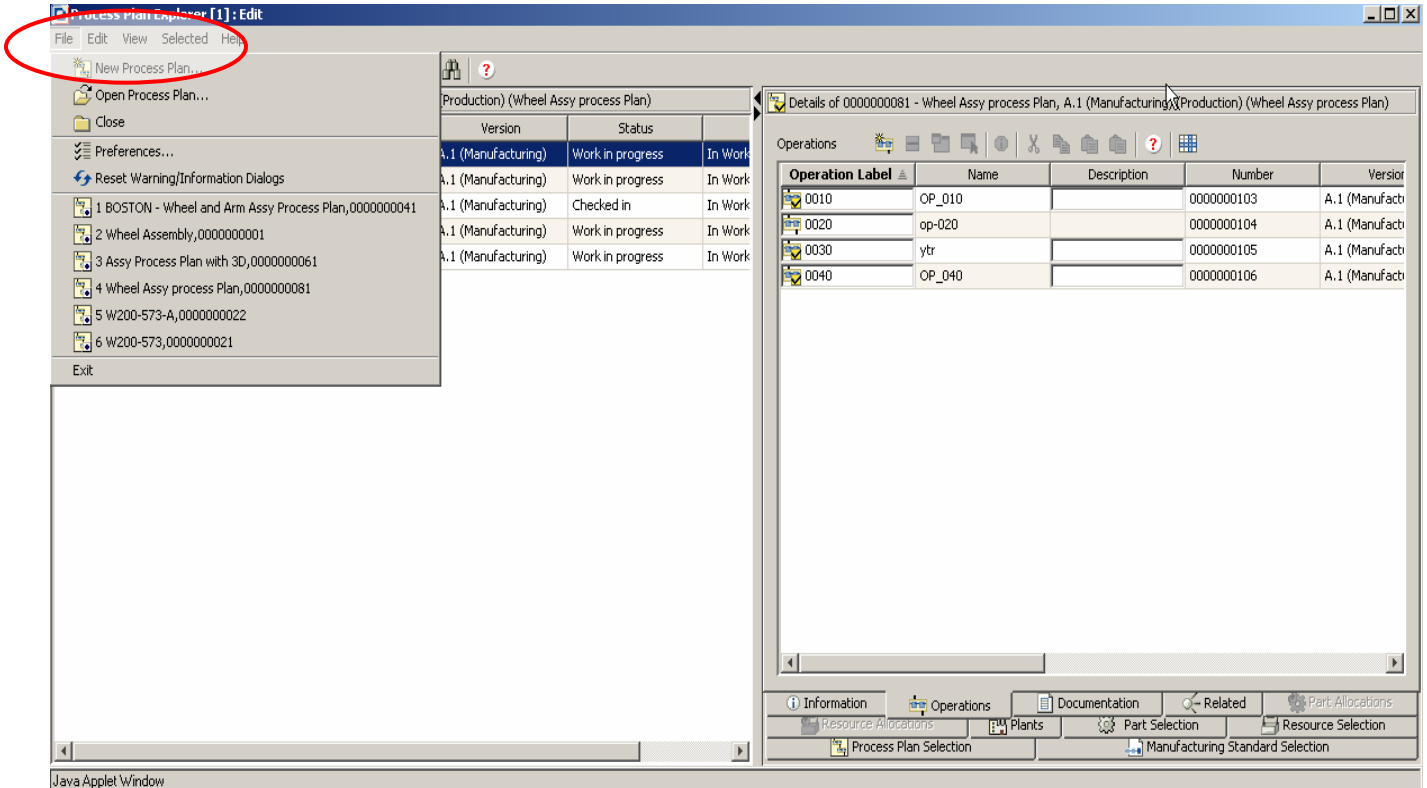
The following types of process plans are available:

- **Production:** Use when documenting instructions that describe how to produce parts.
- **Quality:** Use when documenting instructions that describe how to inspect parts for quality.
- **Maintenance:** Use when documenting instructions that describe how to maintain products.
- **Repair:** Use when documenting instructions that describe how to service and repair products.

The following example highlights the steps in creating a Manufacturing Process Plan utilizing the Process Plan Create Wizard.

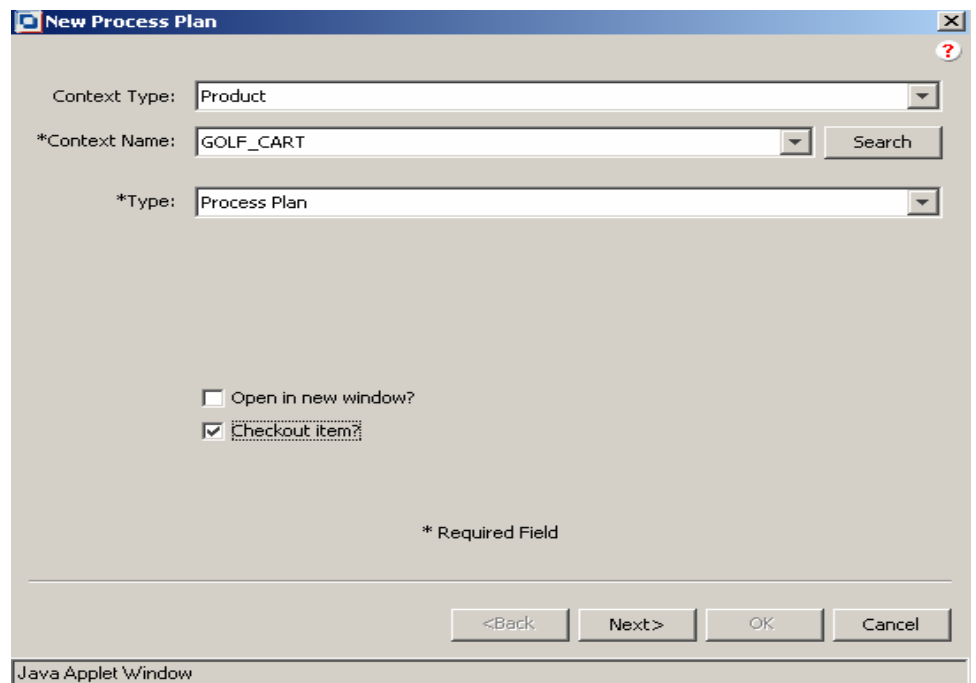
Step 1. Create New Process Plan Selection

File New → New Process Plan : Creates a new process plan, which can be opened in a new window, or replace the current explorer content.



Step 2. Define the Process Plan Context: Type and Name (Product or Library)

The second step of the Process Plan create Wizard allows for the selection of the Context for the Plan, either a Library or Product and the Name of the Context. The type of Process Plan needs to be selected. The user has the option to check-out the Process Plan upon creation and open the Plan in a new window.



Step 3: Define Process Details: (Category, Name, Number, View, Location, Unit, Trace, Standard)

The third step in the Process Plan create Wizard is where more specific information is defined.

Category: defines the type of Process Plan (Production, Quality, Maintenance, or Repair)

Name: Process Plan Name

Number: Process Plan Number (can be auto generated)

View: View Filter (i.e. Engineering, Manufacturing, etc)

Unit: Unit-Of-Measure (i.e. Each, As-Needed, etc.)

Default Trace Code: Define Trace Code (Lot, Lot/Serial, Serial, Untraced)

Standard: Is this Process Plan part of a Manufacturing Standard (True or False)

The screenshot shows a 'New Process Plan' dialog box with the following fields and values:

- *Category: Production
- *Name: Demo PP
- Number: Generated
- View: Manufacturing
- *Location: /GOLF_CART (with a 'Browse...' button)
- *Unit: each
- *Default Trace Code: untraced
- *Standard: false

A legend below the fields states: * Required Field

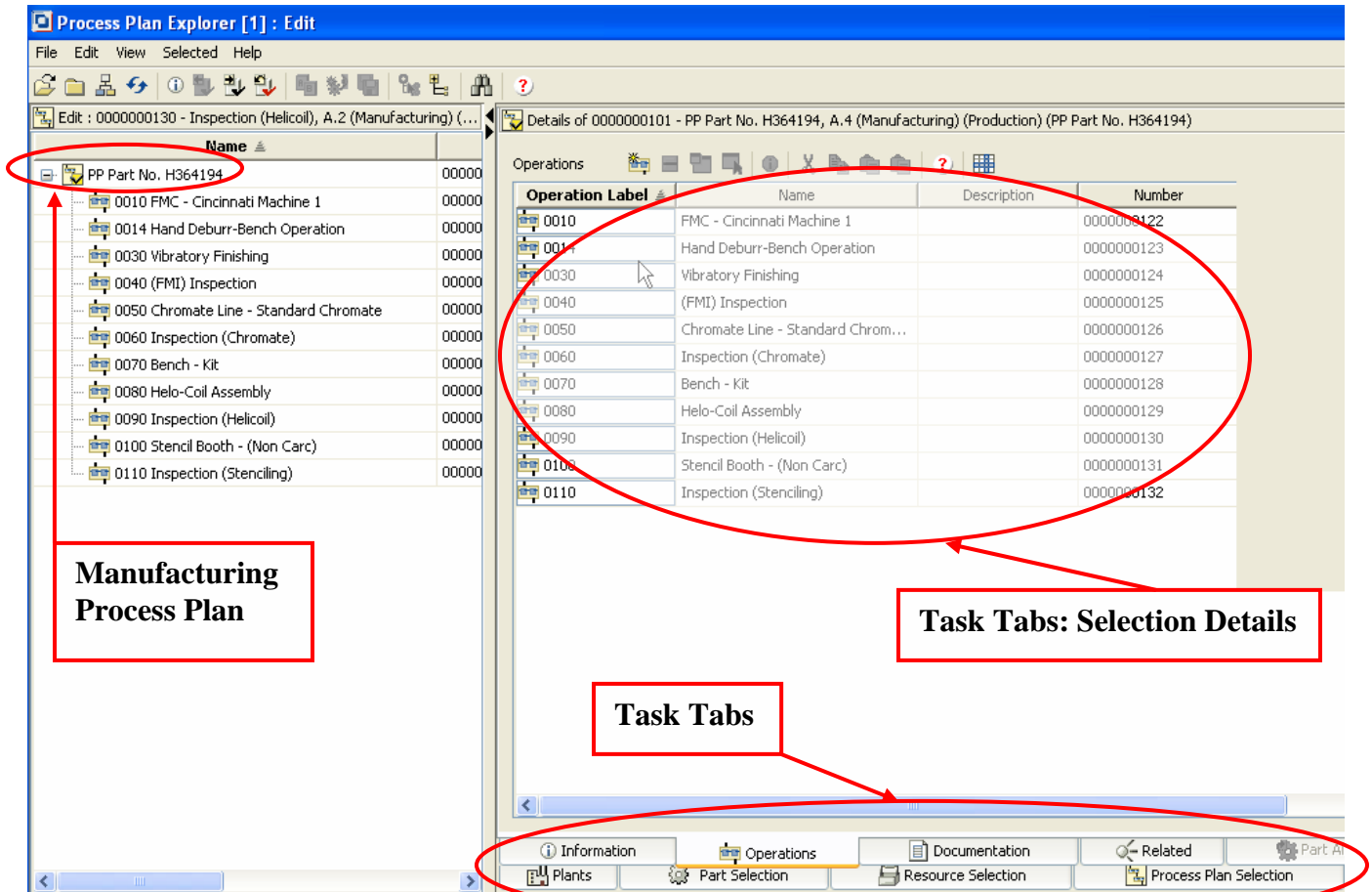
At the bottom of the dialog are four buttons: <Back, Next>, OK, and Cancel.

The window title is 'New Process Plan' and the bottom status bar indicates it is a 'Java Applet Window'.

Upon creation of the Manufacturing Process Plan additional information can be associated to the Plan. The following section highlights the addition information that can be added to the Process Plan via the Tab Selections on the Process Plan Explorer.

The **Process Plan Explorer** consists of a dual-pane panel: the left pane is the structure pane, and displays the process plan in a tree table, the right pane displays information about the object selected in the structure pane. The top object of the tree lists the selected Process Plan.

Process Plan Explorer



The task tabs on the right pane of the **Process Plan Explorer** display information pertaining to the process plan selected in the structure pane on the left. Each Manufacturing Process Plan consists of:

- Information tab:** view or change the attributes of an object selected in the structure pane
- Operations tab:** view the operations that make up the selected object
- Documentation tab:** view, add, change, or remove document associations of the object selected in the structure pane on the left
- Related tab:** view, add, change, or remove manufacturing capabilities, standard procedure and constrained operations associations from the operation selected in the structure pane on the left
- Plants tab:** associate manufacturing facilities with process plan objects
- Part Selection tab:** used to select specific parts for re-use in the current process plan, or operation
- Manufacturing Standard Selection tab:** select specific manufacturing standards for re-use in the current process plan, or to associate with a resource
- Resource Selection tab:** is used select specific resources for re-use in the current process plan
- Resource tab:** view, add, change, or remove resource associations to the operation selected in the structure pane on the left
- Part Allocation tab:** view, add, change, or remove allocated parts, and operated on parts to the operation selected in the structure pane on the left.

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Announcements

Educational Resource Library

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 - Simulation/Analysis
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 - Design Collaboration
- Windchill PDMLink
- Windchill ProjectLink
- Pro/INTRALINK
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[Tips & Techniques: Work Smarter Not Harder!](#)

E-PROFILES IS HERE!!

We have been eagerly anticipating the debut of the new electronic version of Profiles Magazine and now it is here! This new web site will supplement the print edition of the magazine and will

provide new useful features not feasible with paper media. e-Profiles will provide you with 24x7, worldwide access to key information previously available exclusively in the print version. "Tips & Tricks," a popular feature pioneered by Pro/USER, has also moved to the web and will be expanded as the site matures.

Please take a few minutes to check out this new web site. We don't think you will be disappointed.

<http://profilesmagazine.com/>

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Upcoming Events & Training Class Schedules

Upcoming, 2007 Your local Pro/Engineer User Groups
<http://www.ptcuser.org/rugs/>

June 1 – 4, 2008 Long Beach, CA USA
PTC/USER World Event
<http://www.ptcuser.org/>

Events

Our seminars and conferences seek to provide you with relevant information regarding product development trends in your industry as well as innovative software learning experiences. Think of them as a constructive day off where you can share experiences and swap ideas with your peers.

If you can't manage to get away, we'll bring it to you. Check back often for regularly scheduled live webcast events.

[You're Invited to Attend...](#)

Please visit the [PTC Education Services](#) website for the latest training information including course descriptions, schedules, locations, and pricing.

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<http://www.ptc.com/services/edserv/index.htm>

Live Instructor-Lead Virtual PTC Training Courses

Virtual Classrooms provide interactive learning with a trained PTC instructor in convenient and manageable sessions that last approximately 4 hours over a series of days. It's easy to join a class right from your desk using a phone or voice-over IP technology.

Sessions are performed just like a traditional ILT (including interactive exercises where you and the instructor can work on lab exercises together) and feature some of our most popular ILT courses. These sessions cover the exact same material as the traditional ILT in-center courses. Also look for some of our most frequently requested mini-topics delivered in the same format that are only an hour - two hours in duration.

If you have any questions about these sessions or would like to see getting other courses, not on this list, on the schedule please feel free to contact me for more details. They are a great way to bring training to you without you having to worry about location or being out from work for long stretches.

You can register for these sessions just as you would for any normal ILT class either by:

1. calling order admin at <http://www.ptc.com/services/edserv/training/registra.htm> or
2. you can go to PTC University directly at <http://www.ptc.com/learning> and submit a registration request directly. All you have to do is search the catalog by typing in “virtual” in the search field and you will see a listing.

PTC

Note: This PTC E-Newsletter will continue to be used for the following:

- 1) Inform you on events related to PTC products (user groups, conferences, training schedules, etc.)
- 2) Educate you on solutions that are available at PTC
- 3) Tips & Techniques using PTC Products

Note: These messages are compiled in the local PTC office and will be distributed via e-mail.

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