Parametric Manufacturing

Presented by:
Configura, maker of CET Designer
Presenter

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- 1996
- Grand Rapids, MI 2006
- Worked with various manufacturers from Material Handling to Office Furniture industries
Overview

- Define Parametric Manufacturing and the Why
- Barriers to Parametric Manufacturing
- Softwares used in the manufacturing process
- Introduction to Parametric Graphical Configuration (PGC)
- Results of PGC and Parametric Manufacturing working together
- What should you do next?
Parametric Manufacturing

An item that can be priced and manufactured using parts and pieces, and can be described using formulas and code.
Barriers in the process
Barriers to Parametric Manufacturing

• Legacy
• Need better lead times
• Manufacturing/Resource Planning
• MRP/ERP can’t handle that many variants
• We outsource manufacturing & do assembly
• Too slow/costly having R&D engineers draw parametric drawings/Machine Coding
• Too complicated to price and sell (Excel from hell)
• CNC Operator should not have to type in variables (room for errors)
Types of Manufacturing

• Joining
• Machining
• Shearing and Forming
• Casting and Molding
• 3D Printing
From Wikipedia:

“Numerical control (NC) (also computer numerical control (CNC)) is the automated control of machining tools (drills, boring tools, lathes) by means of a computer. An NC machine alters a blank piece of material (metal, plastic, wood, ceramic, or composite) to meet precise specifications by following programmed instructions and without a manual operator.”
CNC Machine Coding

• CNC Controller differences
• Part Program (G-Code)
• Often Parameterizable
• Often Macro Enabled

%  
O100  
G00 G40 G49 G20 G90  
N05 M10  
N10 M05  
N15 G91 G28 Z0  
N20 G90  
N25 T1 M06  
N30 G00 Z.1  
N35 G00 X2.5 Y2.5  
N40 G01 Z-.25 F200  
N45 G01 X5 Y5  
N50 G00 Z.1  
N55 G28 X0 Y0  
N60 M05  
N65 M45  
%
CAD/CAM Tools

• Models can be Parametric
• Graphics based
• Generate outputs for CNC machines
MRP/ERP

• Material Requirements planning (MRP)
• Material Resource Planning (MRP II)
• Enterprise Resource Planning (ERP)

MRP
- Master Production Scheduling
- Bill Of Materials
- Inventory Tracking

1970s

MRP II
- Machine Capacity Scheduling
- Demand Forecasting
- Quality Assurance
- General Accounting

1980s

ERP
- Financial Management
- CRM & Marketing Automation
- Supply Chain Management
- Material Management
- Procurement Management
- Order Management
And more

1990s

FIND YOUR WOW
Product Configurators

• Takes models with Features and Options and generates a Bill of Materials
• May be part of ERP system
• Variant Configuration

1970s 1980s 1990s
Barrier

**SKU/Part/Article/Material Numbers**

+ Simple
+ Easy lookup in Database – may be multi-level in MRP/ERP
- Non-decodable

191.556.24
Barrier

**Model Numbers**

- Model base
- Option codes
- Parameter codes
- Pricing on the Model Number
- TARA-48G2-LJSFJG4N
Barrier

The Part & Model Number Monster

Market Pressure for continuous parametric variation
• Discretification (making continuous data discrete)

Make more part numbers to fit all needs?
Complexity:
• \( n = D1(a) \times D2(b) \times D3(c) \ldots \)
• \#widths \times \#depths \times \#material1 \times \#material2 \ldots \)
• Rigid – can never cope with custom shape modification
**Barrier**

**CPQ – Configuration Engines**

**Positives:**
- Model Number
- Features and Options
- Constraint Rules
- Pricing Rules – Configure Price Quote (CPQ)
- Often links directly to ERP/MRP

**Negatives:**
- Still not handling Custom Shapes
- Product Configuration, no space-planning
Parametric Graphical Configuration (PGC)

Simplifies complex products using graphics and parameters.
Parametric Graphical Configuration (PGC)

- Configuration Engine +
- Cad drawings 2D and 3D
- Project wide Configuration and Rules
- Ability to create/send data in any format
- Sales to Manufacturing with less/no middle hands

![Diagram of a product or system]
Parametric Manufacturing
High Level View
Parametric Manufacturing with PGC

- Reducing/Eliminating Specials
- Reallocate talent to higher skilled tasks
- Removing Pricelists as you know it
- Removing Excel Sheets
- Better customer experience
- Reducing lead time in the Sales Process
Where do I start?

- Audit your processes from point of sale to installation
- Engage in Data mapping
  - Determine your barriers
  - Understand the software you use and their capabilities
- Start with calculating price on Parametric Products
Fully Parametric is Inevitable

- Consequence of Industrial Revolution
- Consequence of Information Age
- Us being Humans
For More Information

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