

Nathan Hartman, Ed.D.

# MODEL-BASED DEFINITION ACROSS THE LIFECYCLE

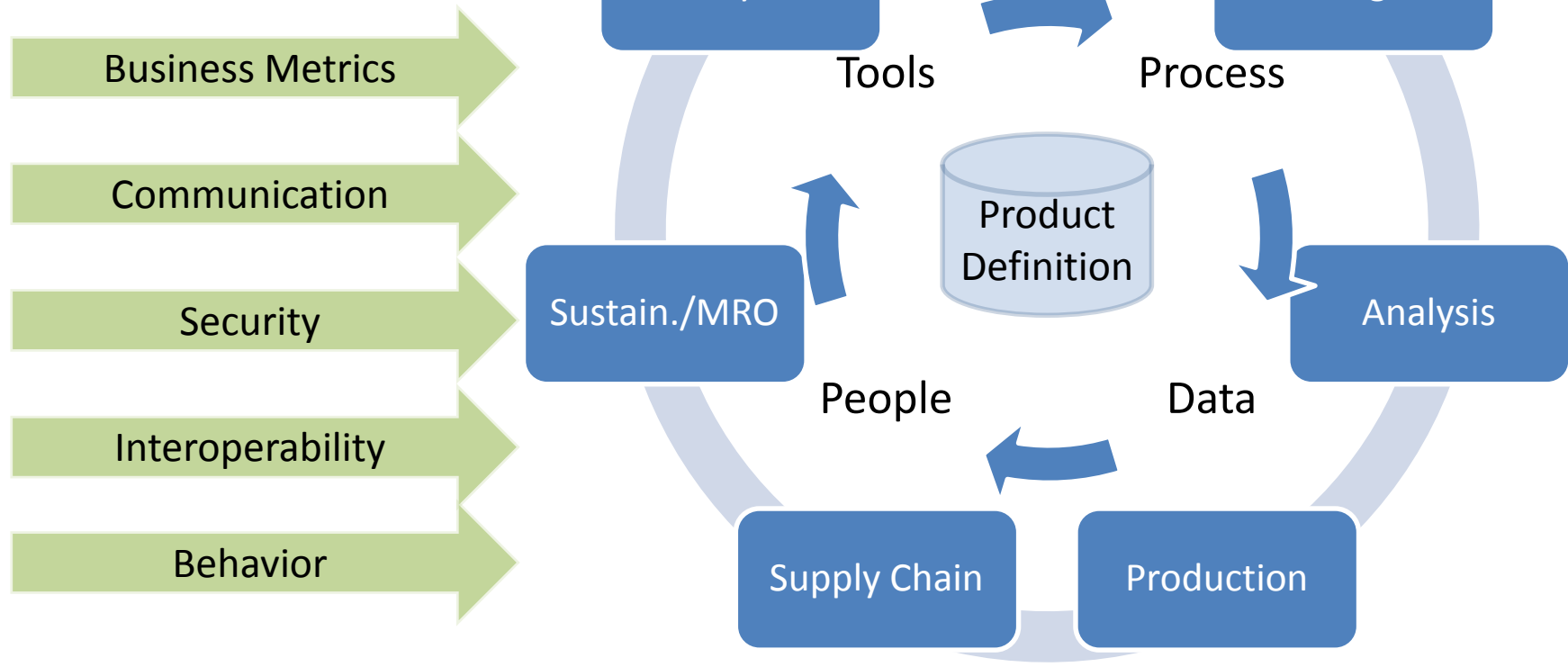
# Major topics

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- What is PLM?
- Collaboration
- MBD/information model/interfaces (human and machine)
- MBE becoming a business environment (merger with ERP and analytics)
- Managing attributes, not files
- Supply network integration/need model-based processes
- Ongoing challenges

# What is PLM?

The digital product definition forms the core of how product and process information is moved through an organization.



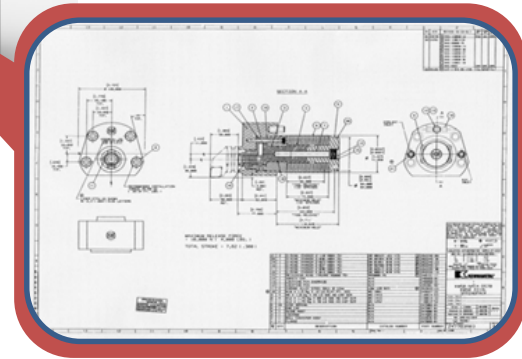
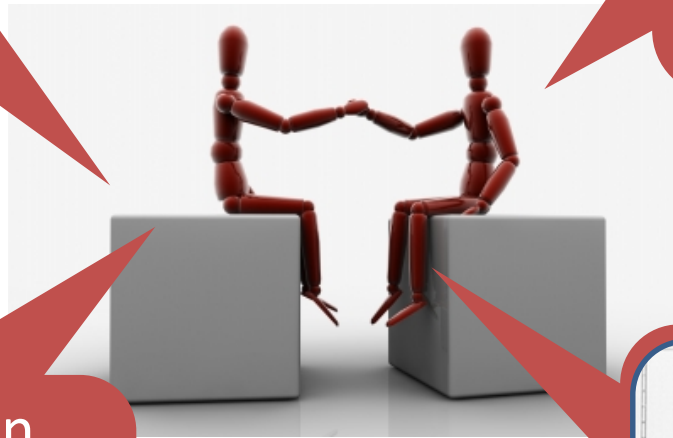
# The collaboration journey...

Yesterday

Communications  
often in serial  
fashion

You trusted the  
data because you  
trusted the person  
that generated  
the data

Collaboration  
meant face-to-  
face  
communication



# The collaboration journey...

Tomorrow

The **3D digital definition** becomes the *conduit* in a standards-based communication process.

The product *model* is the basis for a **secure, authoritative** source of product definition.

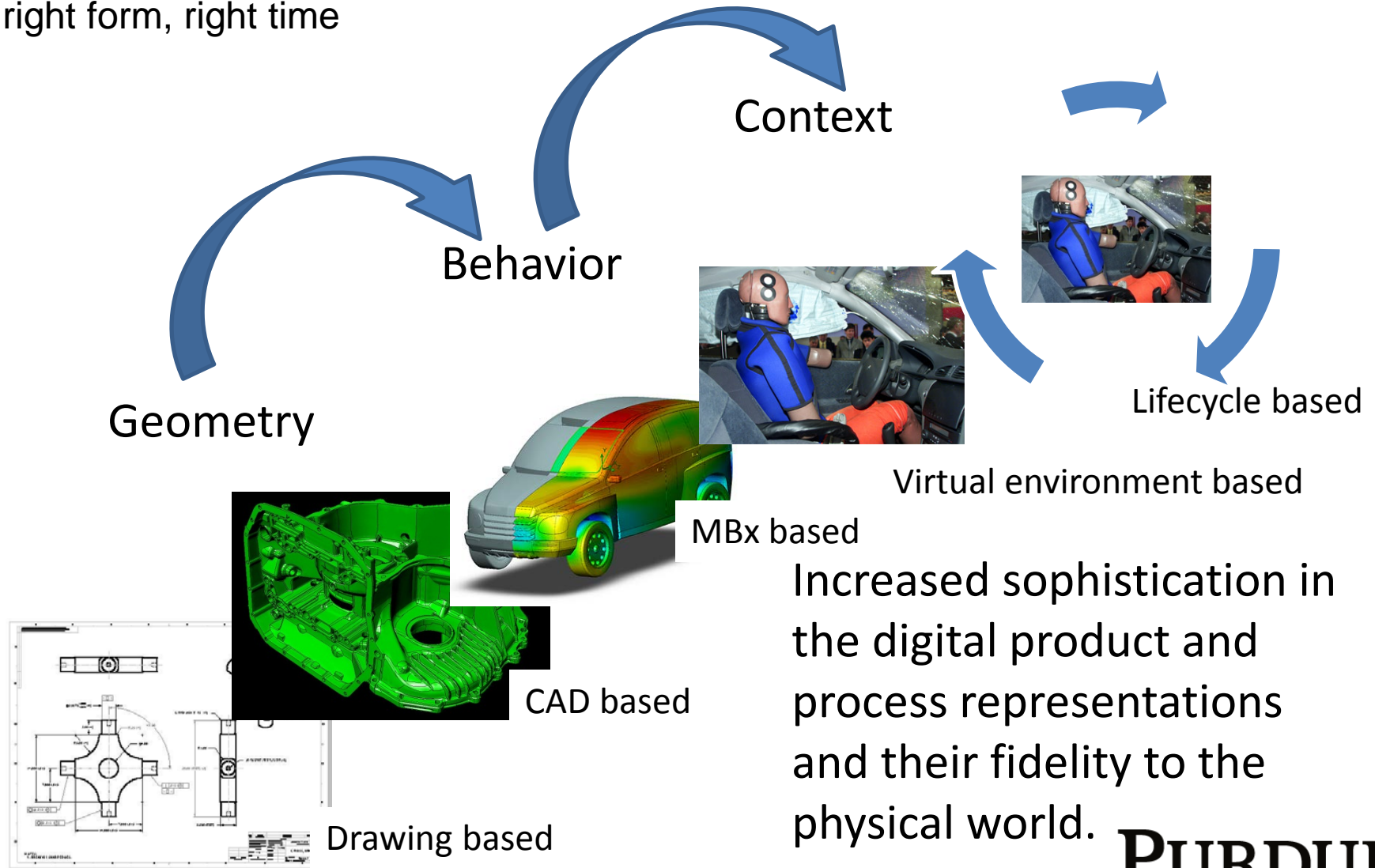


You come to *trust the process* that generates product data (because the person may be unknown).



# Evolution of model-based representations

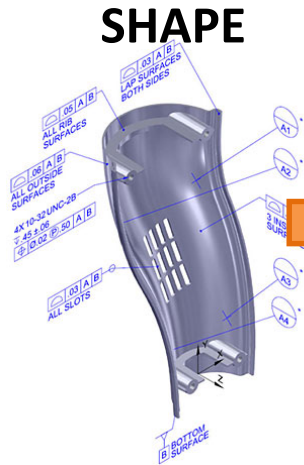
An exercise in information flow: right place, right form, right time



Increased sophistication in the digital product and process representations and their fidelity to the physical world.

# The communications spectrum...

A complete MBD supports lifecycle communication

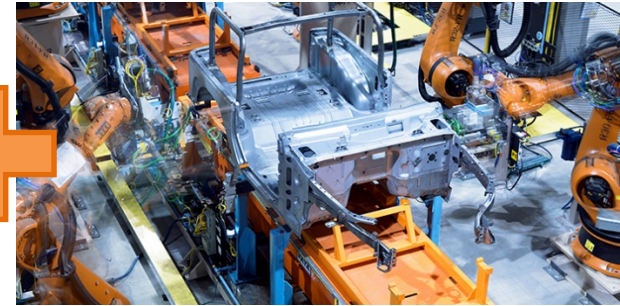


## BEHAVIOR

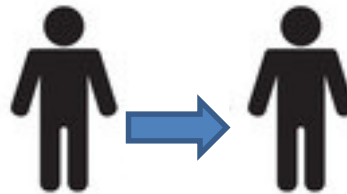
3.

Property	Test Standard DIN/ON EN ISO	corr.to ASTM	Unit	Value	Testing Frequency
Nominal Thickness			mm	78 100 98 196	
			mm	2.0 2.5 3.0 5.0	
			%	+10/-5 +10/-5 +10/-5	every hour
Density (Black)	DIN EN ISO 14632	D 5994	g/cm3	≥ 0.94	per production run 1)
Density (base/coloured)	ISO 1183	D792	g/cm3	≥ 0.931/935	
Melt Flow Rate (190°/5kg)	ISO 1183 Cond T	D 1238 Cond P	g/10 min	≤ 3 ≤ 3 ≤ 3 ≤ 3	per production run 1)
	(190/2, 16kg)	D 1238 Cond E		≤ 1 ≤ 1 ≤ 1 ≤ 1	
Heat Reversion (110°C/1, 5h)	DIN EN ISO 14632	D 1204 modified	%	≤ 3 ≤ 3 ≤ 3 ≤ 2	per production run 1)
Tensile Stress at Yield	DIN EN ISO 527	D 6693	MPa (PSI)	≥ 15 ≥ 15 ≥ 15 ≥ 15 2,200 2,200 2,200 2,200	per production run 1)
Elongated at Yield	DIN EN ISO 527	D 6693	%	≥ 9 ≥ 9 ≥ 9 ≥ 9	per production run 1)
Elongated at Break	DIN EN ISO 527	D 6693	%	≥ 300 ≥ 300 ≥ 300 ≥ 300	per production run 1)
Instrumented Puncture Test (Penetration Test)	ON EN ISO 6603-2	D 4833	N (lbs)	≥ 1500 ≥ 1800 ≥ 2000 ≥ 2500 ≥ 537 ≥ 625 ≥ 750 ≥ 1250	Approval Testing

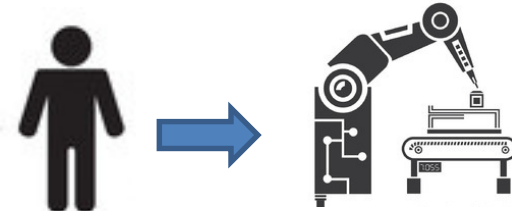
## CONTEXT



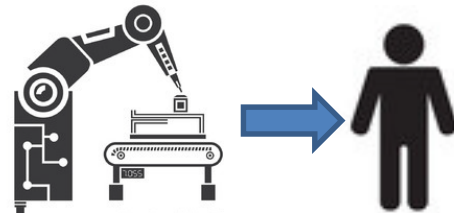
### HUMAN TO HUMAN



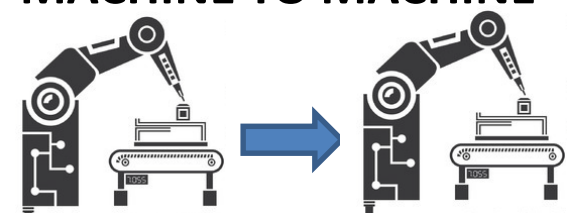
### HUMAN TO MACHINE



### MACHINE TO HUMAN



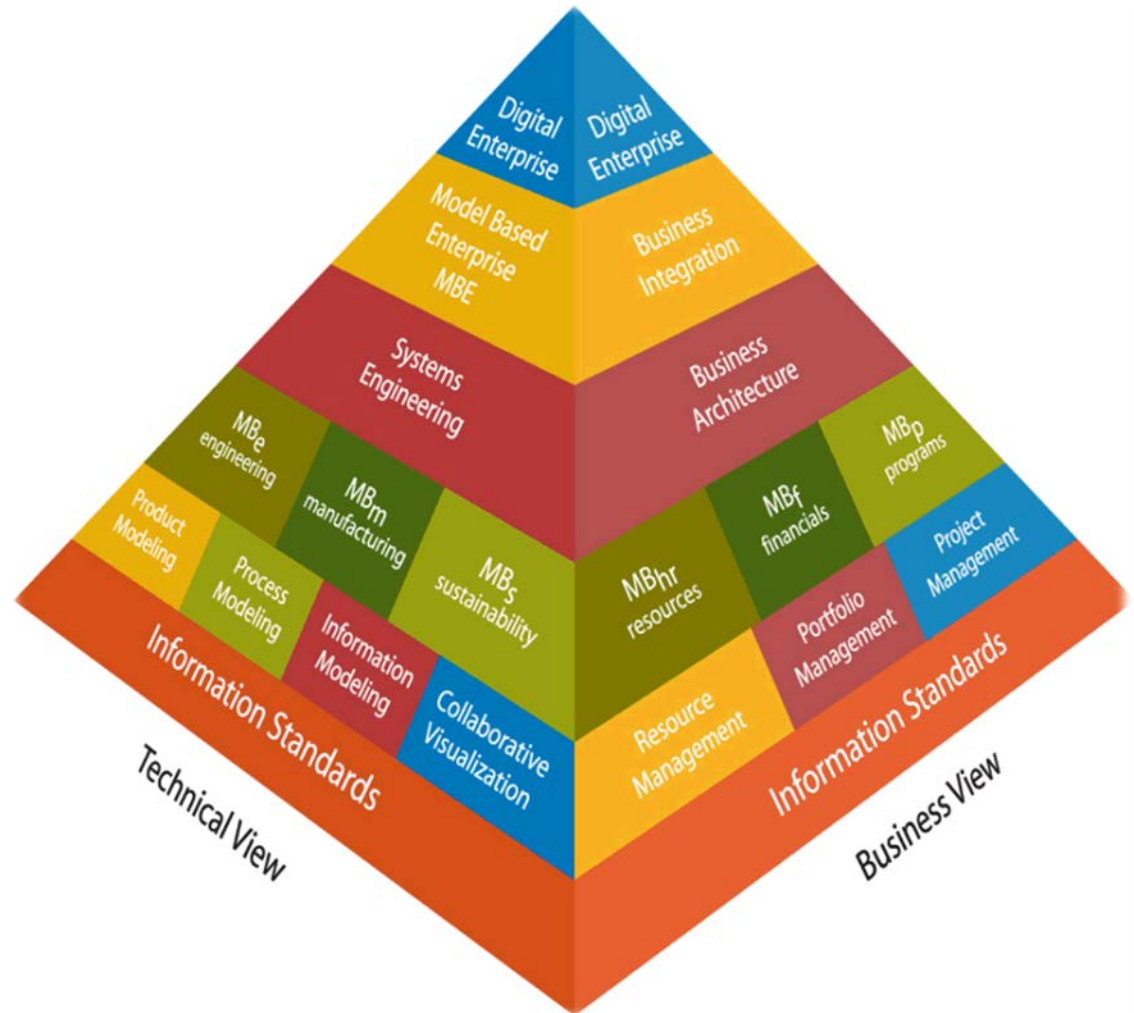
### MACHINE TO MACHINE



# MBD and the digital enterprise

## Making PLM a business platform

- The merger and sharing of data between historical PDM and ERP systems to make a next-generation PLM platform.
- Real-time intelligence to deliver product data in context.
- Ontologies that drive product data interoperability that include behavior and context, as well as shape definition.
- A holistic model-based definition that can accurately and dynamically carry non-engineering attributes.
- Understanding the impacts of product data as a form of intellectual “currency” in the sociotechnical system.





# Moving away from files....

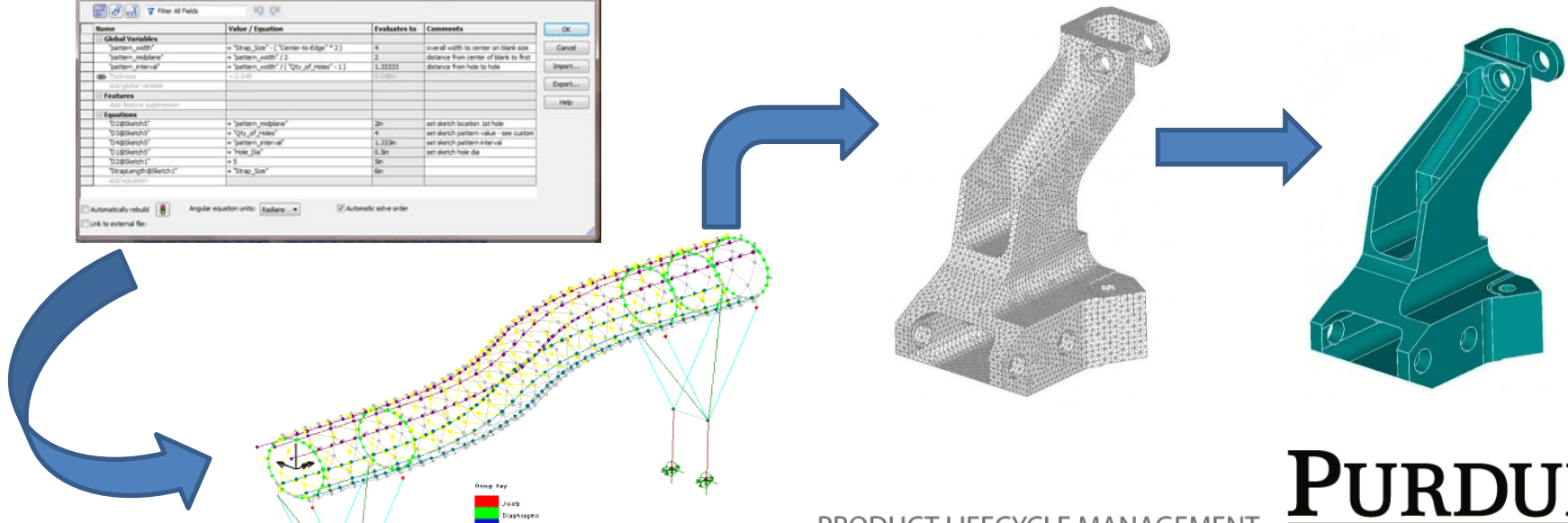
Proprietary formats lead to interoperability and archival challenges



Equations, Global Variables, and Dimensions

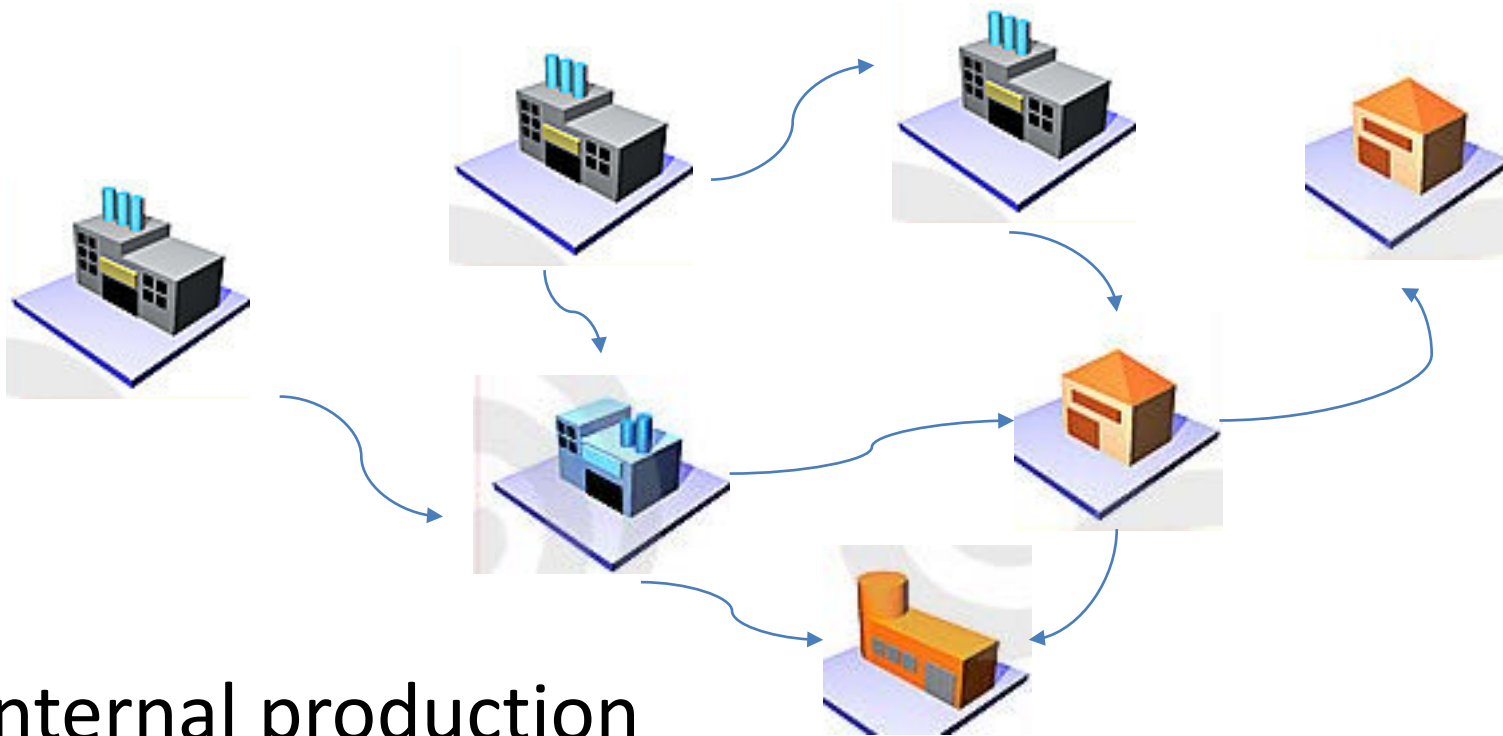
Name	Value / Equation	Evaluates to	Comments
<b>Global Variables</b>			
"pattern_width"	= "Strap_Size" * ("Center-to-edge" + 2)	4	overall width to center on blank size
"pattern_midplane"	= "pattern_width" / 2	2	distance from center of blank to first
"pattern_interval"	= "pattern_width" / ("Qty_of_holes" - 1)	1.33333	distance from hole to hole
<b>Features</b>			
<b>Equations</b>			
"D1@Sketch1"	= "pattern_midplane"	2in	set sketch location 1st hole
"D2@Sketch1"	= "Qty_of_holes"	4	set sketch pattern value - see custom
"D3@Sketch1"	= "pattern_interval"	1.333in	set sketch pattern interval
"D4@Sketch1"	= "hole_Dia"	0.5in	set sketch hole dia
"D5@Sketch1"	= 2	5in	
"Strap_Length@Sketch1"	= "Strap_Size"	6in	

Automatically rebuild    Angular equaton units: **Radians**     Automatic solve order  
 Link to external file



# Integrating the supply chain

Production, Sustainment, Recycling



- Internal production
- Design-Make
- Make-to-model

# Ongoing challenges

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- Driving product lifecycle data with high fidelity representations
- Product data complexity
  - Shape
  - Behavior
  - Context
- Product complexity: combination of mechanical, electrical, and software
- The merger of PLM and Systems Engineering
- Modular data structures to support the distributed enterprise
- Mobility, Collaboration, and Interfaces
- High Performance Computing and Analytics
  - Business drivers
  - Closing the PLM information gap → making it circular
  - Data mining linked to the model-based representation

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