Extracting Business Value From CAD Model Data Transformation

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Contents

Data in CAD Models

- Product Structure & Assembly Information
- Part & product relationships
- Geometric Modeling process
- Design parameters, rules, constraints
- Material & Mass Properties
- Visualization Properties
- Design Data as design tables
- Product Geometry
  - 2D geometry as Sketches
  - 3D geometry as points, curves, surfaces & solids
  - Topological structures (i.e. vertex, edge, face etc.)

Data Structures in CAD Systems

Parameters

Feature

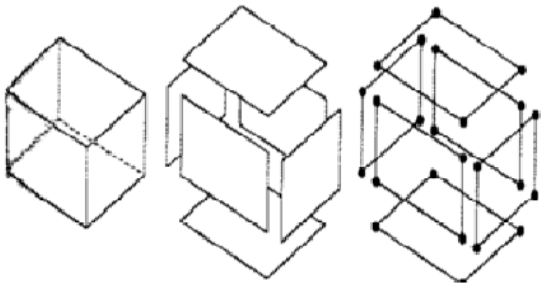
Mass Properties

Visualization Properties

Strength & Hardness

Geometric Behavior

Boundary Representations



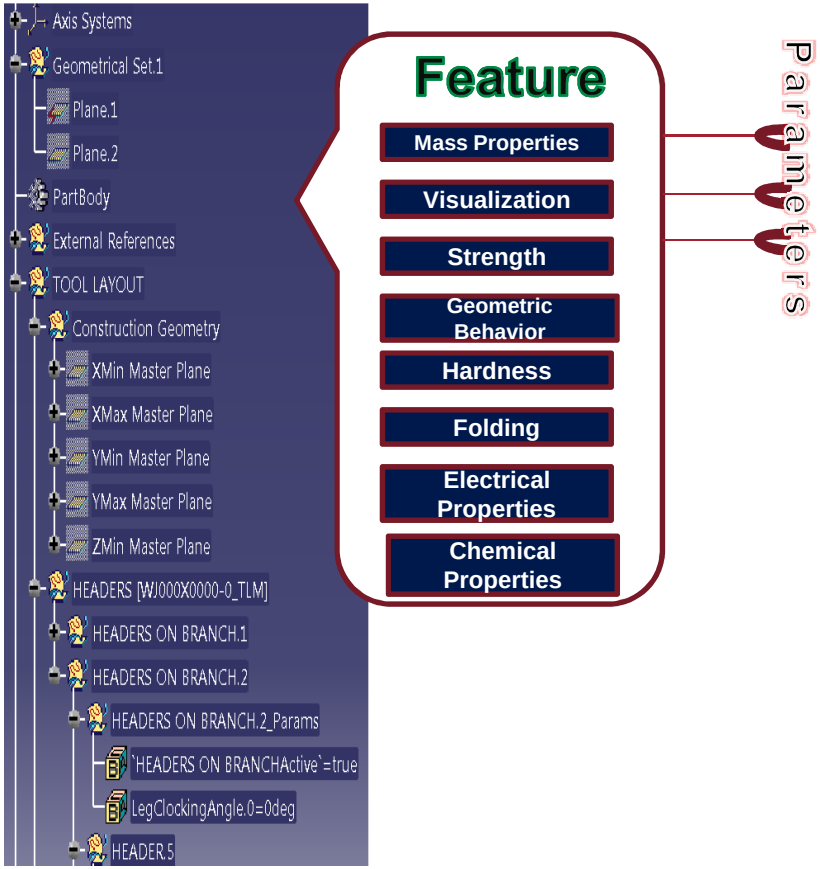
Body

Shells
Lumps
Wires

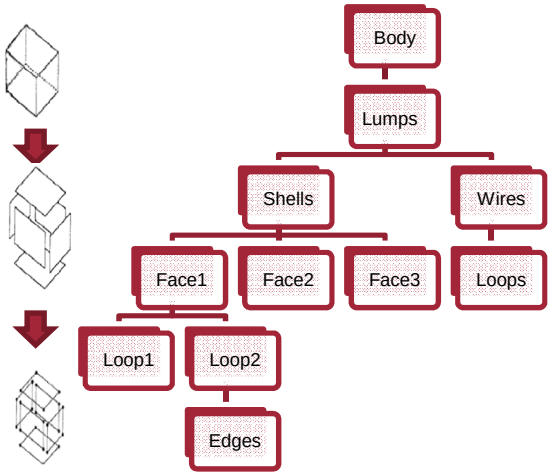
Vertices
Faces
Edges

Data Structures in CAD Systems

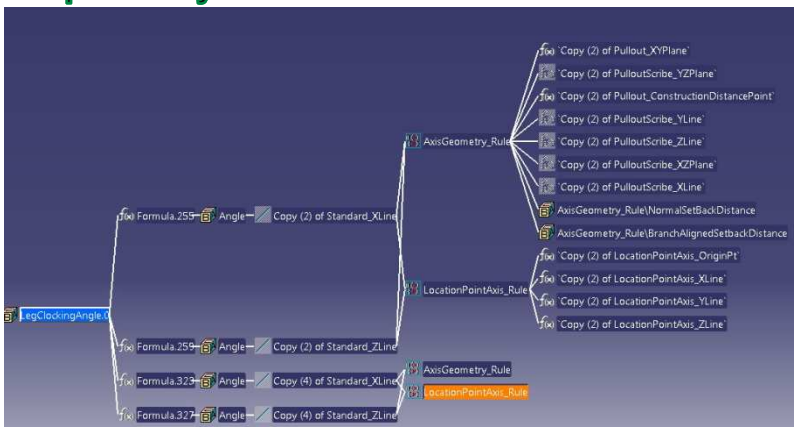
Product Structure Tree



Topology Structure



Dependency DAG



Why Transfer & Transform CAD Data?

The support of PLM throughout the product life, from the product's conceptualization to its disposal, requires reliable, complete and efficient data models.

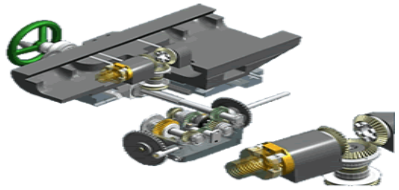
Reference: *NIST Core Product Model (NIST-CPM)*

Complex Product Development process

- is increasingly collaborative
- is distributed globally
- requires exchange of not just geometry data but also designprocess knowledge
- involves a complex supply chain
- involves modeling, analysis & planning systems
- generates complex parts and assemblies

A Structured Transformation Process

CAD Model



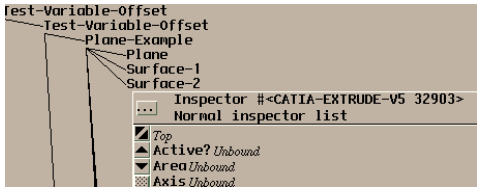
Topology

Features

Product Structure

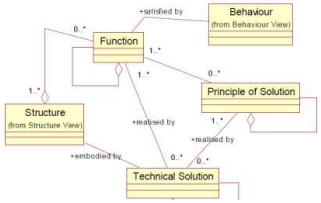
XML Model

Knowledge Model

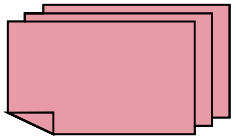


Object Oriented Model

UML/SysML

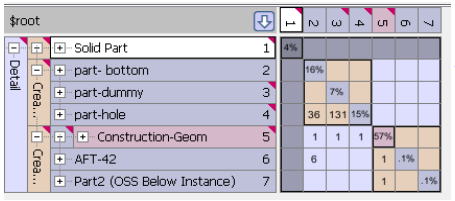


Design Documents

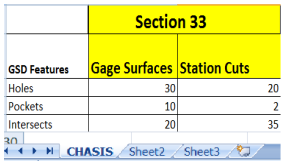


Product Data DB

DSM

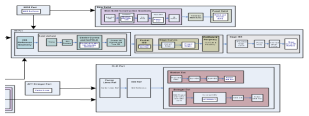


Feature Inventory



Analytics

Design Process Flow



Formal Data Representations

Formal Representation	Applications
XML Model	Inter dependencies Product & Part Structure Multi-CAD enabler
Object Oriented Models	Executable; Enable subsequent knowledge model generation
Spreadsheet	Feeding to statistical data modeling & analytics systems
Charts/Graphs	Decision making process
Database Models	Tuning granularity of PDM systems
Design Structure Matrix (DSM)	Extract design process flow Dependency data

XML Representation of CAD Model

- Neutral Representation of CAD Data
- Captures feature hierarchical and dependency data
- Enables data persistency and reuse
- Most suited for machine translation to desired target representations

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CAD Model Data as Object Oriented Model

- Object Oriented model of Product Structure
- Object Oriented models provide semantics for representing associations in CAD data
- Can be transformed to a domain specific knowledge model
- Can provide a framework to represent CAD data and its design intent
- Can be executed and used in regeneration of the CAD model and in design reuse

Database Models for representing CAD Model Data

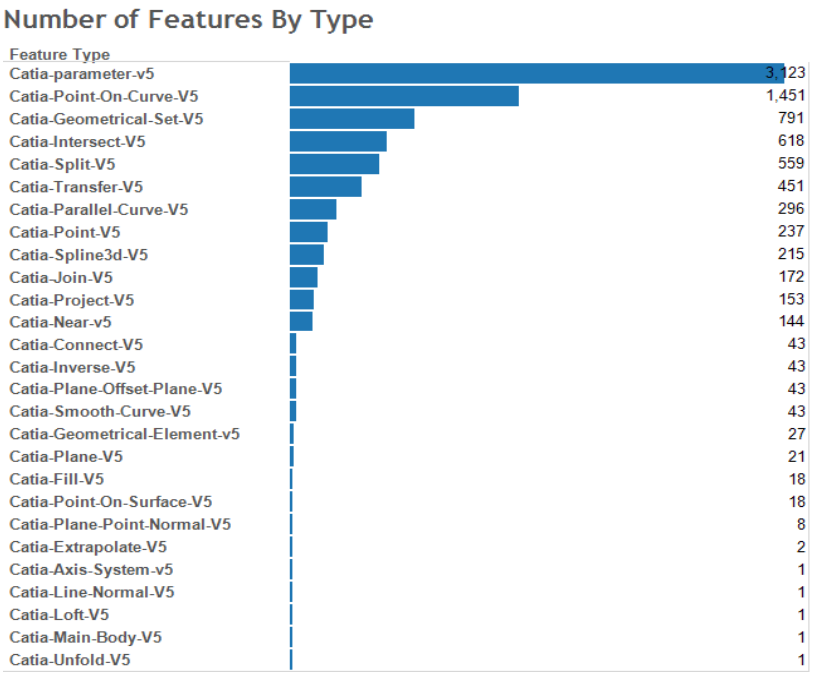
- Database Models add persistency
- Provide effective storage and processing of granular PDM data for a large inventory of assemblies
- Configuration Management, Indexing, Hashing…
- Search, retrieval and reuse
- Enabler for data analytics

Feature Inventory Model

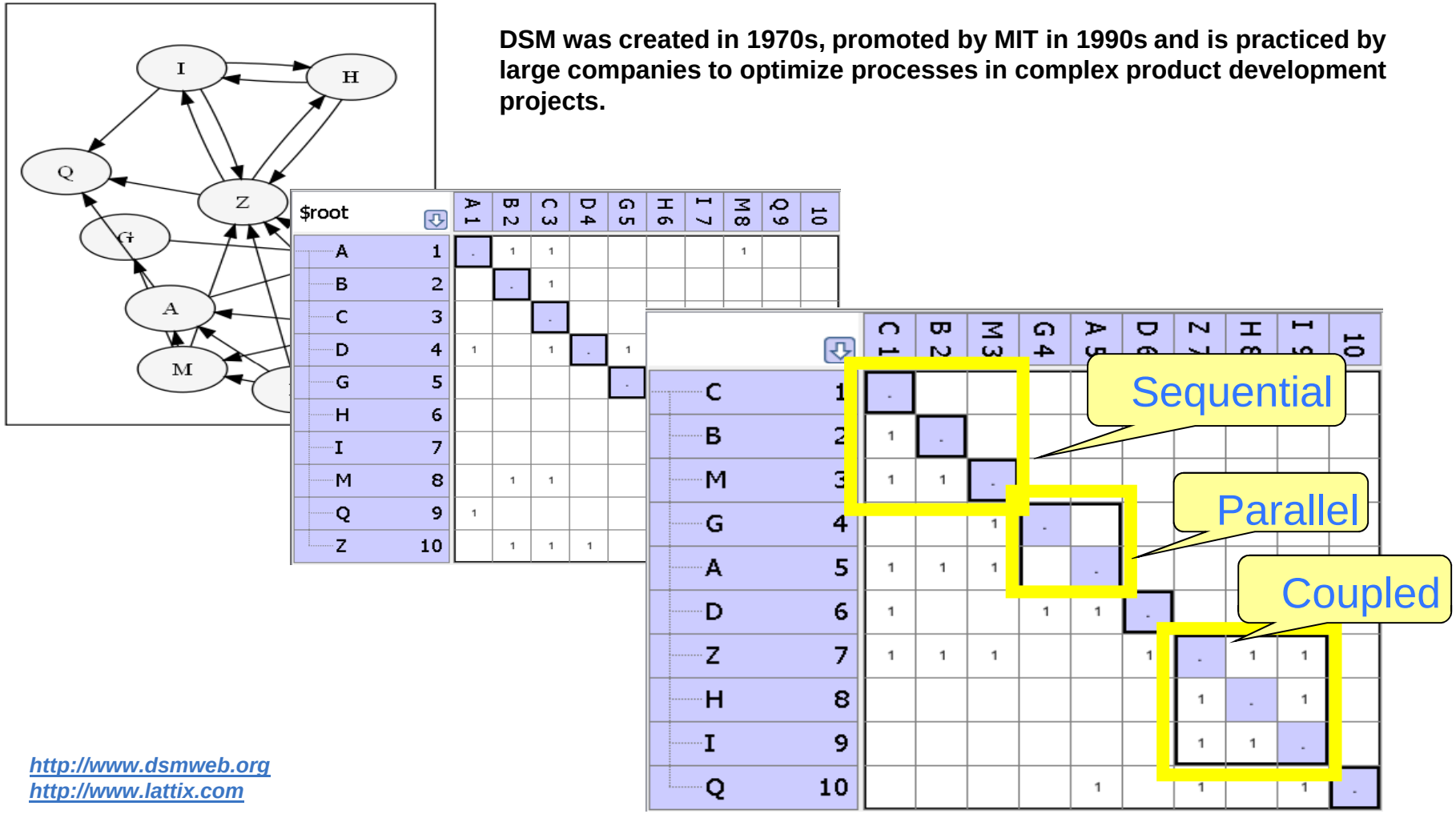
- Captures feature inventory data and other part information
- Part Inter relationships and topology information
- Parts mating information in an assembly context
- Helps in classifying and extracting Features for Computer Aided Process Planning and Inspection Process
- Facilitate data to be processed by analytics systems for statistical modeling
- Value Engineering ??

Charts & Graphs – Business/Data Analytics

- Created as an output from analytics systems
- Perform Trend Analysis
- Useful in making high level business decision based on CAD data
- Supply Chain Processes ??



Design or Dependency Structure Matrix (DSM)

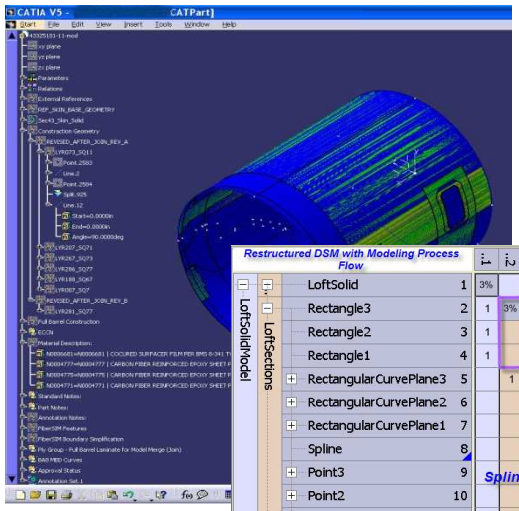


DSM was created in 1970s, promoted by MIT in 1990s and is practiced by large companies to optimize processes in complex product development projects.

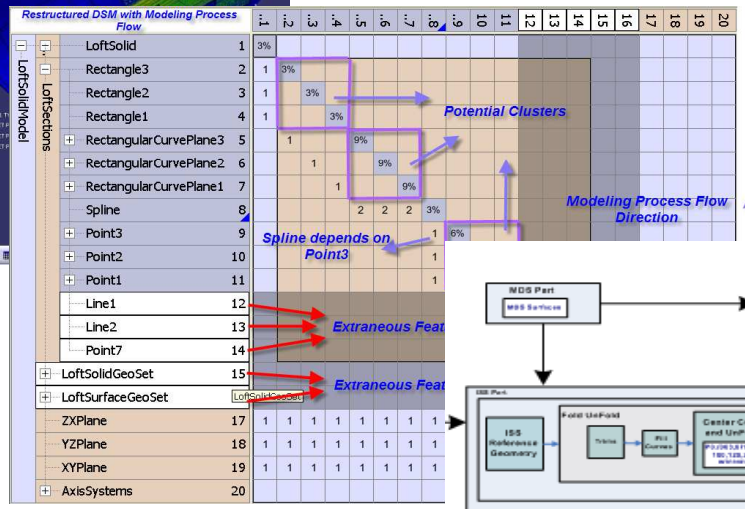
http://www.dsmweb.org
http://www.lattix.com

CAD Model → DSM → Process Flow

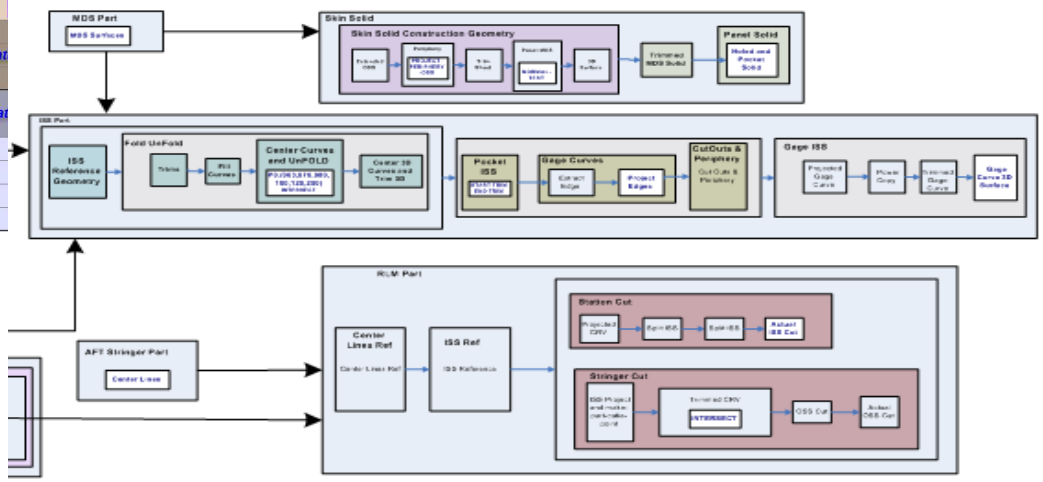
CAD Model



DSM Model



Design Process Flow



- Captures hierarchical structure of CAD Model to a declarative structure
- discover the process flow
- Model Structure Visualization
- Restructure and refine Model
- Reduce Model footprint
- Design Process Documentation
- Reduce Model Complexity
- Design Reuse and Collaboration

Current/Future

- ✓ **Generated an Object Oriented Models of CAD Models**
- ✓ **Generated DSM from CAD model and extracted Design Process Flow**
- ✓ **Generated Feature Inventory Spreadsheets from CAD Model**
- ➢ **What is Big Data and Business Analytics from a CAD Model data perspective??**
- ➢ **Leverage Industry expertise and experience**

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