PSMC Tools and Data Subcommittee

Parts Standards
Delivered as Importable Data

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Complex Problems. Practical Solutions.

Agenda

- Problem statement
- Proposed solution
- Potential gains
  - Qualitative and quantitative
- Development of the business case
  - For manufacturers (OEMs, suppliers)
  - For SDOs and Info Brokers

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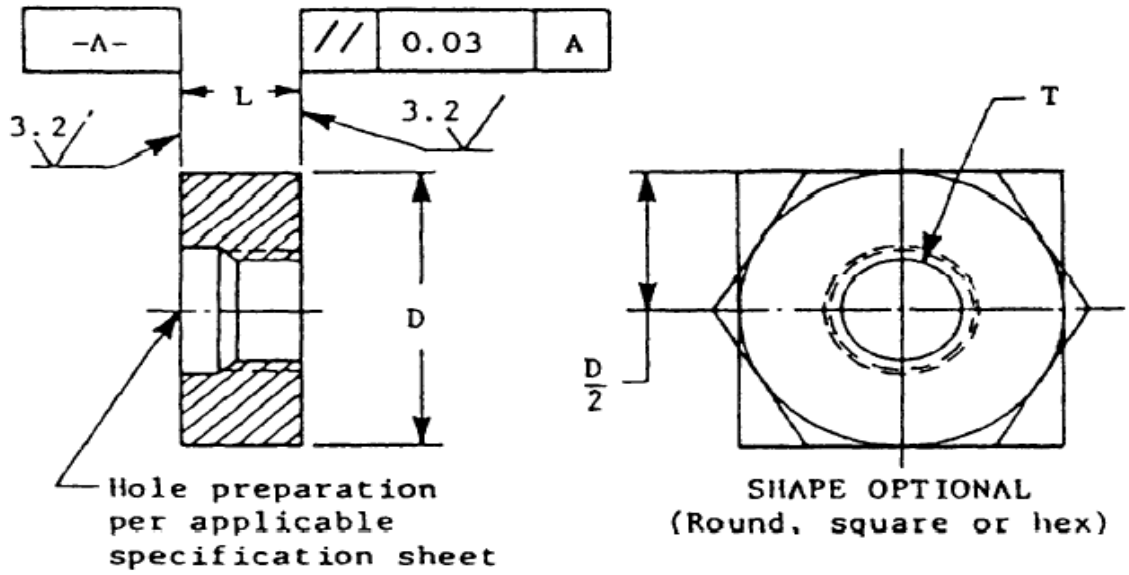
Background/Problem Statement

- Preferred, common, or otherwise ‘standard’ parts are described by government and industry standards
- Standards are document-based



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Background/Problem Statement (cont'd)

- Users of standard parts must create the part in their local parts library (CAD/PLM) manually
  - Parts can be redundantly created (for example, no enterprise-wide, or poor use of, parts library)
  - Every 'creation' is an opportunity for error

Proposed Solution

- Deliver parts standards as data records
  - Make document sections data items
- Creation of the part in a library can be largely automated
- Resulting in:
  - No wasted effort building the part into the library
    - Time saved on the design and modeling steps
  - Elimination of same part built by two different engineers
    - redundant effort or
    - confusion of near-duplicate part designs
  - Increased consistency of standard parts in the parts library
  - Better BOMs with less effort

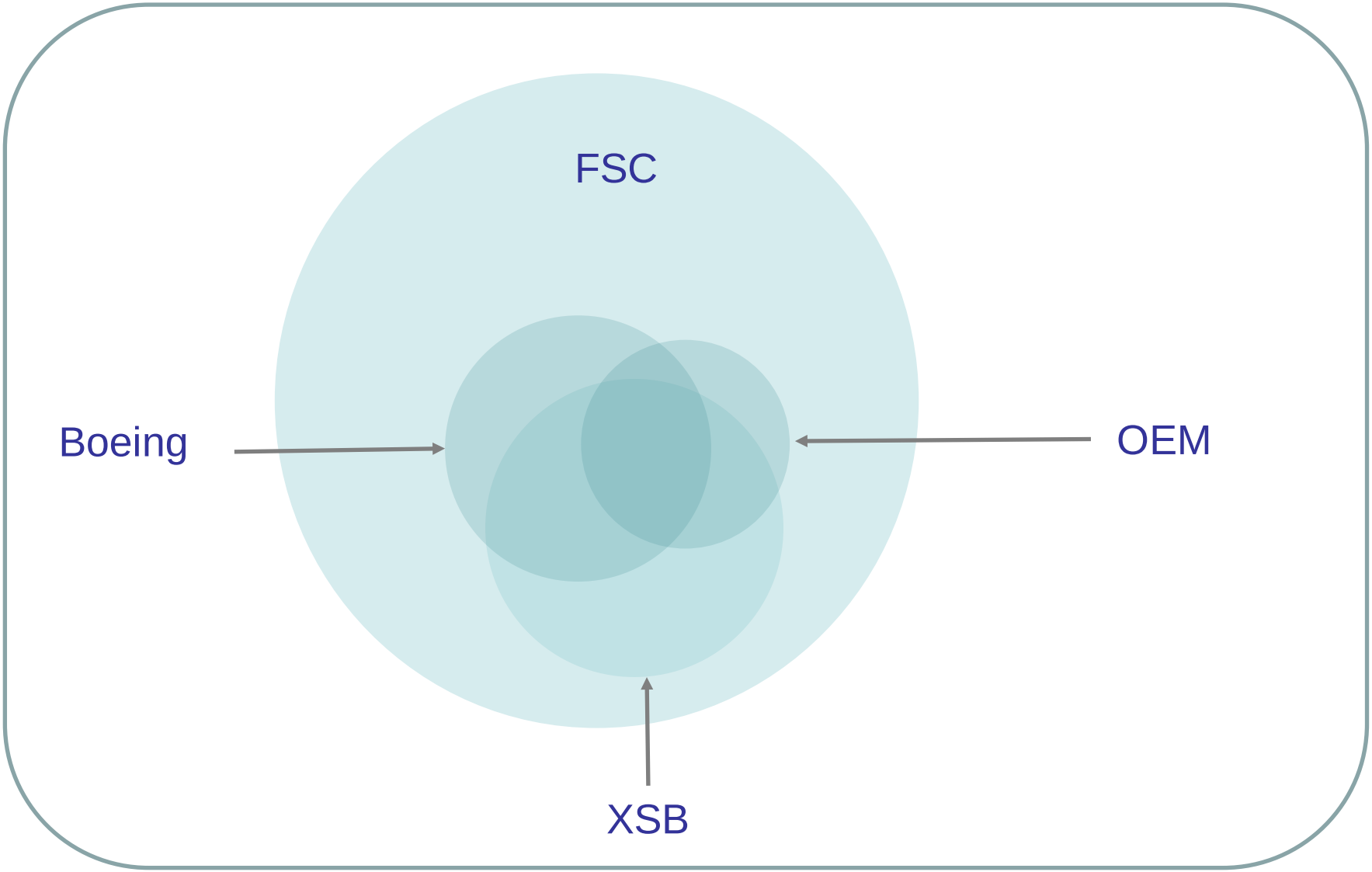
Proposed Solution (cont'd)

- It is no small effort to do this:
  - SDOs will have to change how they publish parts standards
  - Users will have to change processes (import and inspect part data vs create the part)
- We need a standard for:
  - How part standard documents gets broken into data items?
  - What those data items are called?
- So users of parts can easily write code to import them into their parts library(ies)

Feasibility of proposed solution

- Is it possible to create a standard schema for parts standards ?
- Comparing existing parts taxonomies
  - Degrees of commonality in coverage across taxonomies
  - Identify parts shared across taxonomies

Part Taxonomy Landscape



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Approach

- Gain insight into disparate parts classification taxonomies
  - Challenge 1: dealing with varying levels of detail (characteristics – materials, processes, etc.)
  - Challenge 2: extent of coverage by types of parts is variable
  - Challenge 3: classification trees and dimensions
- Design a ‘to-be’ taxonomy with coverage and detail to accommodate existing taxonomies
  - To-be taxonomy will be a hybrid taxonomy
  - Adopting the best features of existing taxonomies
- Identify coverage gaps between existing taxonomies and ‘to-be’ taxonomy
- Extend coverage to missing parts, i.e. translate from source mapping taxonomies to the identified ‘to-be taxonomy

Accomplished to date

- Studying and characterizing taxonomies on-hand:
  - FSC: Classification hierarchy of parts
  - XSB: Ontology dealing with Parts, Materials, and Process Hierarchies
- Comparison of select parts taxonomy
  - Screw
  - Bolt
  - Stud

Background on Data (Federal Supply Classification/ FSC)

FSC GROUP	FSC GROUP DESCRIPTION	FSC CODE	FSC DESCRIPTION
53	Hardware and Abrasives	5305	Screws
53	Hardware and Abrasives	5306	Bolts
53	Hardware and Abrasives	5307	Studs
53	Hardware and Abrasives	5310	Nuts and Washers
53	Hardware and Abrasives	5315	Nails, Machine Keys and Pins
53	Hardware and Abrasives	5320	Rivets
53	Hardware and Abrasives	5325	Fastening Devices
53	Hardware and Abrasives	5330	Packing and Gasket Materials
53	Hardware and Abrasives	5331	O-Rings
53	Hardware and Abrasives	5335	Metal Screening
53	Hardware and Abrasives	5340	Hardware, Commercial
53	Hardware and Abrasives	5341	Brackets
53	Hardware and Abrasives	5342	Hardware, Weapon System
53	Hardware and Abrasives	5345	Disks and Stones, Abrasive**
53	Hardware and Abrasives	5350	Abrasive Materials**
53	Hardware and Abrasives	5355	Knobs and Pointers
53	Hardware and Abrasives	5360	Coil, Flat and Wire Springs
53	Hardware and Abrasives	5365	Bushings, Rings, Shims and Spacers

78 unique group codes

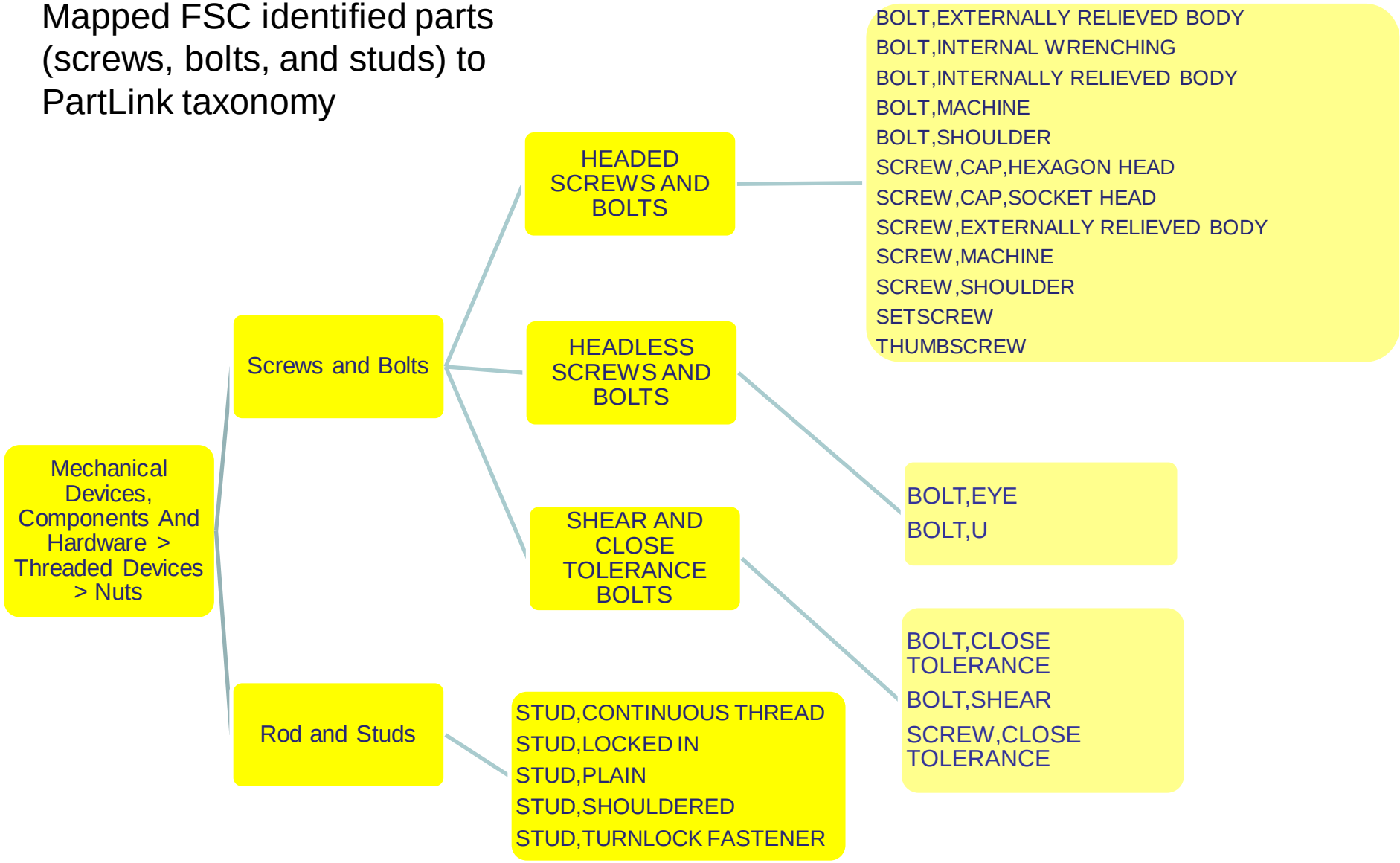
580 unique parts
Max - 37 parts in group
Min - 0 parts in group

Background on Data (XSB PartLink Ontology)

- PartLink taxonomy has 6 levels:
  - Level 1 – 6 entities
  - Level 2 – 103 entities
  - Level 3 – 204 entities
  - Level 4 – 686 entities
  - Level 5 – 122 entities (only some of level 4 have level 5 dependents)
  - Level 6 – 99 entities (only some of level 5 have level 6 dependents)

Background on Data (XSB PartLink Ontology)

Mapped FSC identified parts (screws, bolts, and studs) to PartLink taxonomy



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Background on Data (XSB PartLink Ontology)

Part Hierarchy		
	Part Hierarchy Class	
	PART	root class of the part hierarchy
	>N	interior node of the part hierarchy where N is a unique ID string of digits and D is a node description
	>>INC.NAME	five digit INC code and NAME is the item name for the FCS, for example: prod:00014:BEARING_BALL_ANNULAR
	>>>NIIN	nine digit "National Item Identification Number" assigned to this item of supply in the FCS
	ODE_TYPES	root for a hierarchy of target classes for object properties
	ODE_ENUMERATED_TYPES	root of a hierarchy of enumerated type classes
	ODE_PARAMETERIZED_TYPES	root of a hierarchy of parameterized type classes
	Part Hierarchy Individual	
	prod:CAGECAGEPARTPN	individual part that is an instance of some sub class in
	Part Hierarchy Properties	
	prod:PROP	property associated to a specific class within the part hierarchy where PROP is the property name, for example: prod:A
Material Hierarchy		
	Material Hierarchy Class	
	mat:MATERIAL	root class for the material hierarchy
	mat:METAL	direct subclass of mat:MATERIAL and is the root of the hierarchy of classes for metals and their alloys
	mat:NONMETAL	direct subclass of mat:MATERIAL and is the root of the hierarchy of classes for nonmetals
	mat:ALLOYING_CONSTITUENT	root of the hierarchy for classes representing alloying elements from which metal alloys are composed
	mat:constituent_percentage_4	subclass of type:ODE_Parameterized_Types
	mat:has_base_element	represents the dominant constituent element in a metal or metal alloy and has a target of mat:ALLOYING_CONSTITUENT
	mat:has_constituent	represents a constituent element in a metal alloy and has a target of mat:constituent_percentage_4
	Material Hierarchy Properties	
	mat:has_base_element	represents the dominant constituent element in a metal or metal alloy and has a target of mat:ALLOYING_CONSTITUENT
	mat:has_constituent	represents a constituent element in a metal alloy and has a target of mat:constituent_percentage_4
Process Hierarchy		
	proc:PROCESS	base class for all manufacturing processes
	proc:NONSHAPING_PROCESS	subclass of proc:PROCESS for processes that do not change the shape of an item, e.g PAINTING or HEAT TREATMENT
	proc:QUALITY_PROCESS	subclass of proc:PROCESS for processes related to maintaining production quality, e.g. TESTING or INSPECTION
	proc:SHAPING	subclass of proc:PROCESS for processes that change the shape of an item, e.g DRILLING or FORGING

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Mapping Exercise (cont.)

- Start with FSC group 53 (Hardware and Abrasives)
  - 18 unique parts
- Selected 3 parts for mapping exercise
  - 5305 Screws
  - 5306 Bolts
  - 5307 Studs
- Compare with PartLink taxonomy:
  - 6.v.ii.l.α.β (Screws and Bolts)
  - 6.v.ii.m.α.β (Rod and Studs)

Mapping Exercise (cont.)

- Mapping of FSC and PartLink across three dimensions:
  - Traceability – does this part class exist in target taxonomy?
  - Level of Details – at what level of detail does this part class exist?
  - Containment – is the part class fully/ partially contained at that level of detail in target taxonomy?

- Next slide: sample mapping results

Mapping Exercise Summary

FSC Class	PartLink Mapping Results		
	Traceability	Level of Detail	Containment
5305 Screws	level 6	+ 4	Complete
5306 Bolts	level 6	+ 4	Complete
5307 Studs	level 5	+ 3	Complete
5310 Nuts and Washers	Nuts – level 3 Washers – level 4	+ 1 + 2	Complete
5325 Fastening Devices	Not Found	NA	Not Contained
5320 Rivets	level 2	0	Complete

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Where we want to be

- Study and characterize a range of taxonomies
- Identify and measure gaps between FSC entities and XSB/ OEMs…
- Summarize nature and extent of gaps in coverage and detail.