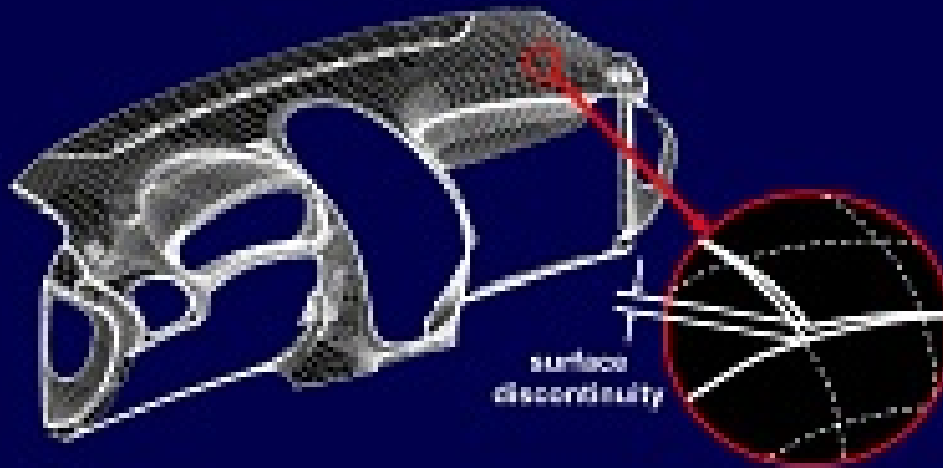


# PDQ

## Product Data Quality



Presentation 2006-11-07

# Vad menas med PDQ?

For the purpose of these guidelines, the term "product data" is defined as any and all product data required from product conception to manufacturing.

Therefore, product data include not just computer-aided design (CAD) data but also computer-aided manufacturing (CAM) data, computer-aided engineering (CAE) data, product data management (PDM) data, and any other kinds of data



# Vad ingår i PDQ idag?

Content marked A appears in this version Content marked B is expected to appear in later versions			Process Chain									
			Define Product	Style Product	Design Product	Evaluate Product	Plan Production	Design Tool	Manufacture Production Tool	Test Tool to Control Quality		
Data Class	CAD data	Geometry	Wireframe Model	A	A	A	A	A	A	A	A	A
			Surface Model	n/a	A	A	A	A	A	A	A	A
			BREP Solid Model	n/a	A	A	A	A	A	A	A	A
			CSG Model	n/a	A	A	A	A	A	A	A	A
		Drawings	2D Drawing	B	B	A	B	B	A	B	B	
			Associative Drawing	n/a	B	B	B	B	B	B	B	
		Non-geometry	Presentation	B	B	B	B	B	B	B	B	
			Parametrics	n/a	B	B	B	B	B	B	n/a	
			Features	n/a	B	B	B	B	B	B	B	
			Assembly	n/a	B	B	B	B	B	B	B	
			Tolerancing	n/a	B	B	B	B	B	B	B	
			Surface Condition	n/a	B	B	B	B	B	B	B	
	Material Properties	n/a	B	B	B	B	B	B	B			
	Parts Information	B	B	B	B	B	B	B	B			
FEA, BEA, ...	n/a	n/a	B	B	B	B	n/a	n/a				



# Exempel på innehåll i PDQ?



## SASIG- Product Data Quality for the Global Automotive Industry

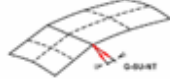
### 3.1.2.2 Non-tangent patches (O, discontinuity): O-BU-NT

**Problem description:** Non-tangent angle between adjacent surface patches— $\rightarrow O_1$  discontinuity.

**Measurement:** Maximum angle between patch normals evaluated at adjacent points along coincident boundaries (provided that  $O_1$  continuity is given).

**Supporting information:** Tangential continuity (given position continuity) means the link-line transition of two adjacent surface patches without a change in the tangential angle before given accuracy. A tangential discontinuity may be visible or felt. In practical use, the acceptable angle difference is related to the neighbouring patch size (larger angles tend to be acceptable with smaller patches).

**Recommendation:** Interactively correct the surface by increasing or modifying it with tangential conditions.



Example Non-tangent patches (O discontinuity). Normal angle shown for illustration.

### 3.1.2.8 Non-smooth patches (O, discontinuity): O-BU-NS

**Problem description:** Large curvature change between adjacent surface patches— $\rightarrow O_1$  discontinuity.

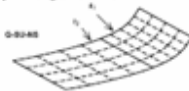
**Measurement:** Curvature continuity at the contact point of two patches (by a given position/tangential continuity) means:

- Check Curvature continuity in consecutive normal section planes.
- Central points of curvature radii to be on same side of the patches.
- Difference of absolute values of radii, divided by mean value of radii, to follow the given accuracy that is:

$$O = |R1 - R2| = \frac{|R1 - R2|}{\frac{R1 + R2}{2}} \text{ (note } O \leq 0.001 \text{ is always positive)}$$

**Supporting information:** Curvature continuity of surfaces is normally required only by the description of component parts with special functions (lines, wires, etc.) or by stylistic elements.

**Recommendation:** Replace the affected elements by elements with suitable curvature conditions at the contact boundary, e.g., neighbouring elements that have constant curvature (by lines, spheres, plane elements, etc.) shall be replaced through free-form surfaces.



Example Non-smooth patches (O discontinuity).

SASIG PDQ

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Issue 21, E-mail: 525475  
Explains 2.6, E-mail: 0954

## SASIG- Product Data Quality for the Global Automotive Industry



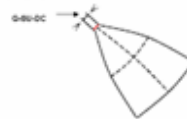
### 3.1.2.4 Degenerate surface boundary: O-BU-DC

**Problem description:** Surface or patch has one boundary that is too short. Note that some systems define a valid triangular surface or patch by setting one boundary length below a specified limit.

**Measurement:** Length of degenerate surface or patch boundary, with this length below the given accuracy for "True" but greater than the chosen accuracy for "Zero length."

**Supporting information:** A surface segment (patch) with exactly one boundary before accuracy ("zero-triangular patch") may lead to non-defined normal vector, thereby affecting the stability of the patch (e.g., patch offset).

**Recommendation:** Manually adjust the segment edge size larger than the tiny element tolerances or describe by means of a three-sided bounded face (note that some systems do not support triangular patches at all). This solution means create a larger rectangular underlying surface and trim back to the desired three-sided face.



Example Degenerate surface boundary.

### 3.1.2.6 Degenerate surface corner: O-BU-CP

**Problem description:** Surface corner forms a sharp or tangent angle.

**Measurement:** Angle between tangents of geometrically adjacent surface boundaries at a surface corner.

**Supporting information:** If the angle between two neighbouring boundary curves of a surface is less than the maximum angle or more than the minimum angle, this can result in unmodifiable or undesirable surface normals in the corner points.

**Recommendation:** Divide the surface (e.g., star-shaped) from the center of the surface into three surfaces or enlarge the surface and generate the required area as a face. If, despite a critical angle, the normals in the surface corners are well-defined, then these cases may possibly be acceptable.



Example Degenerate surface corner.

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## SASIG- Product Data Quality for the Global Automotive Industry



### 3.1.1.6 Self-intersecting curve: O-CU-IB

**Problem description:** Curve intersects itself at one or more locations that are not both endpoints.

**Measurement:** Whether a curve intersects itself within the designated (system or otherwise) accuracy.

**Supporting information:** A self-penetration/intersection in the existence of an intersecting point of a curve with itself. It is always unintentional, being a design purpose. This error causes problems with other geometrical operations, such as the generation of offsets or faces, as well as with 3D programming.

**Recommendation:** Self-penetration often results from faulty development of offsets (offset distance is larger than the inside radius) or projections (two-dimensional curves in one plane) and so on to be avoided whenever possible. Retrospectively separate the curve correctly.



Example Self-intersecting curve.

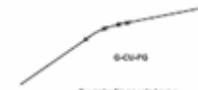
### 3.1.1.7 Fragmented curve: O-CU-CP

**Problem description:** Curve is defined by too many segments.

**Measurement:** Count of segments in curve.

**Supporting information:** An unreasonably high number of segments within a curve is generally a sign of inferable complexity of a curve. This occurs, for example, through merging of different curves in a poor approximation of a curve of higher degree to that of lower degree.

**Recommendation:** Replace the curve with another curve with as few segments as possible. A curve with too many segments and a large number of (smaller) segments can be replaced where necessary through curves with meaningful, higher degrees. (No-computation may be necessary under observation of the given accuracy.)



Example Fragmented curve.

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Scania exempel →



# PDQ used at Scania

Malin Holmström



# Standard used today at Scania

- Standard for Catia V4 in classification of surfaces

**Curvature Continuity, G 2**

**8.4. Curvature Continuity, G 2**  
In order that the connecting curves and surfaces shall be defined as curvature continuous, G 2, then G 1 must be fulfilled and the normal vectors at the endpoints for the curves and surfaces must be equally as long, in order to fulfil curvature continuity the curvature deviation between the normal vectors at the endpoints for both curves and surfaces must be a maximum of 0.1 or 10%, depending on choice of unit. See the heading Curvature Deviation, Chapter 6.5. The endpoints for the curves and surfaces must be locked into each other and the next two checkpoints on both sides of the endpoint must be locked in relation to each other in order to fulfil G 2. See the heading Locking the Checkpoints to Fulfill Continuity, Chapter 9.

**Figure 17.** Connecting curves that fulfil G 2

**Figure 18.** Connecting surfaces that fulfil G 2

**6.5. Curvature Deviation**  
The curvature deviation may be a maximum of 0.1 or 10%, depending on which unit is used. The curvature deviation is calculated using the following formula:  
$$\frac{|C2-C1|}{((C1+C2)/2)} = 0 - 200\% \text{ (or } 0 - 2)$$
  
Where C1 and C2 stand for the curvature of the different curves and the surfaces in the endpoint.

**Figure 8.** Definition of C1 and C2

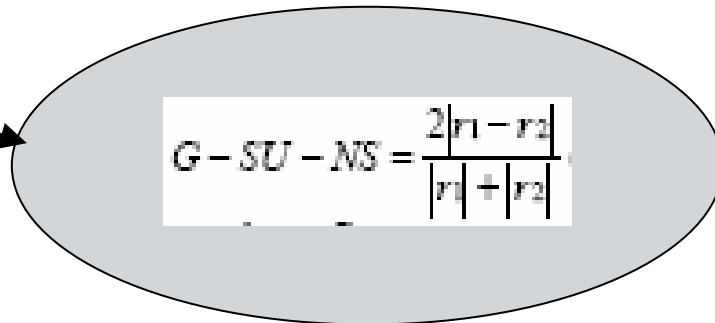
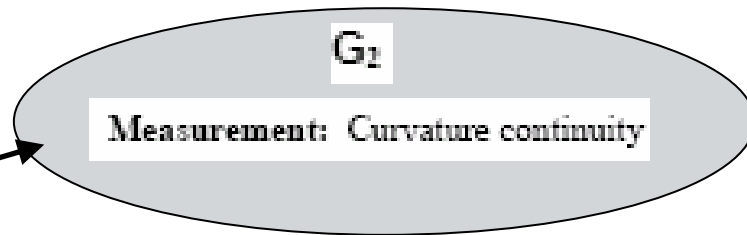
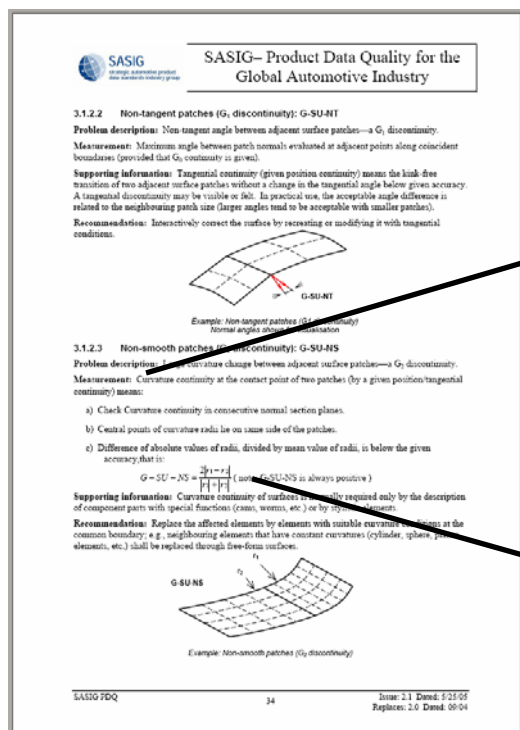
**Figure 7.** Maximum permitted degree for continuous tangent direction

Maximum 0.1 degrees

$$\frac{|C2-C1|}{((C1+C2)/2)} = 0 - 200\% \text{ (or } 0 - 2)$$

# Standard definitions in PDQ today

- The same definition in PDQ



# Tomorrow: Using standards and PDQ together at Scania

Using PDQ with some complements, for example in the areas of tolerance, setting, limit values

- Different user gives different tolerance and limit value

\*För att se definition läs PDQ

[http://www.odette.se/standarder\\_och\\_rekommendationer\\_sasig.asp](http://www.odette.se/standarder_och_rekommendationer_sasig.asp)

SCANIA

Checked/Approved by: SSSIBE; Malin Holmström

Design/Drawn by: SSSIBE; Malin Holmström

Released Date: 20160818

YTKVALITETSKRAV FÖR STYLINGMODELLER I V5

**Toleranser**  
Toleranserna är 0,001 mm  
Kurvaturkontinuitet\* toleransen är 0,1  
Tangentiell kontinuitet\* toleransen är 0,1

**Geometrisk krav**  
Alla symmetrier ska byggas med G3\*.

Alla stylingmodeller ska om möjligt byggas med teoretiska hörn.

Definitioner på vilka ytor som har Klass A, Klass B och Klass C i Ytkvalitetskrav se std 4269.

**Publicering och Scania status**  
Alla publicerade stylingmodeller ska läsas till InWorkFrozen innan de släpps till konstruktion. Alla stylingmodeller ska publiceras med Scania status;

**R** = Restriktivt tillämpbar (koncept). På denna stylingmodell får påsiktsmodeller beställas.

**P** = Preliminär för serieproduktion (Preliminär modell). Prototyp får beställas.

**PR** = Preliminär för serieproduktion och restriktivt tillämpbar. Ansvarig fordonsdesigner har godkänt stylingmodellen för serieproduktion. För att höjas till S måste konstruktion godkänna släpp mm.

**S** = Seriegodkänd, serieverktyg får beställas.

\*För att se definition läs PDQ  
[http://www.odette.se/standarder\\_och\\_rekommendationer\\_sasig.asp](http://www.odette.se/standarder_och_rekommendationer_sasig.asp)



SCANIA

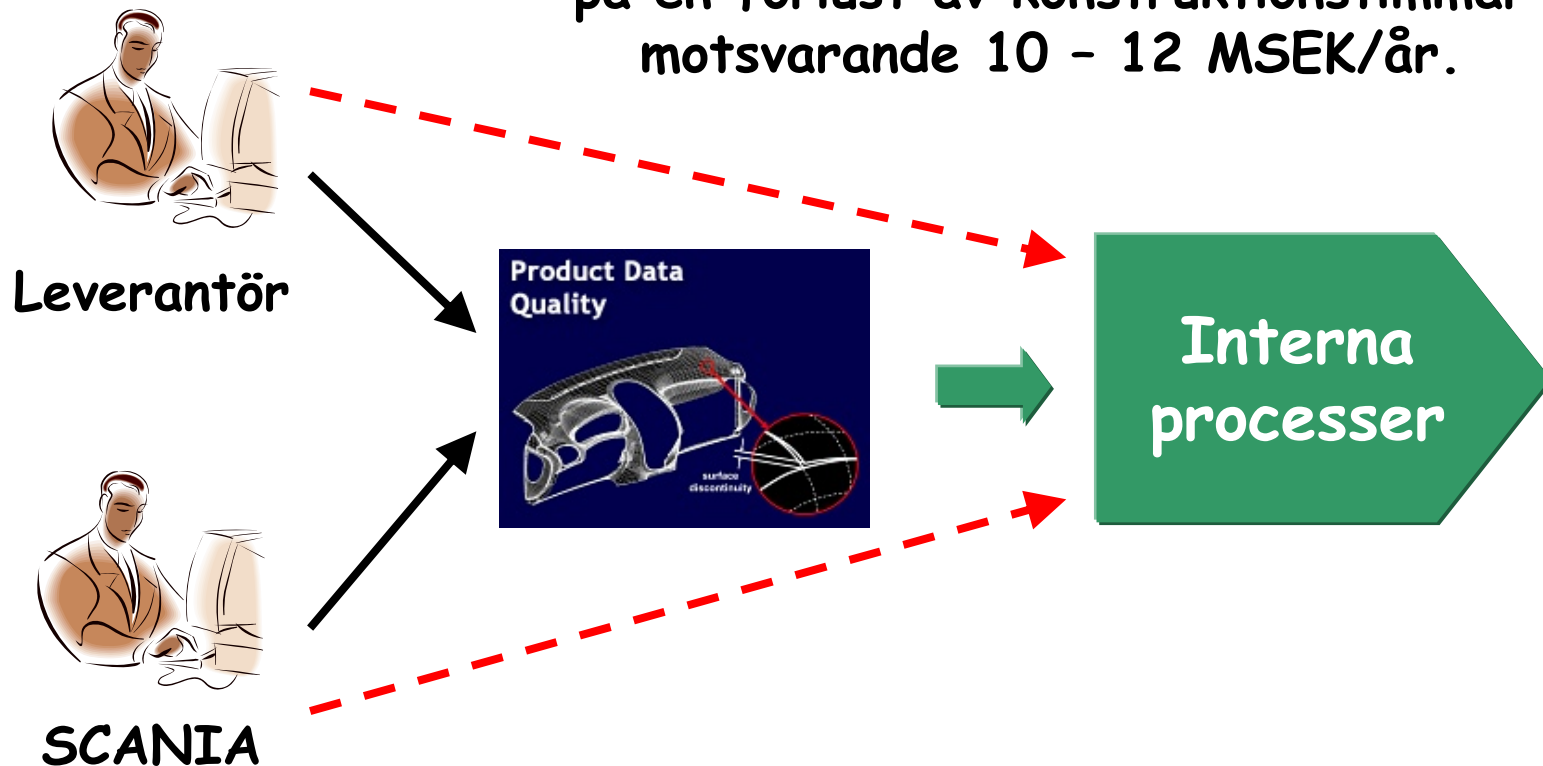


# Example of benefits

- **The same definition of standard on all companies**
- **Suppliers will understand the definition easier**
- **All the companies can reduce there documentation in standards**
- **Reduce internal work with heeling cad-models**
- **Possibility to reduce supplier costs**

# Vinster med PDQ

Interna beräkningar på SCANIA pekar på en förlust av konstruktionstimmar motsvarande 10 - 12 MSEK/år.



# Nästa steg inom PDQ?



Högskola



Leverantör



OEM

Ansökan  
Xxxxxxx  
xxxxxxx  
xxxxxxx  
xxxxxxx

