



CoCoDeal

automatisierter 3D-Datenaustausch für die Fertigung

17. Bayreuther 3D-Konstrukteurstag

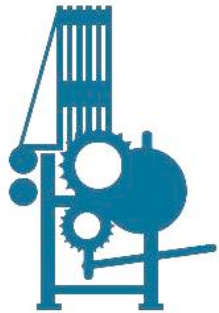
Bayreuth

16. September 2015

Dipl.-Ing. Claudia Kleinschrodt, Prof. Dr.-Ing. Frank Rieg

Industrie 4.0

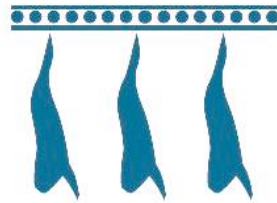
Von der ersten zur vierten industriellen Revolution



Erster mechanischer Webstuhl
1784

1. Industrielle Revolution
Durch Einführung mechanischer
Produktionsanlagen mit Hilfe von
Wasser- und Dampfkraft

Ende
18. Jahrhundert



Erstes Fließband
1870

2. Industrielle Revolution
Durch Einführung arbeitsteilender
Massenproduktion mit Hilfe von
elektrischer Energie

Beginn 20. Jahrhundert



Erste Speicherprogrammierbare
Steuerung (SPS)
1969

3. Industrielle Revolution
Durch Einsatz von Elektronik und IT
zur weiteren Automatisierung der
Produktion

Beginn der 1970er-Jahre
20. Jahrhundert



Smart Factory

4. Industrielle Revolution
Auf Basis von cyberphysischen
Systemen

heute

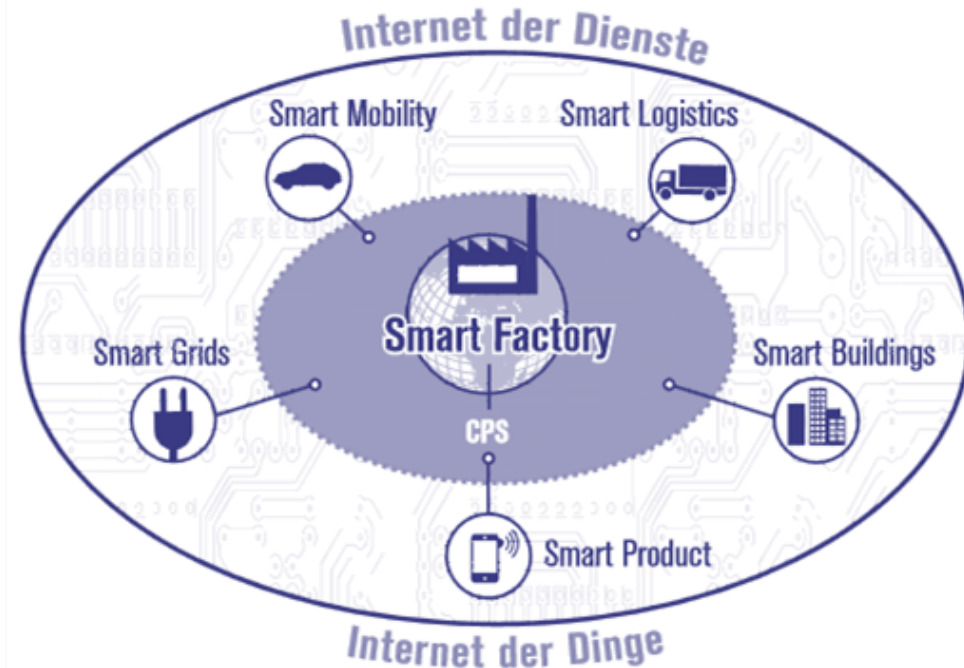
Quelle: DFKI, 2011



„Industrie 4.0 als Teil einer vernetzten, intelligenten Welt“

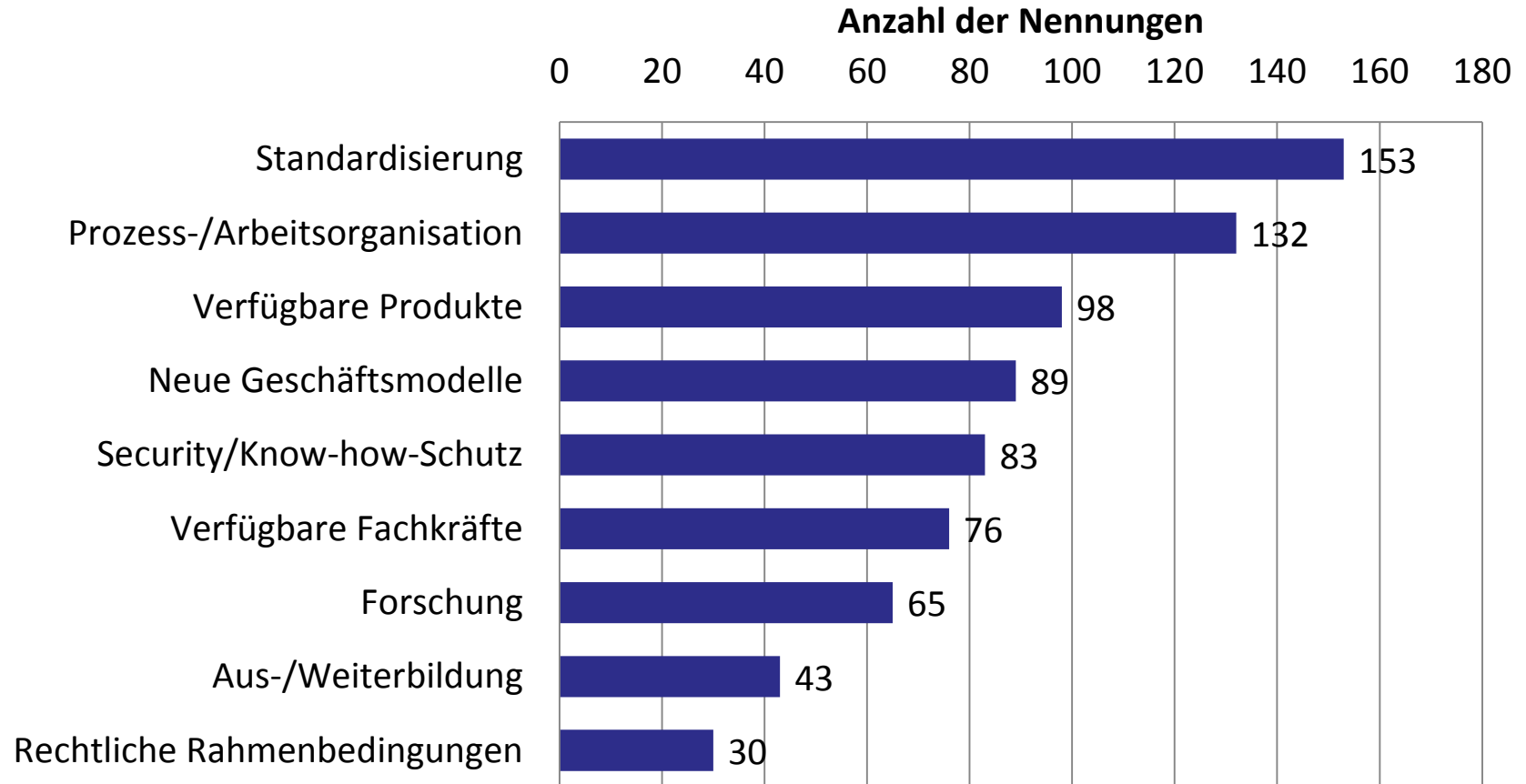
Erhoffte Potenziale:

- Individualisierung der Kundenwünsche
- Flexibilisierung
- Optimierte Entscheidungsfindung
- Ressourcenproduktivität und -effizienz
- Wertschöpfungspotenziale durch neue Dienstleistungen
- Demografie-sensible Arbeitsgestaltung
- Work-Life-Balance
- Wettbewerbsfähigkeit als Hochlohnstandort





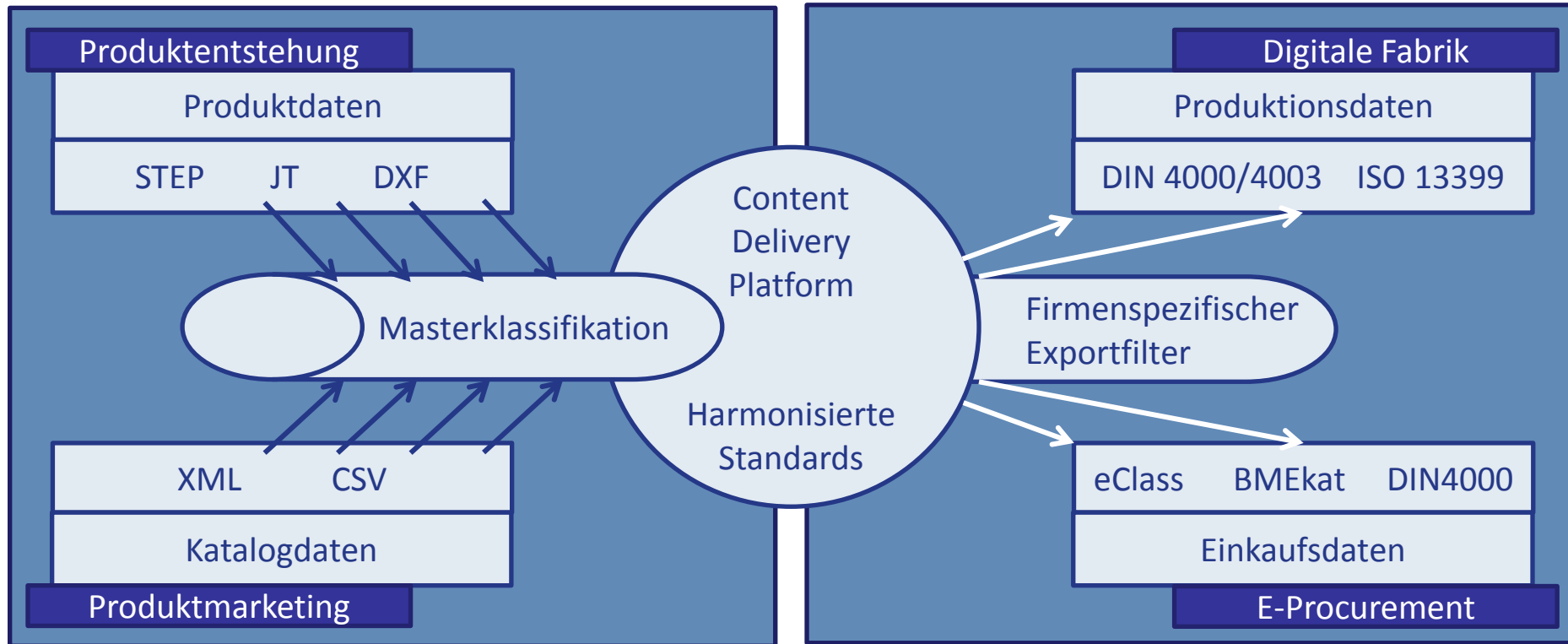
Welches sind die größten Herausforderungen auf dem Weg zur Umsetzung von Industrie 4.0?

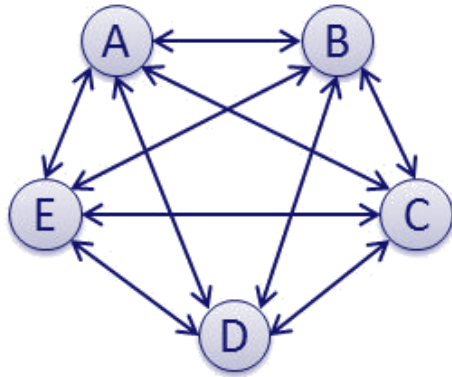




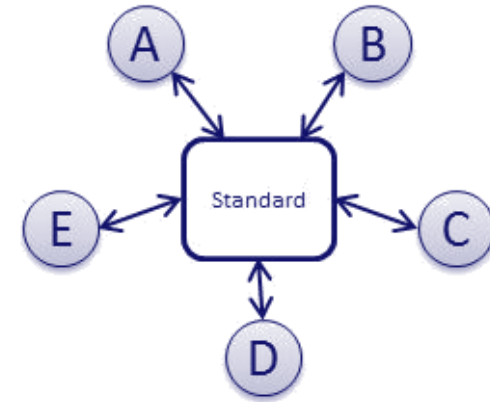
CoCoDeal - Content Collection and Data Delivery Standards

Harmonisierung von Standards zur Vereinfachung der Datenbereitstellung für die Digitale Fabrik und den elektronischen Einkauf



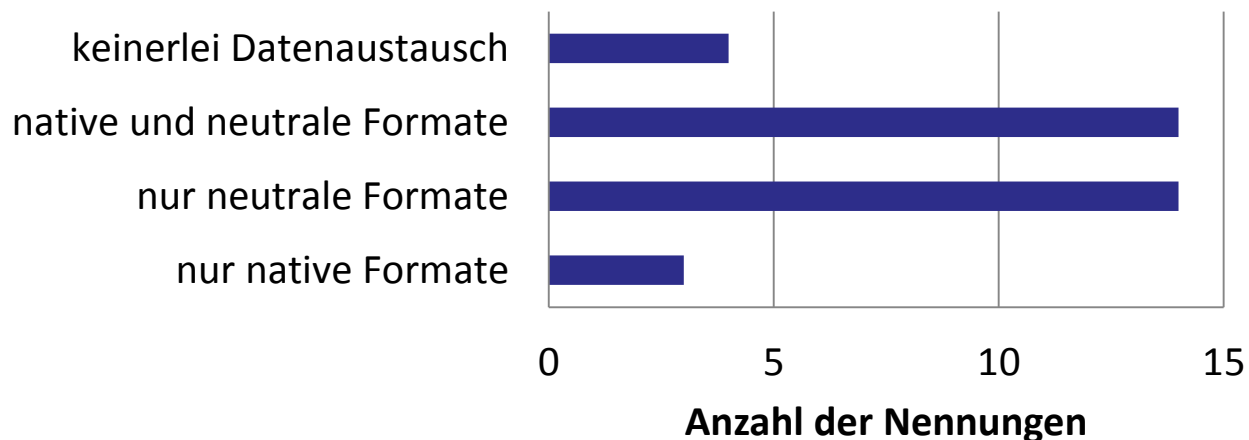


Austausch mittels nativer Formate



Austausch mittels neutraler Formate

Über welche Formate werden CAD-Daten in Firmen ausgetauscht?





STEP - Standard for the exchange of product model data

- Existiert seit 1992 als ISO-Norm (ISO 10303)
- Von Anfang an als umfangreicher Standard entwickelt
- Verschiedene Anwendungsprotokolle zur Darstellung branchenspezifischer Informationen (AP214: Core data for automotive mechanical design processes)
- 60% der Befragten tauschen CAD-Daten über STEP AP214 aus
- In allen handelsüblichen CAD-Systemen implementiert

Datenübertragung via STEP

STEP-Dateien in verschiedenen Programmen



```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION('CATIA V5 STEP Exchange',CAX-IF Rec.Pacs.--- Model Styling and Organization---1.2---2011-12-15',2;1);
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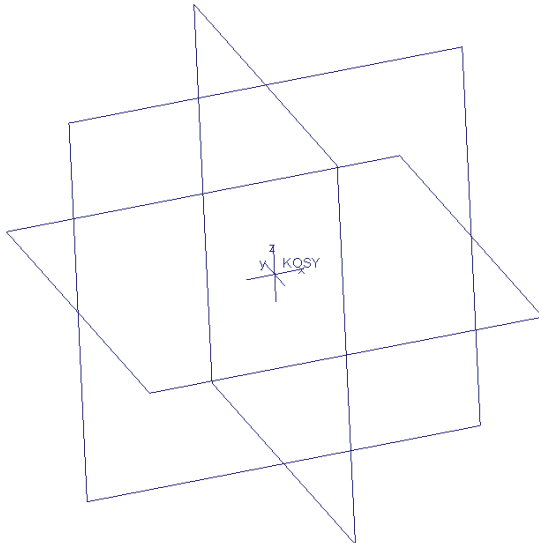
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FILE_NAME('D:\Uni_Projekte\CocCoDeal\BlokTest\standard_KoSy_CatiaV5.stp','2015-06-24T07:02:38+00:00','none','none','CATIA Version 5-6 Release 2014','CATIA V5 STEP AP214','none');
```

```
FILE_SCHEMA('AUTOMOTIVE_DESIGN { 1 0 10303 214 1 1 1 1 }');
```

```
ENDSEC;
```

```
DATA;
#5=PRODUCT('standard_KoSy_CatiaV5','',#2);
#2=PRODUCT_CONTEXT('mechanical');
#1=APPLICATION_CONTEXT('automotive_design');
#10=PRODUCT_DEFINITION('','#6,#9);
#3=PRODUCT_DEFINITION_CONTEXT('part definition','#1,');
#11=PRODUCT_DEFINITION_SHAPE('','',#10);
#19=SHAPE_REPRESENTATION('(#18),#16);
#18=AXIS2_PLACEMENT_3D('','#17,S,S);
#17=CARTESIAN_POINT('','(0,0,0));
#8=PRODUCT_RELATED_PRODUCT_CATEGORY('part,S,#5);
#7=PRODUCT_CATEGORY('part',specification);
#15=UNCERTAINTY_MEASURE_WITH_UNIT(LENGTH_MEASURE(0.005),#12,'distance_accuracy_value','CONFUSED CURVE UNCERTAINTY');
#4=APPLICATION_PROTOCOL_DEFINITION('international_standard','automotive_design',2001,#1);
#9=PRODUCT_CATEGORY_RELATIONSHIP('','',#8);
#6=PRODUCT_DEFINITION_FORMATION_WITH_SPECIFIED_SOURCE('','',#5,NOT_KNOWN);
#20=SHAPE_DEFINITION_REPRESENTATION(#11,#19);
#12=(LENGTH_UNIT)NAMED_UNIT('SI_UNIT(MILLI,METRE,););
#13=(NAMED_UNIT('PLANE_ANGLE_UNIT(SI_UNIT(S,RADIAN,););
#14=(NAMED_UNIT('SI_UNIT(S,STERADIAN,SOLID_ANGLE_UNIT));
#16=(GEOMETRIC_REPRESENTATION_CONTEXT)(GLOBAL_UNCERTAINTY_ASSIGNED_CONTEXT(#15)GLOBAL_UNIT_ASSIGNED_CONTEXT(#12,#13,#14)REPRESENTATION_CONTEXT('));
ENDSEC;
```

Catia V5-6R2014



```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION('','',2;1);
FILE_NAME('STANDARD_KOSY_CRE030','2015-06-24T','claudia.kleinschrodt','');
PRO/ENGINEER BY PARAMETRIC TECHNOLOGY CORPORATION, 20140900,
PRO/ENGINEER BY PARAMETRIC TECHNOLOGY CORPORATION, 20140900';
FILE_SCHEMA('AUTOMOTIVE_DESIGN { 1 0 10303 214 1 1 1 1 }');
```

```
ENDSEC;
DATA;
#19=CARTESIAN_POINT('','(0,0,0,0,0,0));
#20=DIRECTION('','(0,0,0,0,1,0,0));
#21=DIRECTION('','(1,0,0,0,0,0,0));
#22=AXIS2_PLACEMENT_3D('KSYS',#19,#20,#21);
#23=DRAUGHTING_PRE_DEFINED_CURVE_FONT('continuous',#24);
#24=CURVE_STYLE('','#23,POSITIVE_LENGTH_MEASURE(0.7),#27);
#25=PRESENTATION_STYLE_ASSIGNMENT('(#24);
#26=STYLED_ITEM('(#25),#22);
#27=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#28=DIRECTION('','(1,0,0,0,0,0,0));
#29=DIRECTION('','(0,0,1,0,0,0,0));
#30=AXIS2_PLACEMENT_3D('','#27,#28,#29);
#31=PLANE('RIGHT',#30);
#32=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#33=DIRECTION('','(0,0,1,0,0,0,0));
#34=DIRECTION('','(0,0,0,0,1,0,0));
#35=AXIS2_PLACEMENT_3D('','#32,#33,#34);
#36=PLANE('GREEN',#35);
#37=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#38=DIRECTION('','(0,0,0,0,1,0,0));
#39=DIRECTION('','(1,0,0,0,0,0,0));
#40=AXIS2_PLACEMENT_3D('','#37,#38,#39);
#41=PLANE('ORANGE',#40);
#42=PRESENTATION_LAYER_ASSIGNMENT('EBENEN','',#31,#36,#41);
#43=PRESENTATION_LAYER_ASSIGNMENT('KOSYS','',#22);
#46=PLANE_ANGLE_MEASURE_WITH_UNIT(PLANE_ANGLE_MEASURE(1.7453292519946-2),#45);
#47=(CONVERSION_BASED_UNIT(DEGREE)#46)NAMED_UNIT('PLANE_ANGLE_UNIT));
#49=UNCERTAINTY_MEASURE_WITH_UNIT(LENGTH_MEASURE(3.4725443380506-2),#44,'distance_accuracy_value','Maximum model space distance between geometric entities at asserted connectivities');
#52=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#53=DIRECTION('','(0,0,0,0,1,0,0));
#54=DIRECTION('','(1,0,0,0,0,0,0));
#57=CONSTRUCTIVE_GEOMETRY_REPRESENTATION_RELATIONSHIP('','',#56,#51);
#58=MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION('','',#26),#50);
#59=APPLICATION_CONTEXT('automotive_design');
#60=APPLICATION_PROTOCOL_DEFINITION('international_standard','automotive_design',2001,#59);
#61=PRODUCT_DEFINITION_CONTEXT('part definition',#59,'design');
#62=PRODUCT_CONTEXT('','',#59,'mechanical');
#63=PRODUCT('STANDARD_KOSY_CRE030','STANDARD_KOSY_CRE030','NOT SPECIFIED',#62);
#64=PRODUCT_DEFINITION_FORMATION('','LAST_VERSION',#63);
#68=PRODUCT_RELATED_PRODUCT_CATEGORY('part','',#63);
#1=DRAUGHTING_PRE_DEFINED_COLOUR('blue');
#2=DRAUGHTING_PRE_DEFINED_COLOUR('green');
#3=COLOUR_RGB('1.1E-2,1.2E-2,1.0E-1);
#4=COLOUR_RGB('3.92E-1,2.2E-1,2.2E-2);
#5=COLOUR_RGB('4.1E-1,0.0E,2.2E-1);
#6=COLOUR_RGB('5.019607843137E-1,5.019607843137E-1,5.019607843137E-1);
#7=COLOUR_RGB('6.E-1,4.E-1,2.E-1);
#8=COLOUR_RGB('6.E-1,4.E-1,4.E-1);
#9=COLOUR_RGB('6.92E-1,7.426E-1,7.9E-1);
#10=COLOUR_RGB('7.84314E-1,7.84314E-1,7.84314E-1);
#11=COLOUR_RGB('8.E-1,8.E-1,8.E-1);
#12=COLOUR_RGB('8.784E-1,9.49E-1,1.0E-1);
#13=COLOUR_RGB('9.6E-1,9.6E-1,9.6E-1);
#14=COLOUR_RGB('9.8E-1,6.27E-1,0.0E-1);
#15=DRAUGHTING_PRE_DEFINED_COLOUR('red');
#16=DRAUGHTING_PRE_DEFINED_COLOUR('yellow');
#17=COLOUR_RGB('1.0E,1.0E,0.49E-1);
#18=DRAUGHTING_PRE_DEFINED_COLOUR('white');
#44=(LENGTH_UNIT)NAMED_UNIT('SI_UNIT(MILLI,METRE,););
#45=(NAMED_UNIT('PLANE_ANGLE_UNIT(SI_UNIT(S,RADIAN,););
#48=(NAMED_UNIT('SI_UNIT(S,STERADIAN,SOLID_ANGLE_UNIT));
#50=(GEOMETRIC_REPRESENTATION_CONTEXT)(3)GLOBAL_UNCERTAINTY_ASSIGNED_CONTEXT((#49)GLOBAL_UNIT_ASSIGNED_CONTEXT((#44,#47,#48)REPRESENTATION_CONTEXT('101','3));
#51=CONSTRUCTIVE_GEOMETRY_REPRESENTATION('supplemental geometry',#22,#31,#36,#41),#50);
#55=AXIS2_PLACEMENT_3D('','',#52,#33,#54);
#56=SHAPE_REPRESENTATION('','',#55),#50);
#65=PRODUCT_DEFINITION('part definition','',#64,#61);
#66=PRODUCT_DEFINITION_SHAPE('','SHAPE FOR STANDARD_KOSY_CRE030',#65);
#67=SHAPE_DEFINITION_REPRESENTATION(#66,#56);
ENDSEC;
```

Creo 3.0 M030

```
ISO-10303-21;
HEADER;
/* Generated by software containing ST-Developer
* from STEP Tools, Inc. (www.steptools.com)
*/
/* OPTION: using custom schema-name function */
FILE_DESCRIPTION('description ' ('),
/* implementation_level ' / 2;1);
```

```
FILE_NAME[
/* name ' / standard_KoSy_nx10.stp,
/* time_stamp ' / 2015-06-24T09:03:40+02:00,
/* author ' ('),
/* organization ' ('),
/* preprocessor_version ' / ST-DEVELOPER V16',
/* originating_system ' / SIEMENS PLM Software NX 10.0,
/* authorisation ' / '];
```

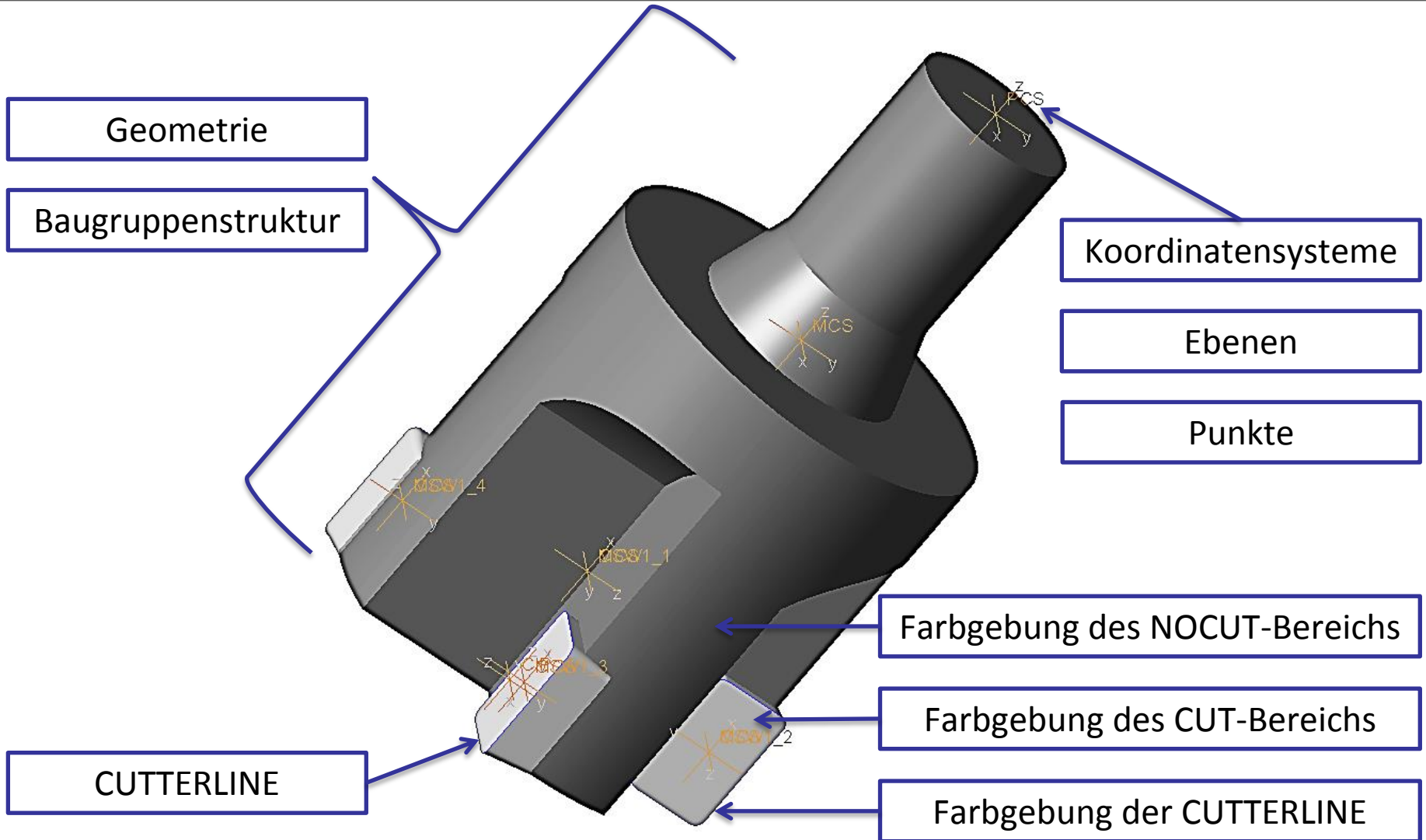
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FILE_SCHEMA (('AUTOMOTIVE_DESIGN { 1 0 10303 214 3 1 1 1 }));
ENDSEC;
DATA;
#10=CONSTRUCTIVE_GEOMETRY_REPRESENTATION_RELATIONSHIP('supplemental geometry',#22,#11);
#11=CONSTRUCTIVE_GEOMETRY_REPRESENTATION('supplemental geometry',#30),#38);
#12=SHAPE_DEFINITION_REPRESENTATION(#13,#22);
#13=PRODUCT_DEFINITION_SHAPE('','',#14);
#14=PRODUCT_DEFINITION('','',#15);
#15=PRODUCT_DEFINITION_CONTEXT('part definition',#21,'design');
#16=PRODUCT_DEFINITION_FORMATION_WITH_SPECIFIED_SOURCE('','',#18,NOT_KNOWN);
#17=PRODUCT_RELATED_PRODUCT_CATEGORY('part','',#18);
#18=PRODUCT('standard_KoSy_nx10','standard_KoSy_nx10','',#19);
#19=PRODUCT_CONTEXT('','',#21,'mechanical');
#20=APPLICATION_PROTOCOL_DEFINITION('international_standard','automotive_design',2010,#21);
#21=APPLICATION_CONTEXT('core data for automotive mechanical design processes);
#22=SHAPE_REPRESENTATION('standard_KoSy_nx10-None',#29),#38);
#23=PRESENTATION_LAYER_ASSIGNMENT('S1','Layer 61',#30);
#24=STYLED_ITEM('','',#25),#30);
#25=PRESENTATION_STYLE_ASSIGNMENT('','',#26);
#26=CURVE_STYLE('','',#28,POSITIVE_LENGTH_MEASURE(0.7),#27);
#27=COLOUR_RGB('Medium Maroon',0.6,0.4,0.4);
#28=DRAUGHTING_PRE_DEFINED_CURVE_FONT('continuous');
#29=AXIS2_PLACEMENT_3D('','',#35,#31,#32);
#30=AXIS2_PLACEMENT_3D('','',#36,#33,#34);
#31=DIRECTION('','(0,0,1,0,0,0,0));
#32=DIRECTION('','(1,0,0,0,0,0,0));
#33=DIRECTION('','(0,0,1,0,0,0,0));
#34=DIRECTION('','(1,0,0,0,0,0,0));
#35=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#36=CARTESIAN_POINT('','(0,0,0,0,0,0,0));
#37=MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION('','',#24),#38);
#38=(
GEOMETRIC_REPRESENTATION_CONTEXT(3)
GLOBAL_UNCERTAINTY_ASSIGNED_CONTEXT((#39))
GLOBAL_UNIT_ASSIGNED_CONTEXT((#45,#41,#40))
REPRESENTATION_CONTEXT('standard_KoSy_nx10','TOP_LEVEL_ASSEMBLY_PART')
);
#39=UNCERTAINTY_MEASURE_WITH_UNIT(LENGTH_MEASURE(2.E-5),#45,'DISTANCE_ACCURACY_VALUE','Maximum Tolerance applied to model');
#40=(
NAMED_UNIT('SI_UNIT(S,STERADIAN)
SOLID_ANGLE_UNIT)
);
#41=(
CONVERSION_BASED_UNIT(DEGREE',#43)
NAMED_UNIT(#42)
PLANE_ANGLE_UNIT)
);
#42=DIMENSIONAL_EXPONENTS(0,0,0,0,0,0,0,0);
#43=PLANE_ANGLE_MEASURE_WITH_UNIT(PLANE_ANGLE_MEASURE(0.174532925),#44);
#44=(
NAMED_UNIT('SI_UNIT(S,RADIAN)
PLANE_ANGLE_UNIT)
);
#45=(
LENGTH_UNIT)
NAMED_UNIT('SI_UNIT(MILLI,METRE,););
);
ENDSEC;
```

NX 10.0

Beispiel eines 3D-CAD-Modells eines Werkzeugs



Merkmale eines Schaftfräasers

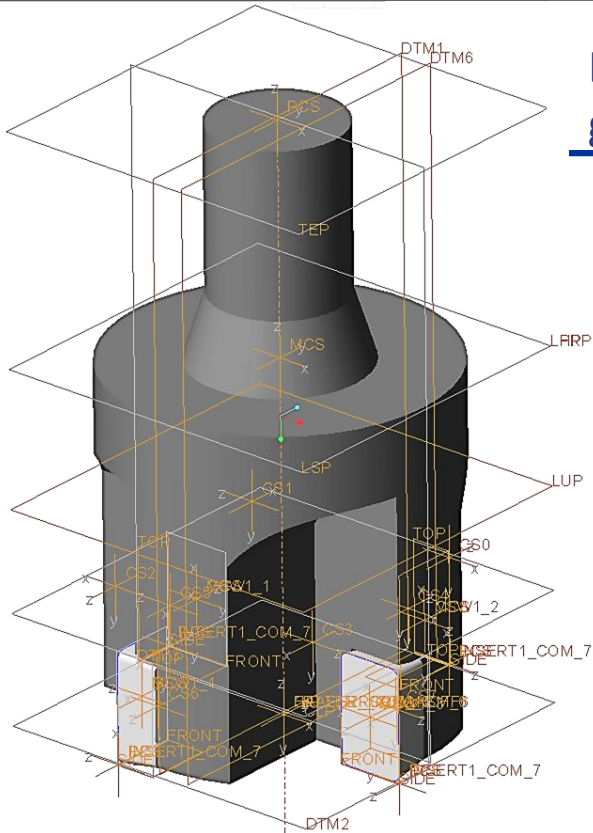


Beispiel eines 3D-CAD-Modells eines Werkzeugs

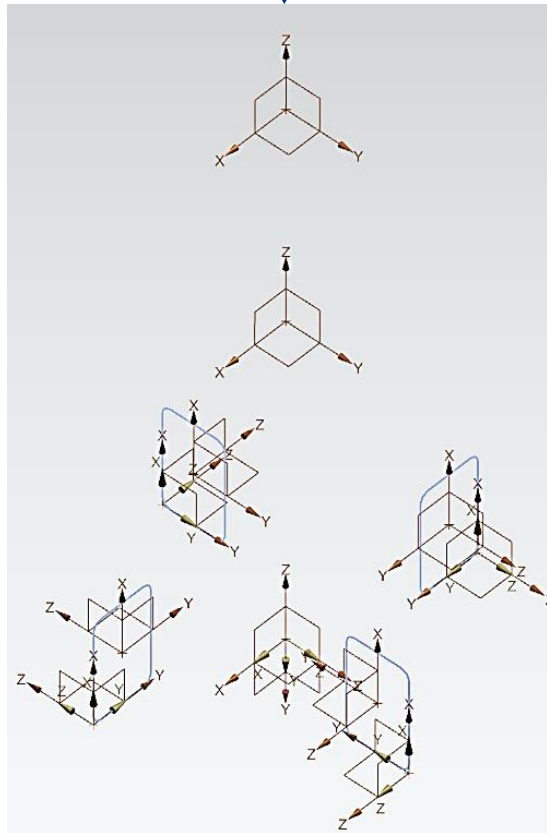


Aus Creo 3.0 exportierte STEP in NX 10.0

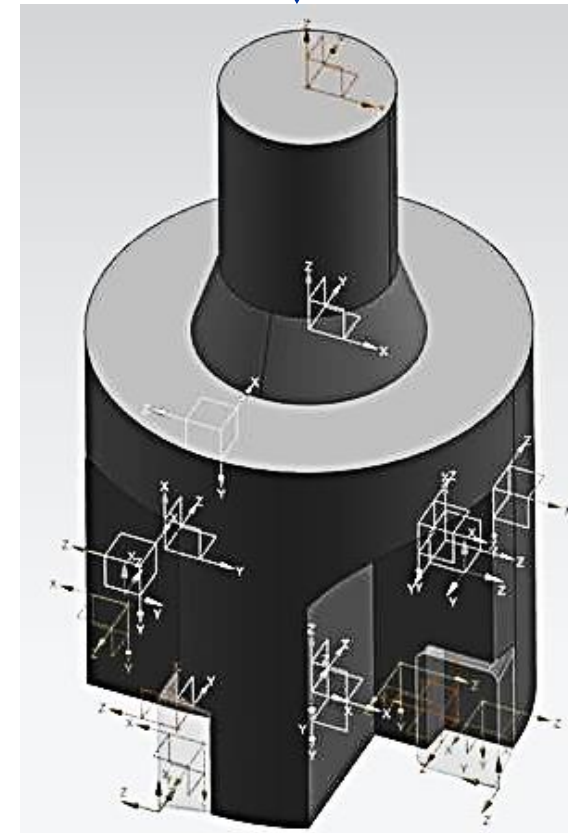
Ergebnis der Übertragung abhängig von den
gewählten Ex- und Importeinstellungen



Creo 3.0 M030



NX10.0



Beispiel eines 3D-CAD-Modells eines Werkzeugs



Zusammenfassung der Untersuchungen am ausgewählten Werkzeug

Ergebnisse der Übertragung nach DIN 4003	EXPORT	Import		
		Pro/E Wildfire 5.0	Catia V5R21	NX 7.5
Pro/E Wildfire 5.0	+ + + + +	+ + + + +	+ + ● ● +	+ - ● ● -
Catia V5R21	+ + + + +	+ + + + +	+ + + + +	+ - ● ● +
NX 7.5	+ ● ● + +	+ ● ● + +	+ - ● + +	+ ● ● + +

Ergebnisse der Übertragung nach DIN 4003	EXPORT	Import		
		Creo 3.0 M030	Catia V5-6R2014	NX 10.0
Creo 3.0 M030	+ + + + +	+ + + + +	+ + ● + +	+ ● ● + +
Catia V5-6R2014	+ + + + +	+ + ● + +	+ + + + +	+ ● ● + +
NX 10.0	+ - ● + +	+ - ● + +	+ - ● + +	+ - ● + +

- Geometrie
- Schneidkantenlinie
- übertragen
- Koordinatensysteme
- Baugruppenstruktur
- teilweise übertragen
- Farbe (Cut, Nocut, Schneidkantenlinie)
- nicht übertragen



- Breite Analyse des Datenaustauschs anhand diverser Werkzeuge und verschiedener CAD-Systeme
- Konstruktionsempfehlungen
- Handlungsempfehlungen für Ex- und Importeinstellungen
- Programm „STEP-file Checker“ zur automatischen Überprüfung von STEP-Dateien
- Berücksichtigung der Anforderungen aus der Industrie durch regelmäßige Umfragen



- Analyse der Austauschqualität weiterer CAD-Programme
- Validierung der Ergebnisse anhand weiterer Beispiele
- Optimierung des „STEP-file Checker“
- Eingabe der Ergebnisse in Normengremien