“Metrology Standards Activities” at the Automotive Industry Action Group (AIAG)

Robert Waite
DaimlerChrysler

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

ia.cmm International Conference
Sinsheim (Germany), April 28th, 2005

Metrology Interoperability Project Team (MIPT)

Consists of a broad base of global corporations and universities collaborating to resolve metrology system interoperability issues.

<u>Responsibilities Include:</u>

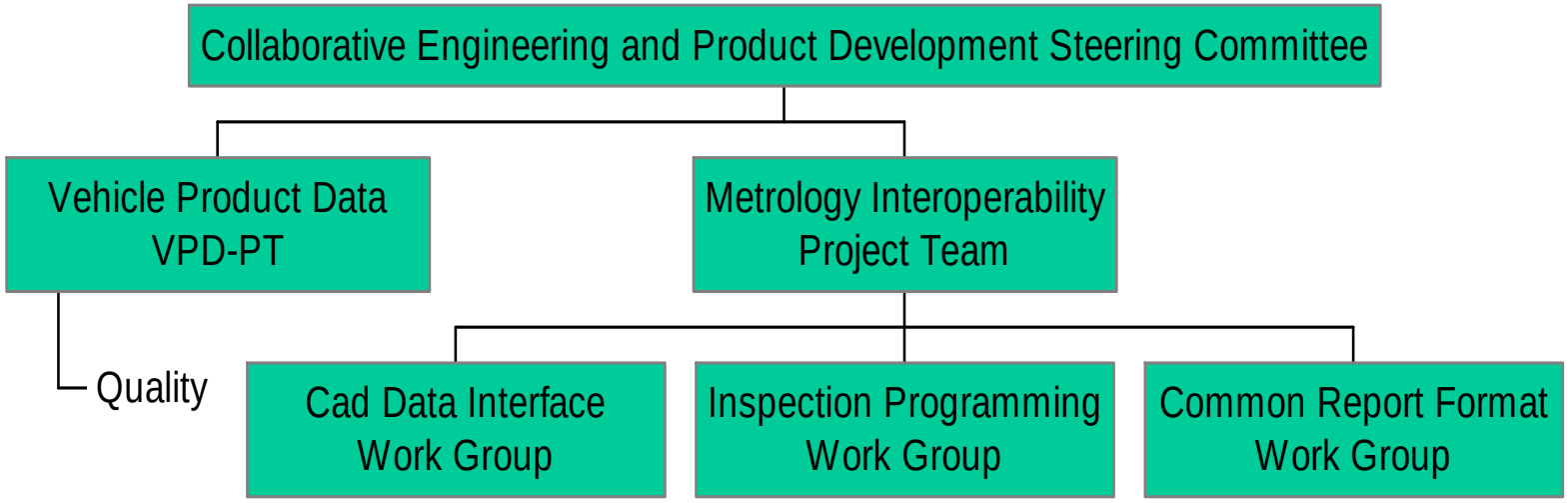
- Development of a Standards Infrastructure
- Coordination of Standards Efforts, US and Europe
  - I++/DME = Any software runs any CMM
  - European DMIS Users Group (EDUG)
- Management of (3) Work Groups

Work Teams

The project team organized three work groups to resolve the high priority interface issues.

- Inspection Program Portability
- Common Inspection Results Data Format
- CAD Data Flow to Machine Software

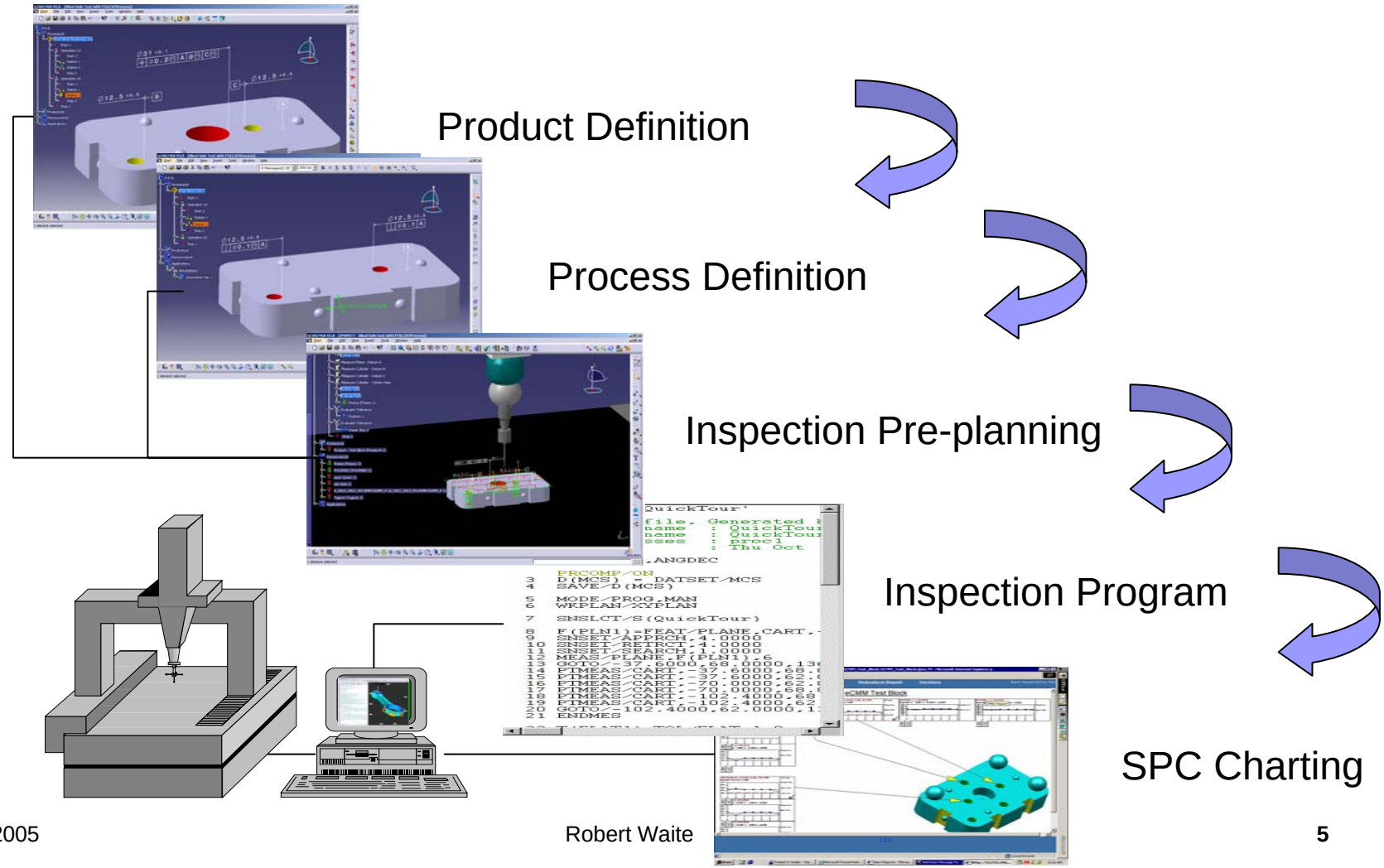
Metrology Interoperability Project Team (MIPT)



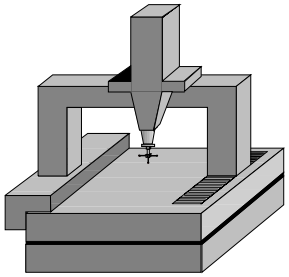
AIAG

Chair: Robert Waite — DaimlerChrysler
Co-Chair: Glen Allan — Ford
SPC Ad-Hoc: Richard Engel — General Motors

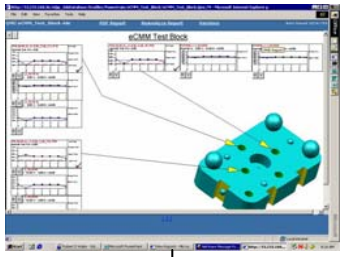
Design and Planning



Execution and Analysis

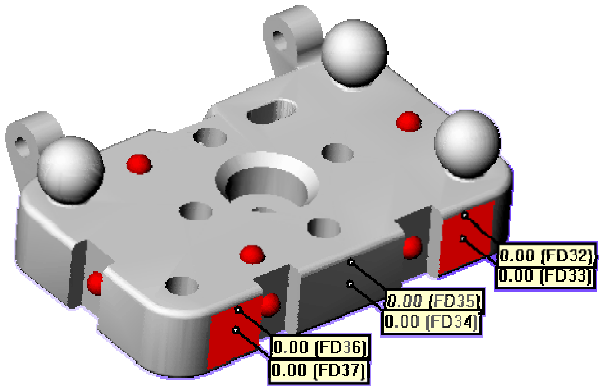


DML

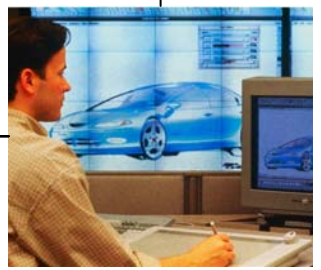


Corp CMM Database

Local CMM



Corp Quality Database

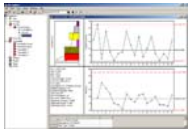


User

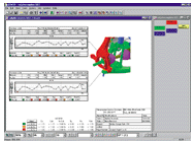
?

?

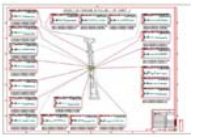
Local OP 10



Local OP 20



Local Op 30

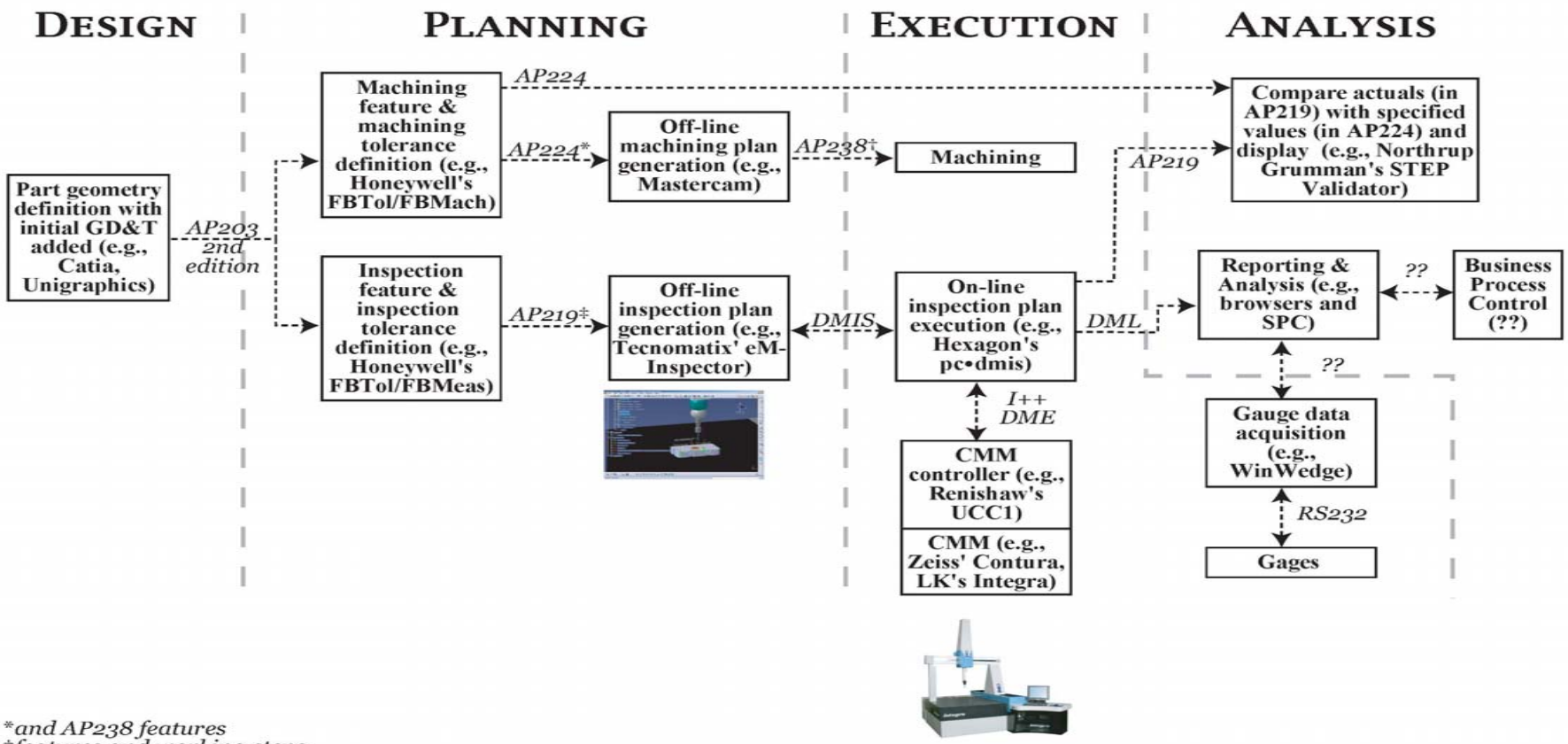


2 ite

The MIPT Approach

ia.cmm INTERNATIONAL ASSOCIATION CMM MANUFACTURERS

Standards Infrastructure for Dimensional Metrology and Machining Systems

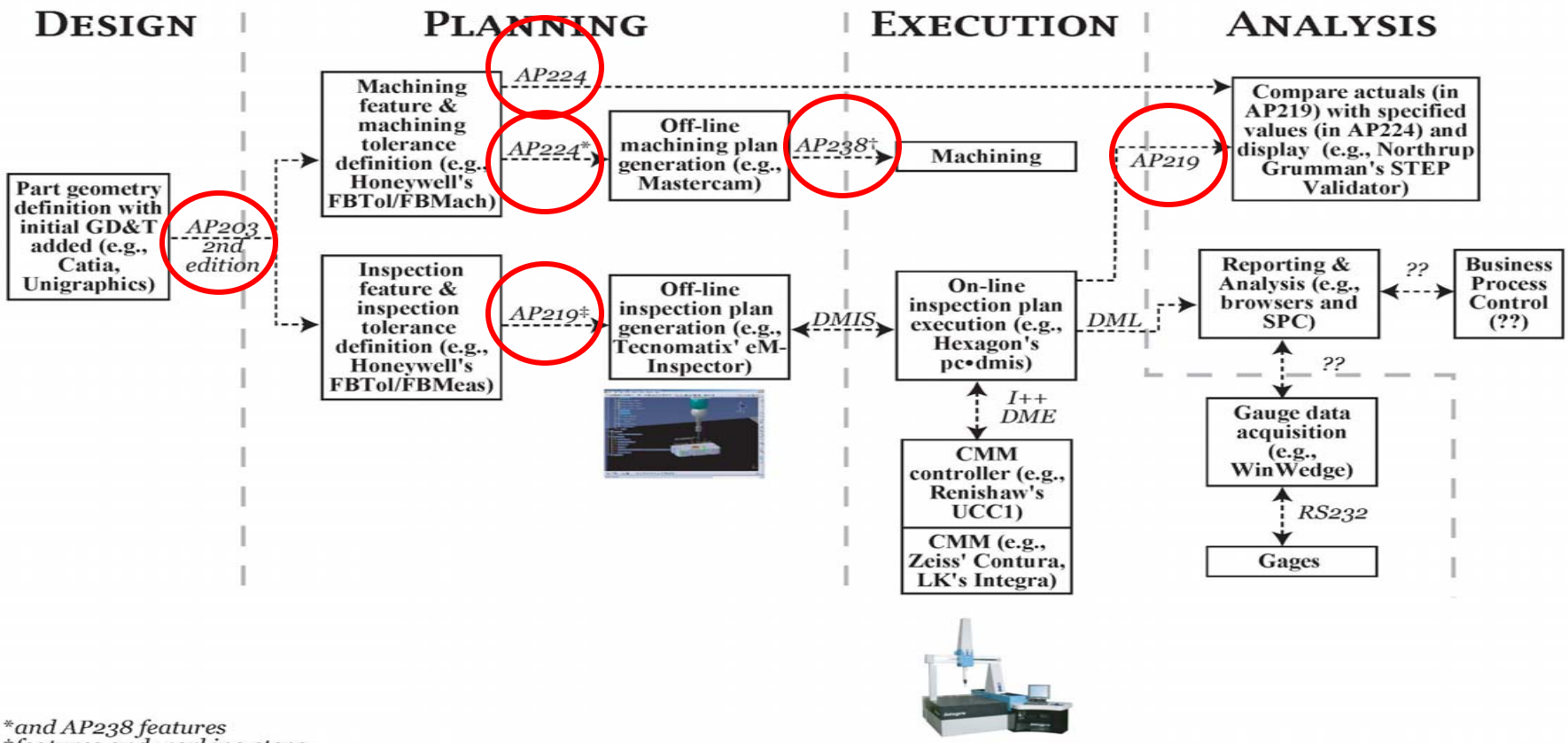


*and AP238 features
†features and working steps
‡contains reference to part geometry

1/26/05 (Horst)

CAD Data Work Group

Standards Infrastructure for Dimensional Metrology and Machining Systems



*and AP238 features
†features and working steps
‡contains reference to part geometry

1/26/05 (Horst)

Standard for the Exchange of Product Model Data (STEP)

•Geometry	STEP 203
•Automotive Design	STEP 214
•Machining Features	STEP 224
•Inspection Features	STEP 219*
•NC Information	STEP 238

*CD Ballot Review, tentative completion summer of '06

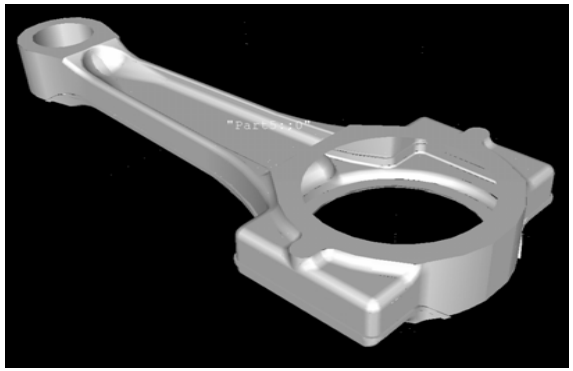


Figure 1: STEP part (AP203) of the connecting rod from DaimlerChrysler loaded into I-DEAS 8.2.

Pro's

- Reduces cost of data transfer
- Reduces cost of data repair
- Allows re-use of existing data
- Eliminates cost of custom translators

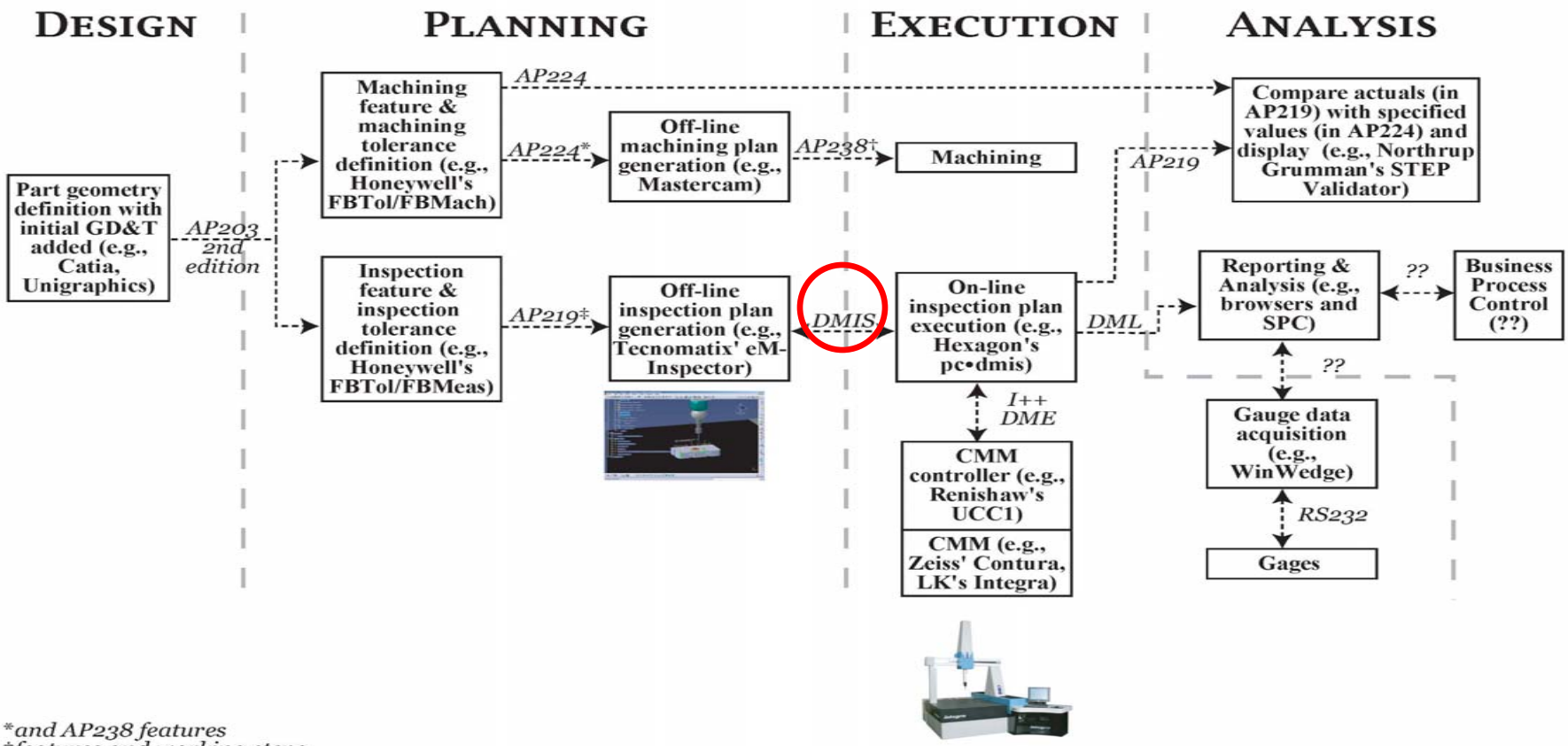
Con's

- Complex
- Long development times
- Acceptance by suppliers

Inspection Program Work Group

ia.cmm INTERNATIONAL ASSOCIATION CMM MANUFACTURERS

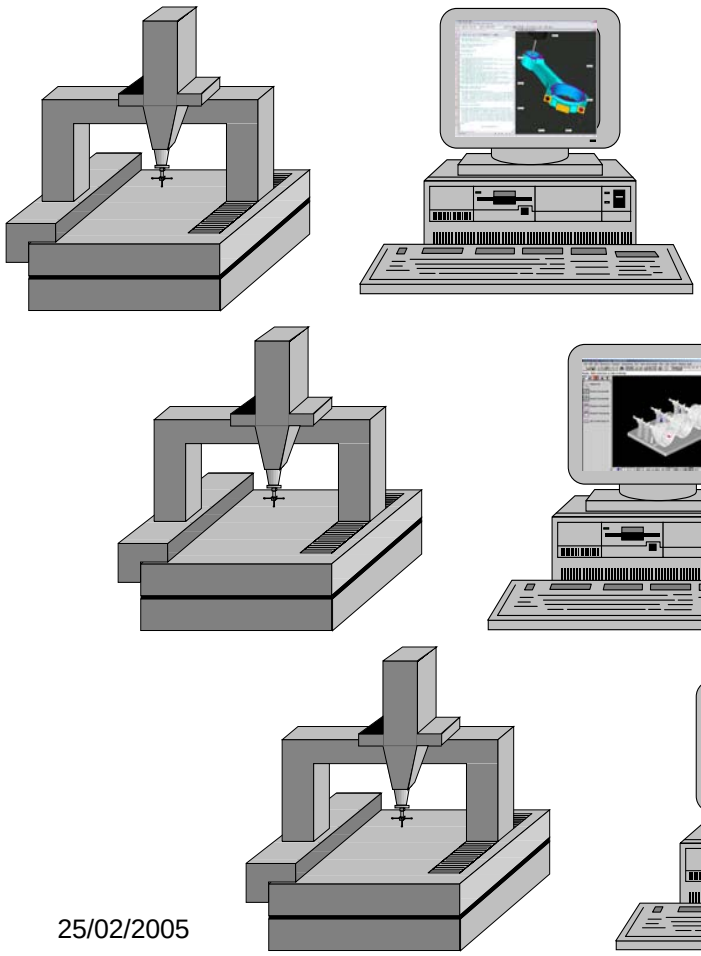
Standards Infrastructure for Dimensional Metrology and Machining Systems



*and AP238 features
†features and working steps
‡contains reference to part geometry

1/26/05 (Horst)

Inspection Program Work Group



Dimensional Measurement Interface Standard DMIS 5.0

```
>>1   DMISMN/'QuickTour'
      $$ DMIS file, Generated
      $$ Task name   : QuickTou
      $$ Cell name   : QuickTou
      $$ Processes   : proc1
      $$ Date        : Thu Oct
  2   UNITS/Mm,ANGDEC
      PRCOMP/ON
  3   D(MCS) = DATSET/MCS
  4   SAVE/D(MCS)
  5   MODE/PROG,MAN
  6   WKPLAN/XYPLAN
  7   SNSLCT/S(QuickTour)
  8   F(PLN1)=FEAT/PLANE,CART,-
  9   SNSET/APPRCH,4.0000
 10   SNSET/RETRCT,4.0000
 11   SNSET/SEARCH,1.0000
 12   MEAS/PLANE,F(PLN1),6
 13   GOTO/-37.6000,68.0000,13
 14   PTMEAS/CART,-37.6000,68.
 15   PTMEAS/CART,-37.6000,62.
 16   PTMEAS/CART,-70.0000,62.
 17   PTMEAS/CART,-70.0000,68.
 18   PTMEAS/CART,-102.4000,68
 19   PTMEAS/CART,-102.4000,62
 20   GOTO/-102.4000,62.0000,1
 21   ENDMES
```

DMIS Conformance Classes

Describes a subset of Major / Minor Words and Parameters

Priority 1	Necessary to accurately/completely measure and report a typical powertrain component				
Priority 2	Necessary to implement the off-line tool for production				
Priority 3	"Nice to have" or not applicable to powertrain - future development				
COMMAND	PARAMETERS		DEVELOPMENT PRIORITY		
ACLRAT	ACLRAT/var_1			2	
	var_1	MESACL,var_2		2	
		POSACL,var_2		2	
		ROTACL,var_3		2	
	var_2	MPMM,n			3
		MMPSS,n			3
		IPMM,n			3
		IPSS,n			3
		var_4		2	
	var_3	RPMM,n			3
		var_4		2	
	var_4	PCENT,n		2	
		HIGH			3
		LOW			3
		DEFAULT			3
ALGDEF	VA(label)=ALGDEF/var_1				3
	var_1	CODE,n			3
		'name' var_2			3
	var_2	,parameter var_2			3
ASSIGN	varname=ASSIGN/expr			2	
BADTST	BADTST/var_1			2	
	var_1	ON		2	
		OFF		2	
BOUND	BOUND/var_1 var_2 var_3		1		
	var_1	F(label1)	1		
		T(label1)	1		
	var_2	F(label3)	1		
		FA(label4)	1		

Application Profiles

- Specific to a domain:
  - Power Train
  - Sheet Metal
  - Aerospace

Initial Development by David Amstutz

DMIS Conformance Classes

Pro's

- Allows the customer to specify what areas of the DMIS standard a supplier must conform to
- Allows suppliers to self-certify compliance to the DMIS standard
- Provides a basis for interoperability testing

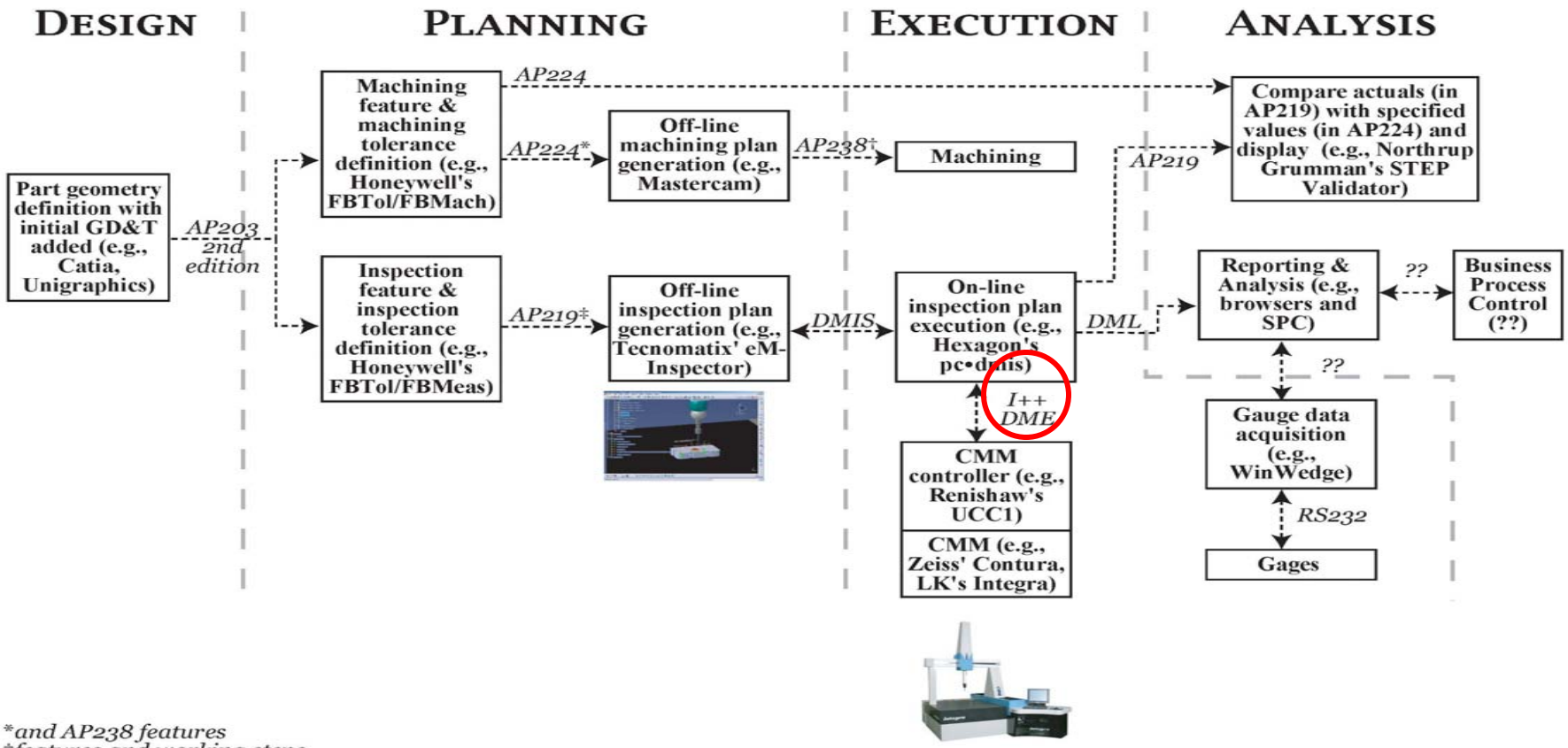
Con's

- Acceptance by suppliers
- Acceptance by power train users
- Effectively a competitive machine language

I++/DME
Interface Standard

ia.cmm INTERNATIONAL ASSOCIATION CMM MANUFACTURERS

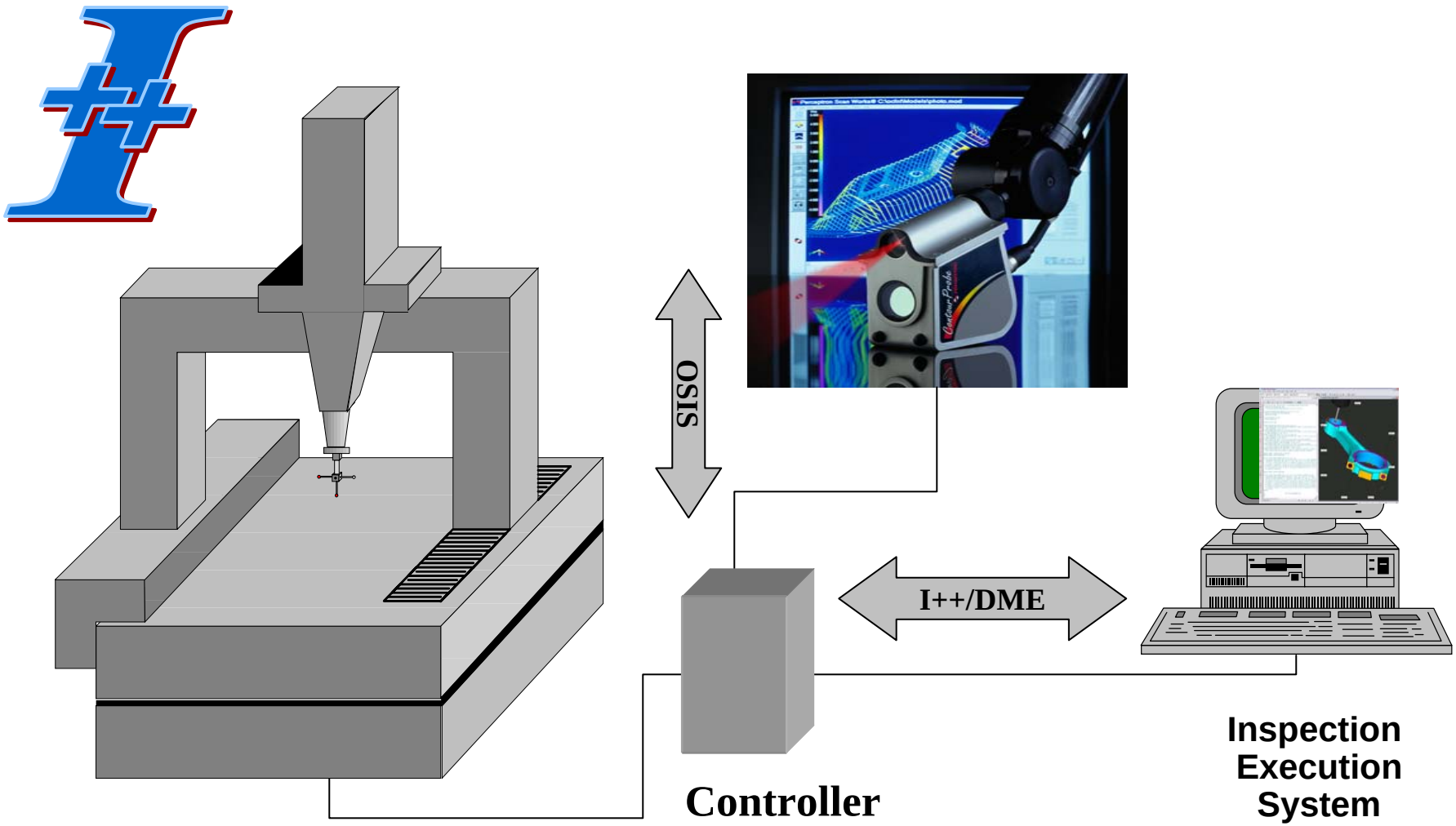
Standards Infrastructure for Dimensional Metrology and Machining Systems



*and AP238 features
†features and working steps
‡contains reference to part geometry

1/26/05 (Horst)

I++/DME Interface



I++/DME Interface

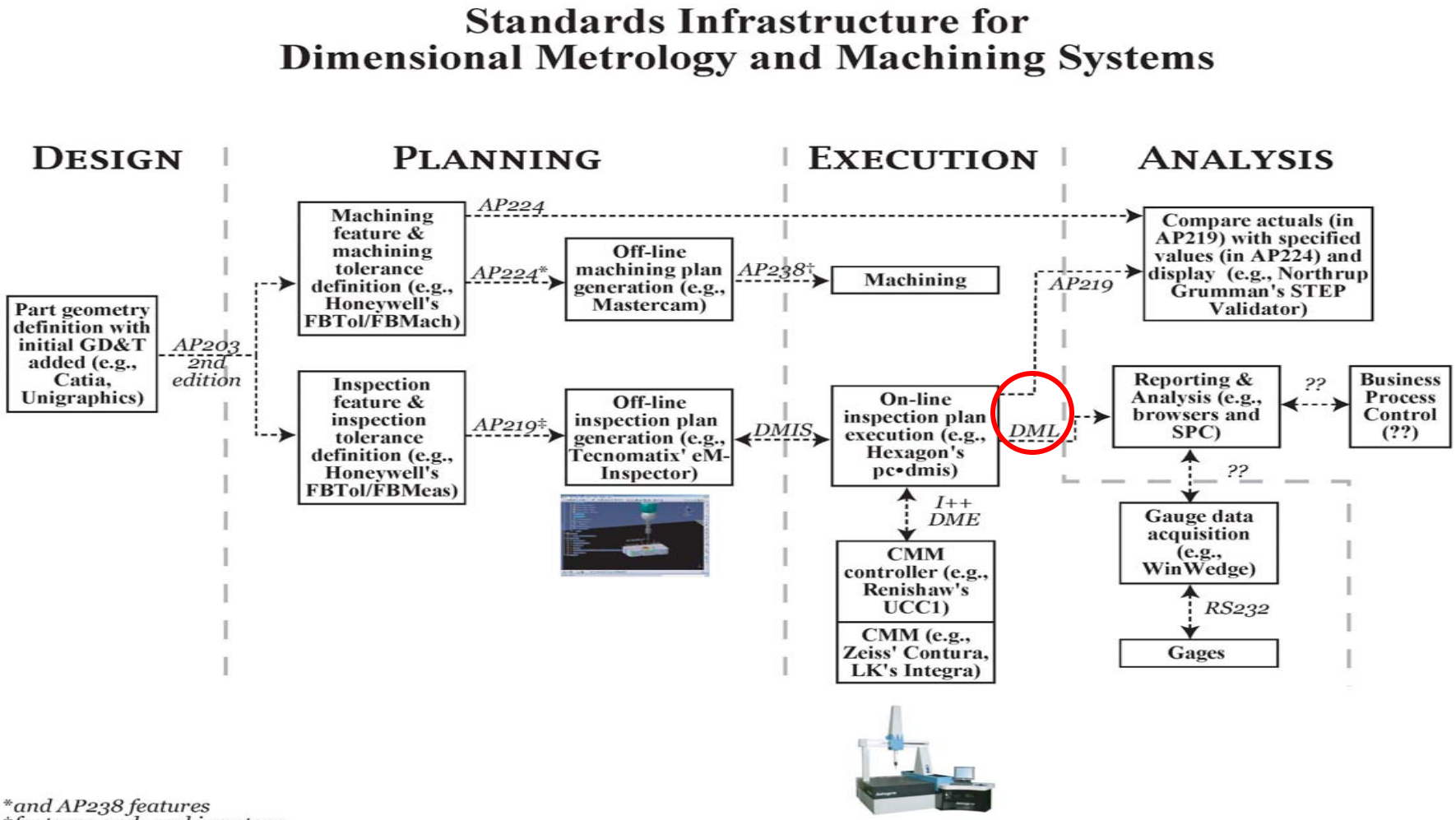
<u>Pro‘s</u>

- Sensor and claibration technology remains on the server side.
- Well described
- Allows for integration of a common user interface

<u>Con‘s</u>

- Requires two interfaces one for programming, one for calibration of tools
- May not support all information required from the planning stage
- May not be accepted by suppliers

Dimensional Markup Language (DML)



Dimensional Markup Language (DML)

- Describes all information required for analysis or re-analysis of CMM coordinate data.
- Moves single file packages of inspection results
- Format is directly compatible with next generation web technology

Dimensional Markup Language (DML)

INTERNATIONAL ASSOCIATION CMM MANUFACTURERS

Pro's

- All data required for analysis or re-analysis of a single inspection run
- Harmonized with STEP AP219 and DMIS
- Directly compatible with latest web technology

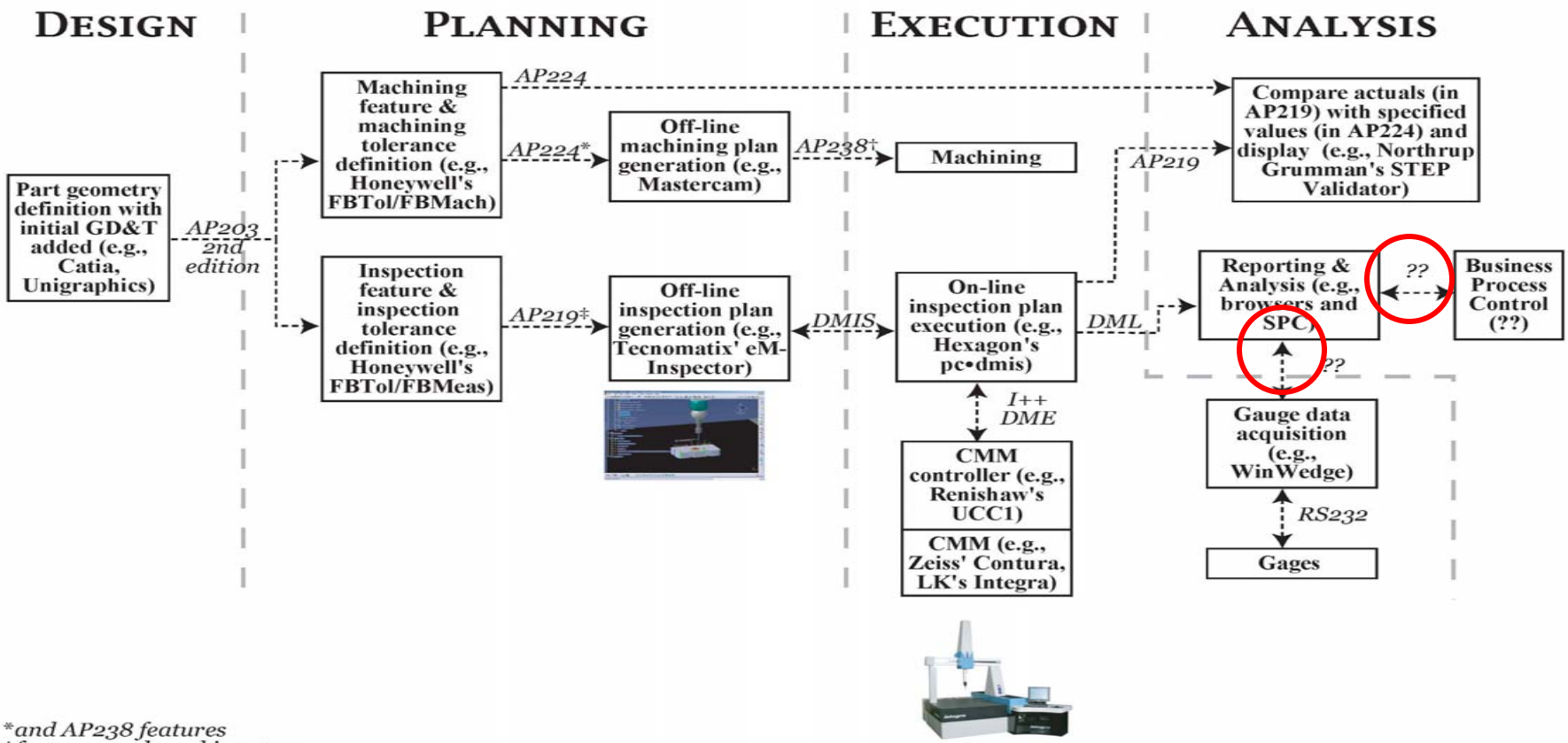
Con's

- Increased data file size
- Not efficient at hauling SPC data requirements

Ad-Hoc Committee
"SPC Data Hauling Requirements"

ia.cmm INTERNATIONAL ASSOCIATION CMM MANUFACTURERS

Standards Infrastructure for Dimensional Metrology and Machining Systems

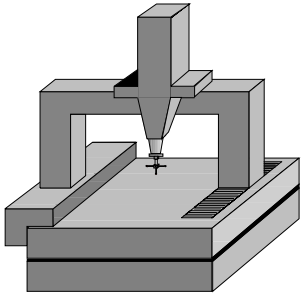


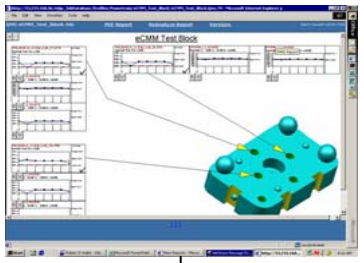
*and AP238 features
†features and working steps
‡contains reference to part geometry

1/26/05 (Horst)

Ad-Hoc Committee
“SPC Data Hauling Requirements”

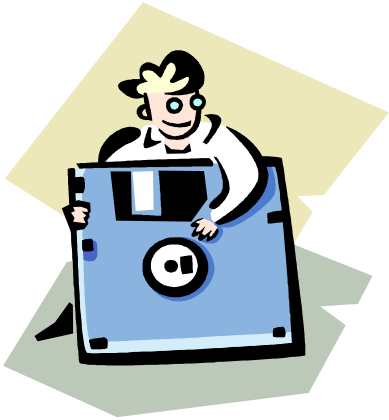
ia.cmm INTERNATIONAL ASSOCIATION • CMM MANUFACTURERS





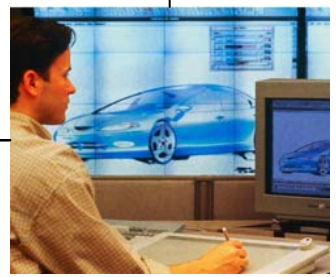
DML

Local CMM



Corp CMM Database

Corp Quality Database

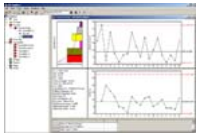


User

?

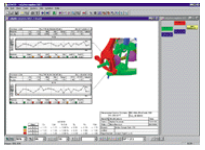
QML?

Local OP 10

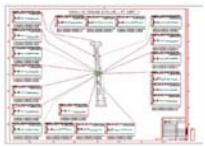


ıite

Local OP 20

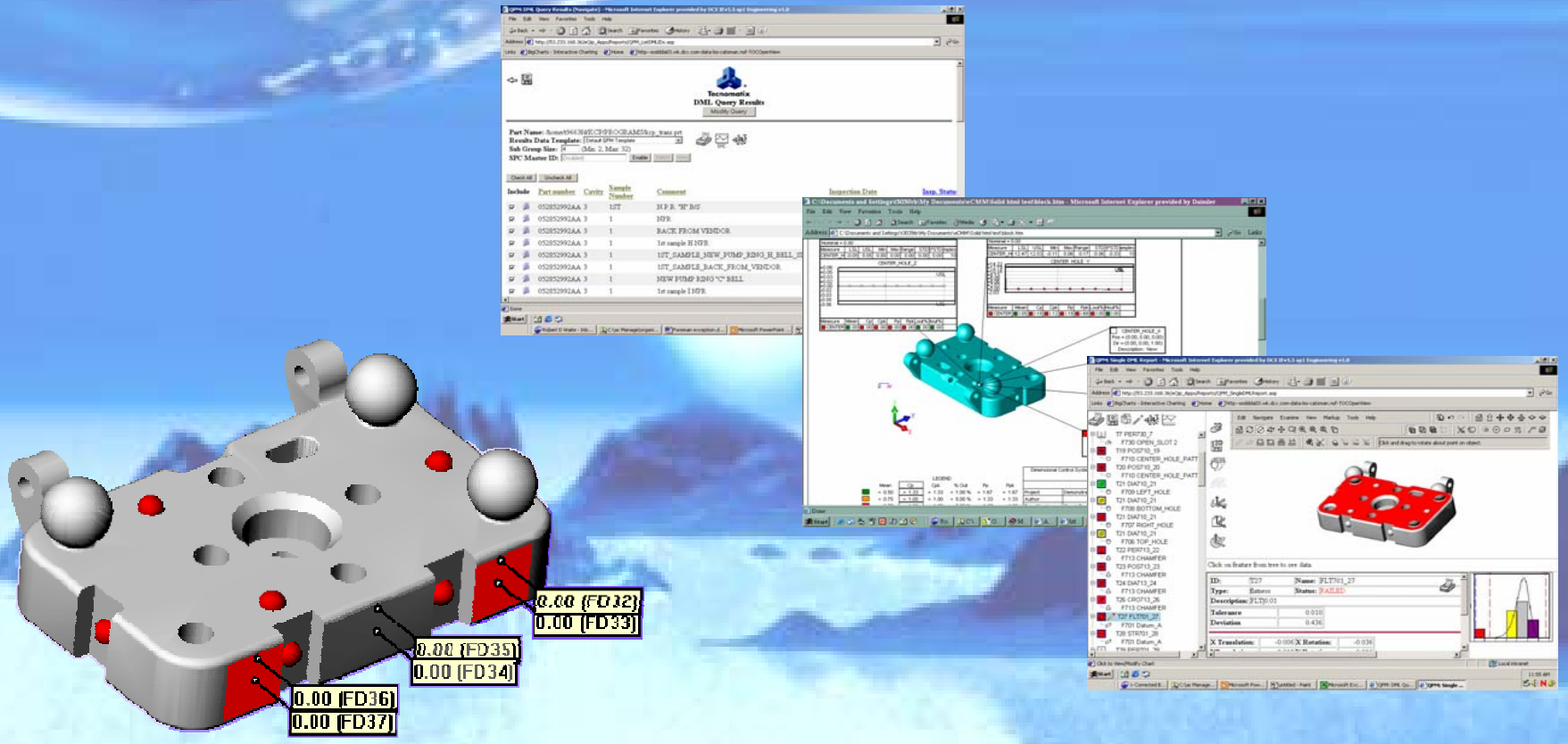


Local Op 30



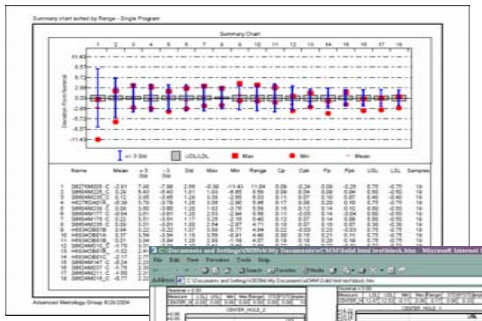
Web based Quality Process

eCMM

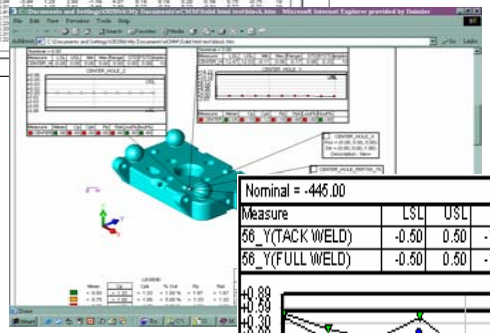


New products are enabled by new standards!

"The value of speaking in a common language."

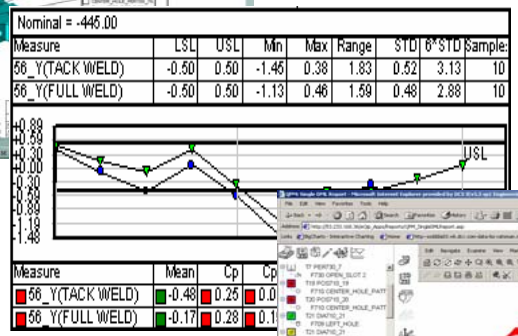


Summarize quality problems



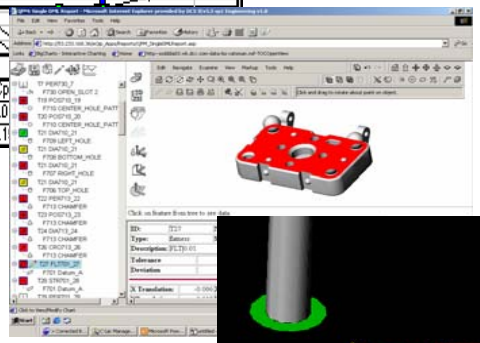
Determine process capability

GDM3D

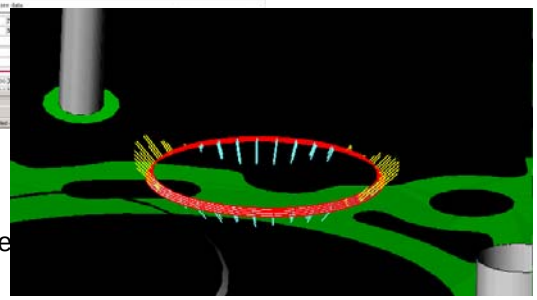


Correlate multiple gage results

DML



Investigate specific data files



Graphical display of feature data

eM-Insight

Current ’05 Objectives

- Completion of I++/DME integrations and testing
- Publish Dimensional Markup Language
- Publish DMIS Application Profiles
- Consensus of an SPC industry standard
- Two standards demonstrations
  - Quality Expo April, 2005
  - Control Show in Germany April, 2005
- Proof of concept test for CAD data standards

Next Steps

Ad-hoc committee collaborating on SPC data hauling requirements

- •Community acceptance of one standard
- •Determine user requirements
- •Harmonization issues

<u>Status</u>

- ➢AIAG ad-hoc committee formed Feb 15, 2005
  - •Committee meeting March 2005
  - •Next meeting is in mid May
  - •QML, DML, ?

Collaboration

Collaboration is enabled by standard practices…….

- Users must agree to support a standards infrastructure even if they do not intend to use a particular standard.
- The infrastructure must support a wide variety of different processes for different corporations
- There must be objective testing and integration support
- There must be enforcement by purchase contracts to only buy interoperable solutions

Metrology Standards Demonstration
Quality Expo 2005
Chicago, Illinois USA