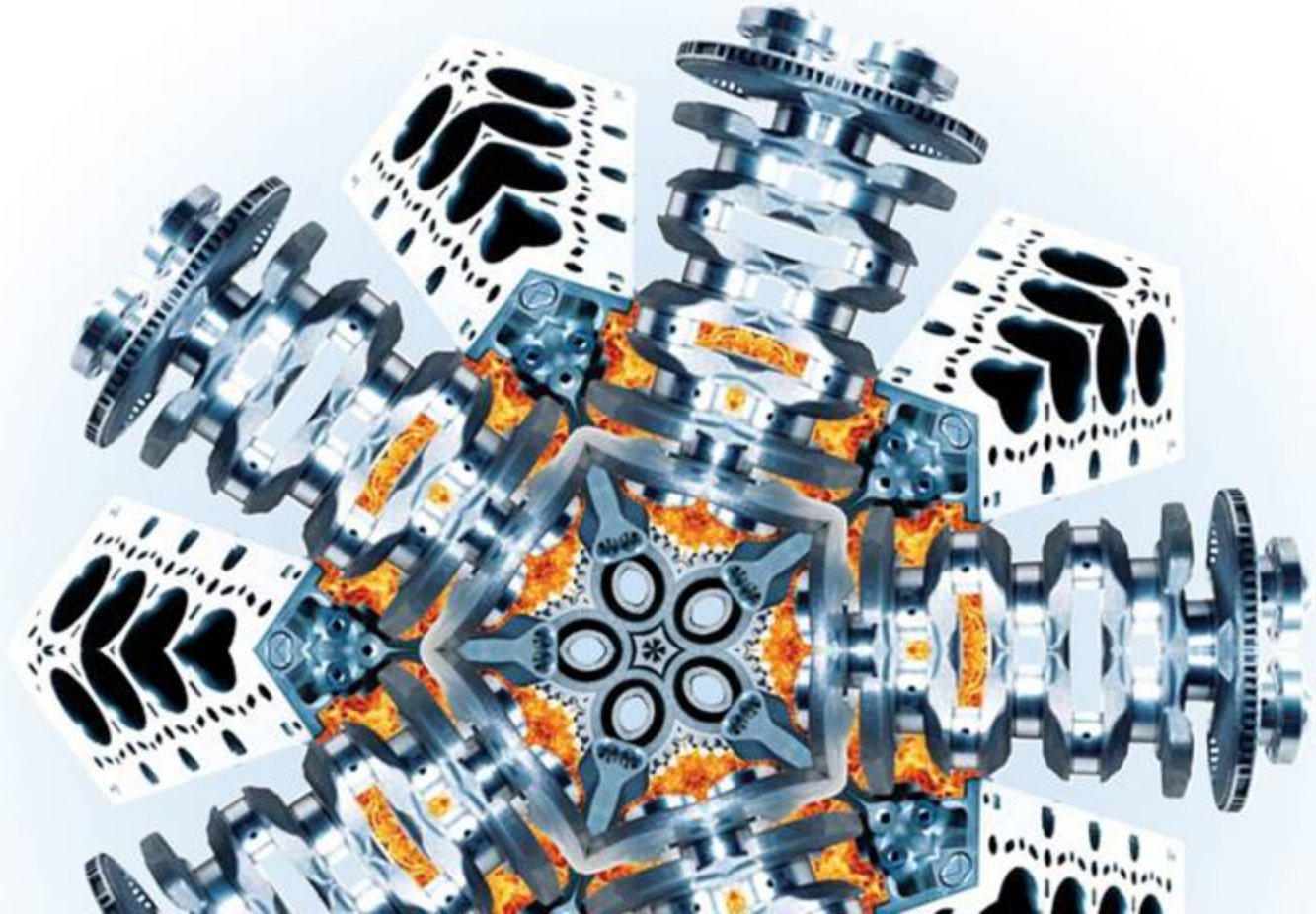
New Markets, New Standards?

Challenges within an OEM-oriented, heterogeneous CAx-Environment

Dr. Klaus Zamazal
AVL List GmbH

Johannes Kern
CADENAS GmbH

26.02.2009



Prof. Helmut O. List
Owner and CEO

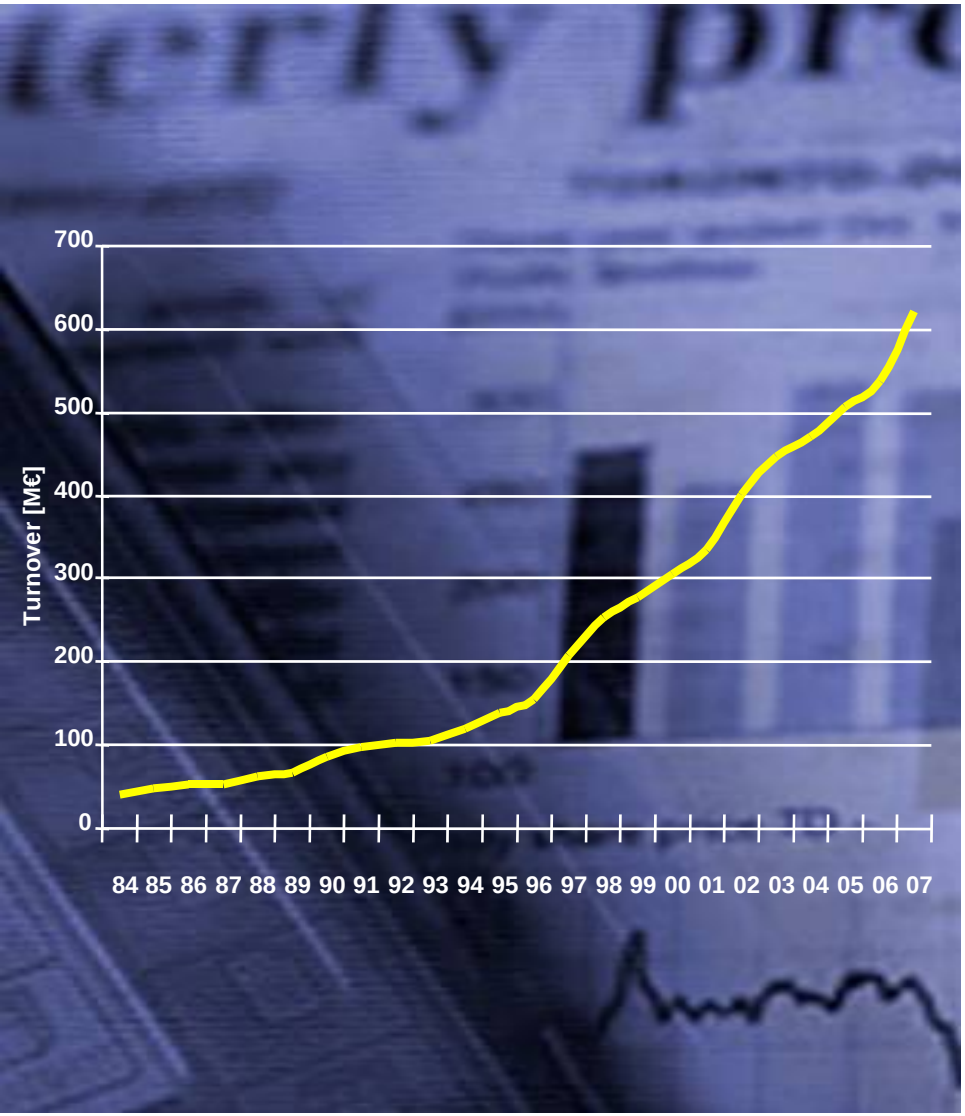
AVL is the world's largest private and independent powertrain engineering company

Development of powertrain systems with internal combustion engines

Software for engine and vehicle simulation

Instrumentation and test systems for engine and vehicle development

Enterprise Development



Total growth :

1987: 52 Mio €
2007: 620 Mio €

Total increase in employees:

1987: 830
2007: 4100

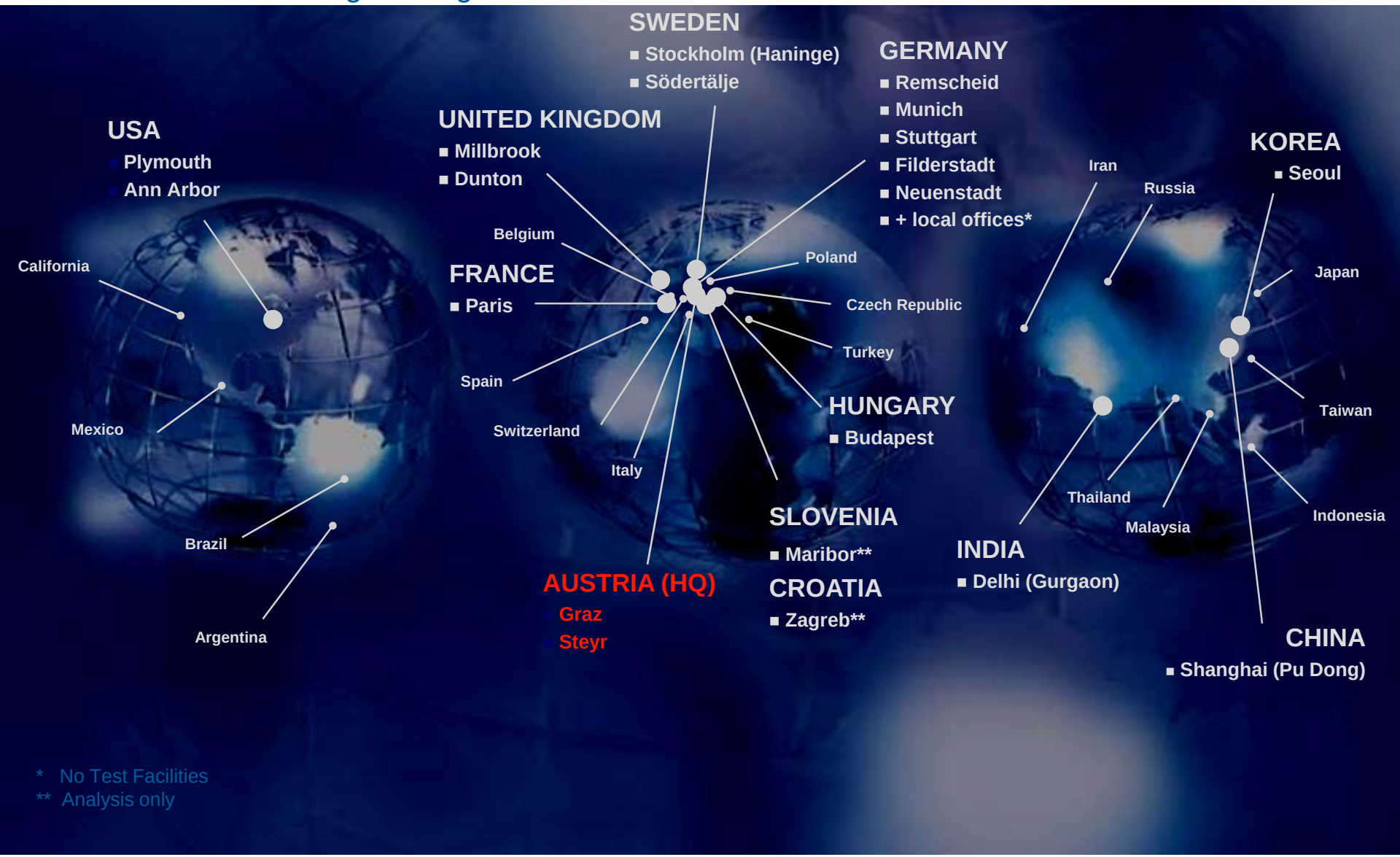
Average R&D spending:

10 % of turnover

Average export quota:

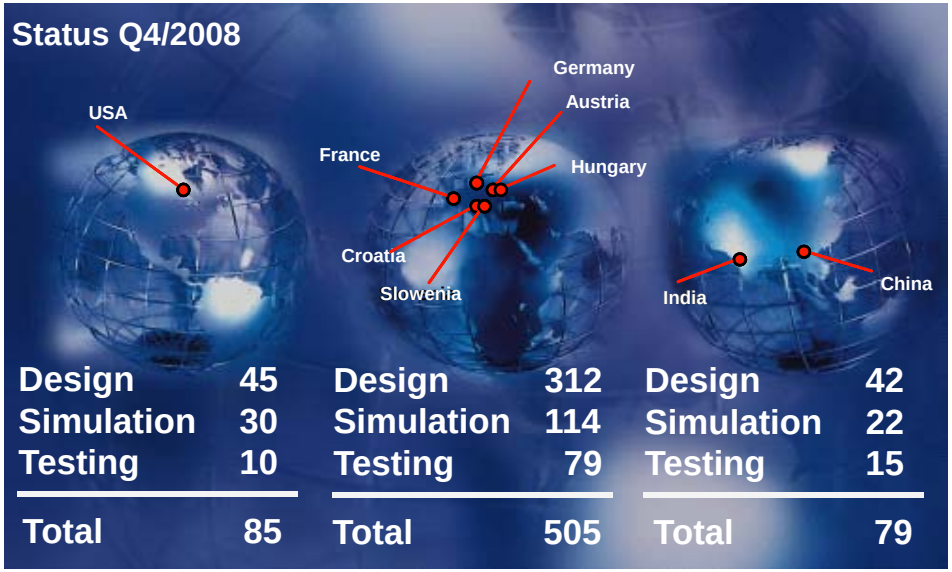
96 % of turnover

The Global Network of AVL Powertrain Engineering



* No Test Facilities
** Analysis only

AVL BASE ENGINE TEAM

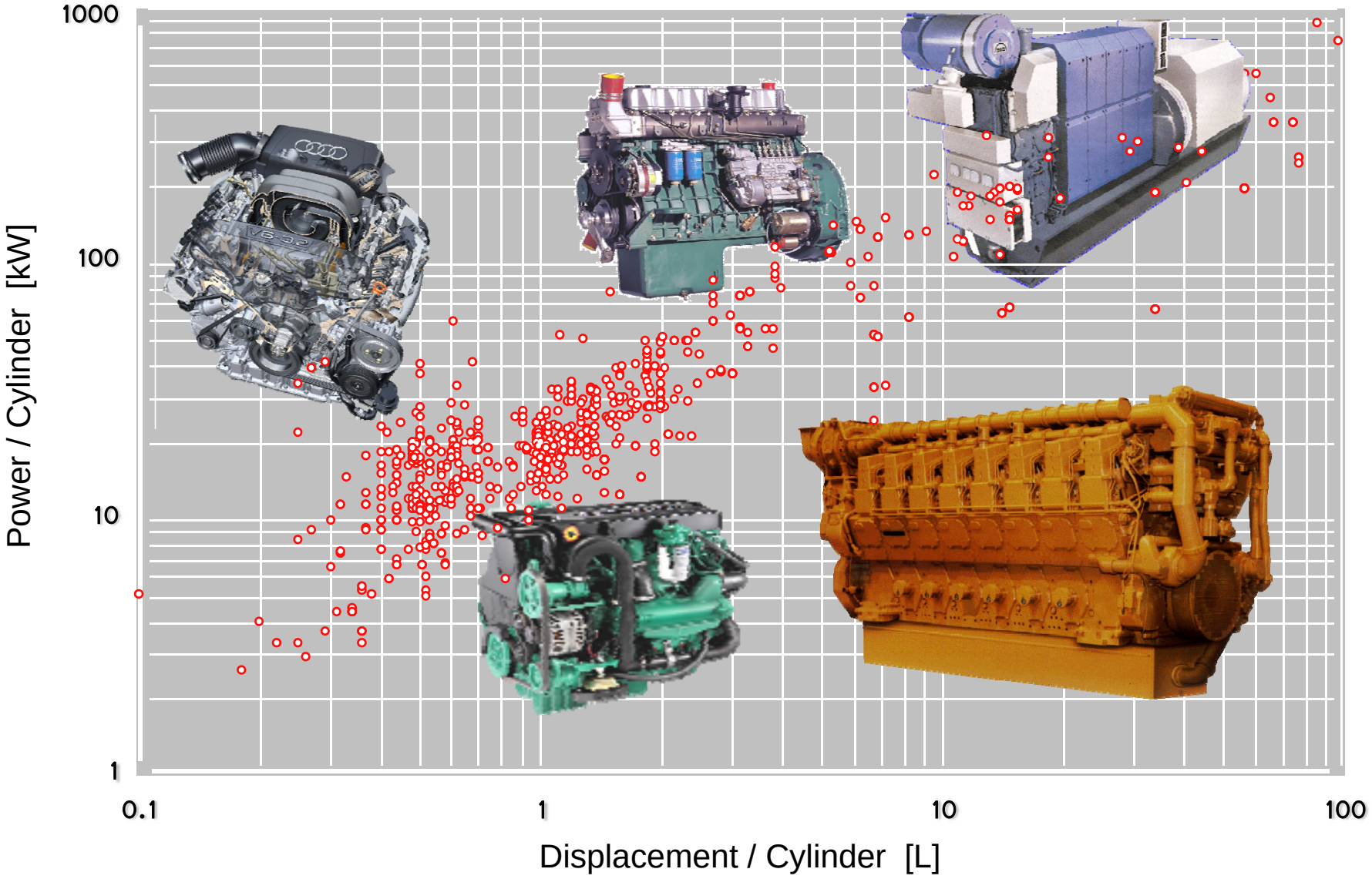


More than 600 Engineers globally - near to all customers

Competence in production development projects – 25 Engines in 10 years

Standardized processes, methods and quality management

AVL has been involved in the development of more than 1000 combustion engines



CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

Implemented Solution

Project's Organisation

Next Steps

Summary and Conclusion

CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

- **Broad Variety**
- **Following AVL's Engine Development Processes**
- **Multi Site & Project Orientation**
- **Global Customers' Focus**
- **Heterogenous Tool Environment**

Implemented Solution

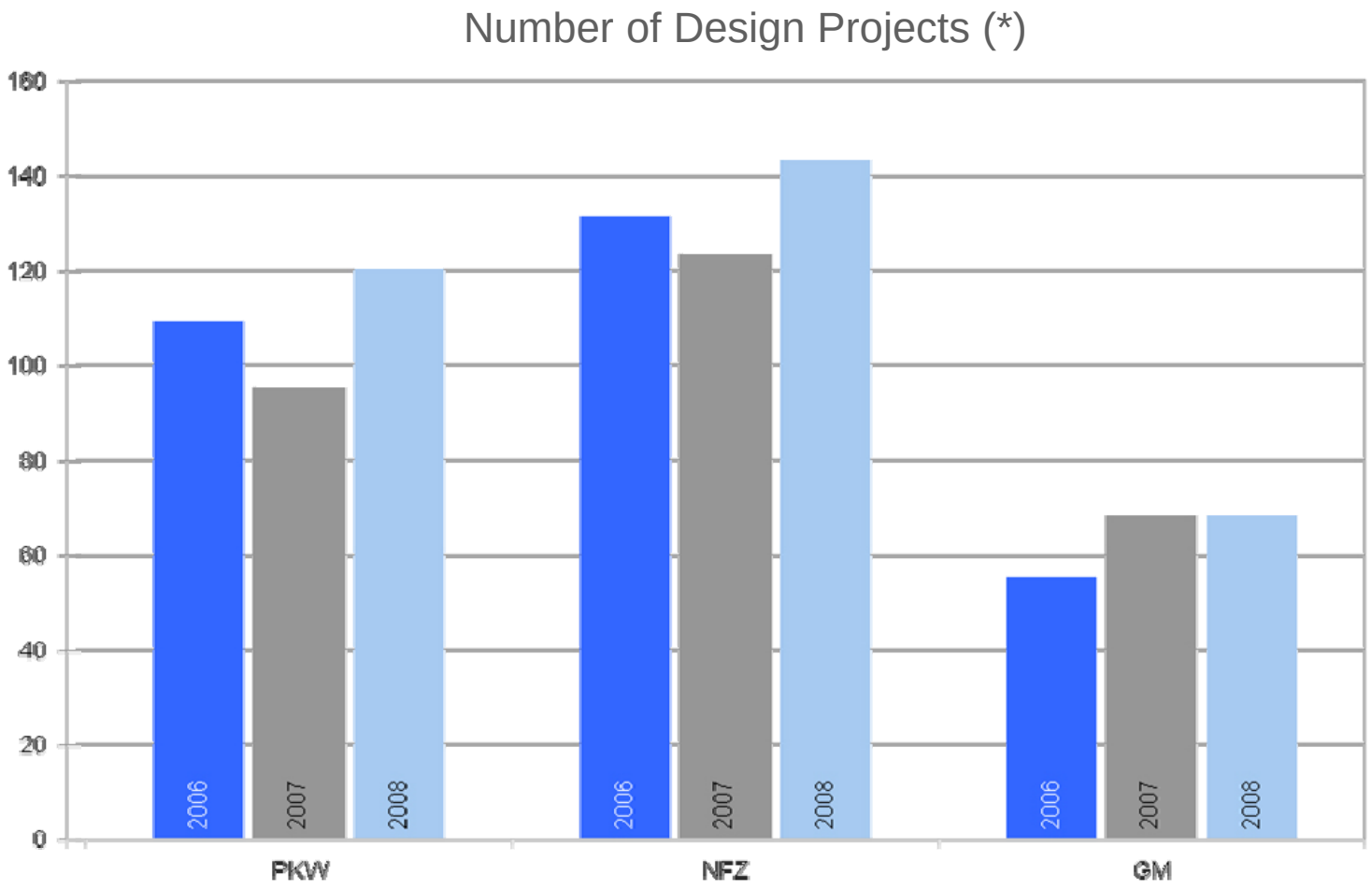
Project's Organisation

Next Steps

Summary and Conclusion

AVL's DESIGN CHALLENGES

Modern Solutions with Broad Variety



PKW…Passenger V's

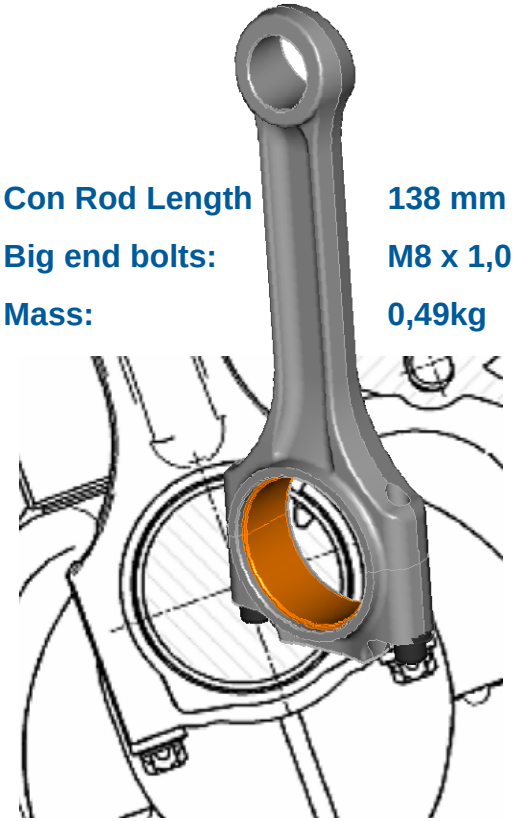
NFZ…Commerzial V's

GM…Large Engines

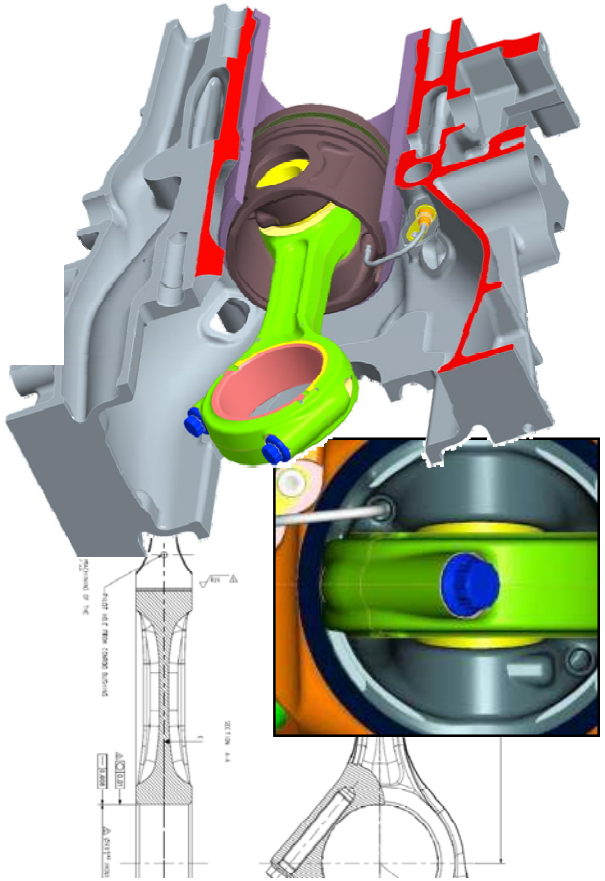
(*) executed in Headquarter Graz

AVL's DESIGN CHALLENGES

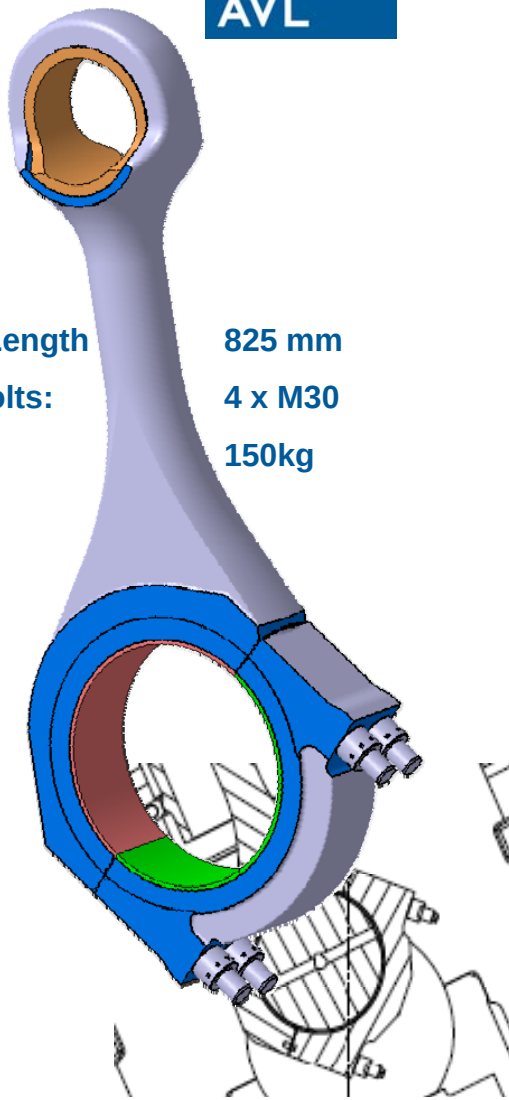
Modern Solutions with Broad Variety



Con Rod Length 138 mm
Big end bolts: M8 x 1,0
Mass: 0,49kg



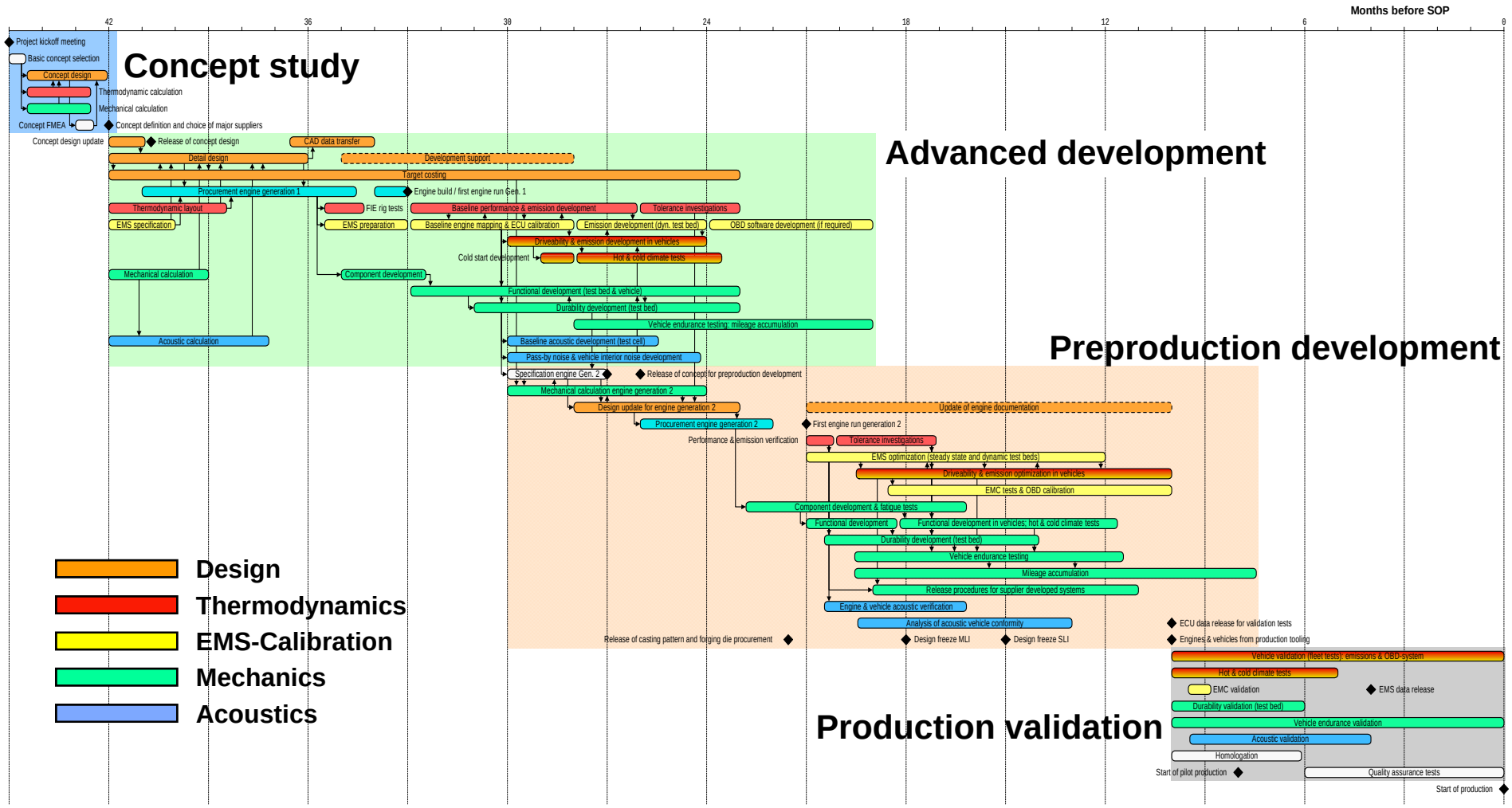
Con Rod Length 243 mm
Big end bolts: M12 x 1,25
Mass: 5,3kg



Con Rod Length 825 mm
Big end bolts: 4 x M30
Mass: 150kg

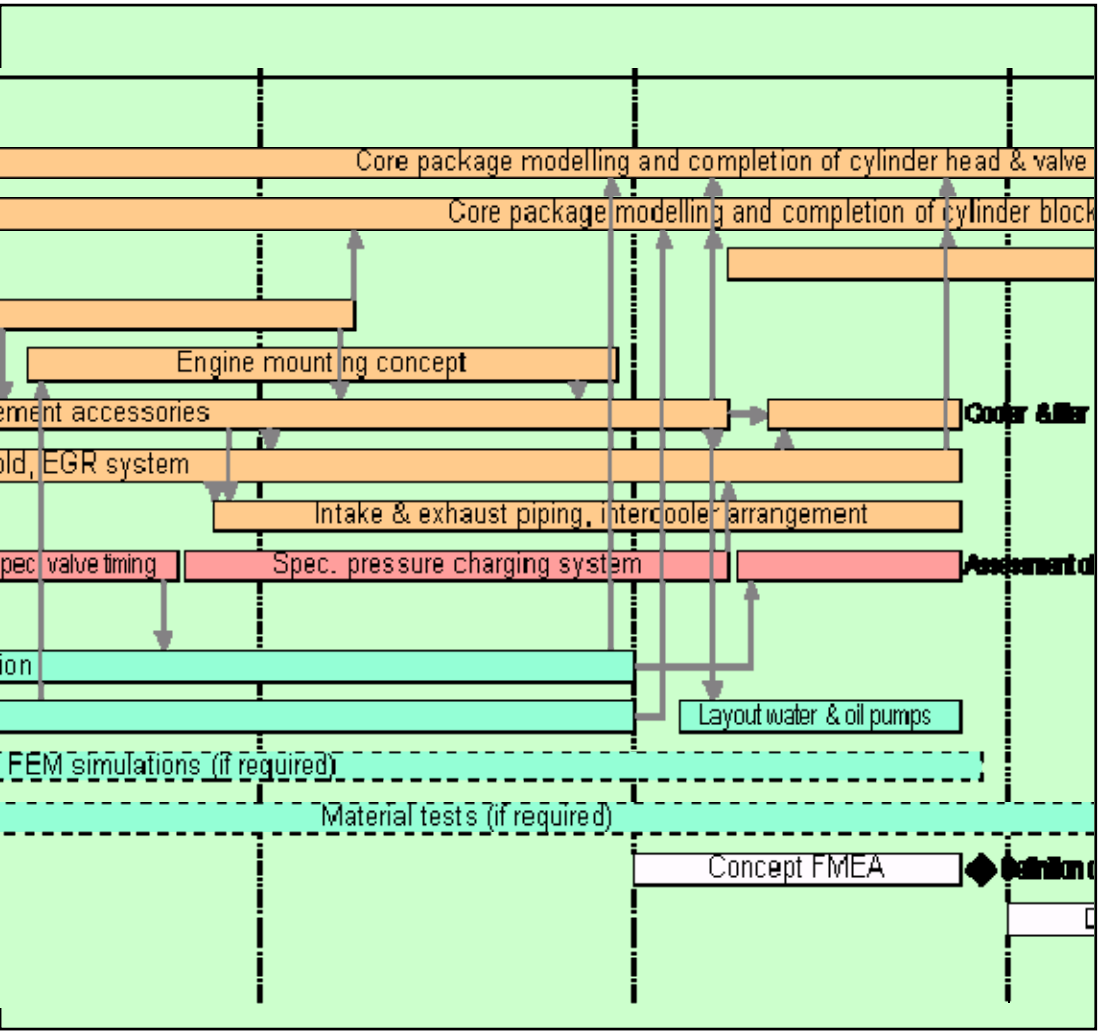
AVL's DESIGN CHALLENGES

AVL Engine Development Process (standardized and continuously improved since 1998)



AVL's DESIGN CHALLENGES

AVL Engine Development Process - Detailed view of development tasks



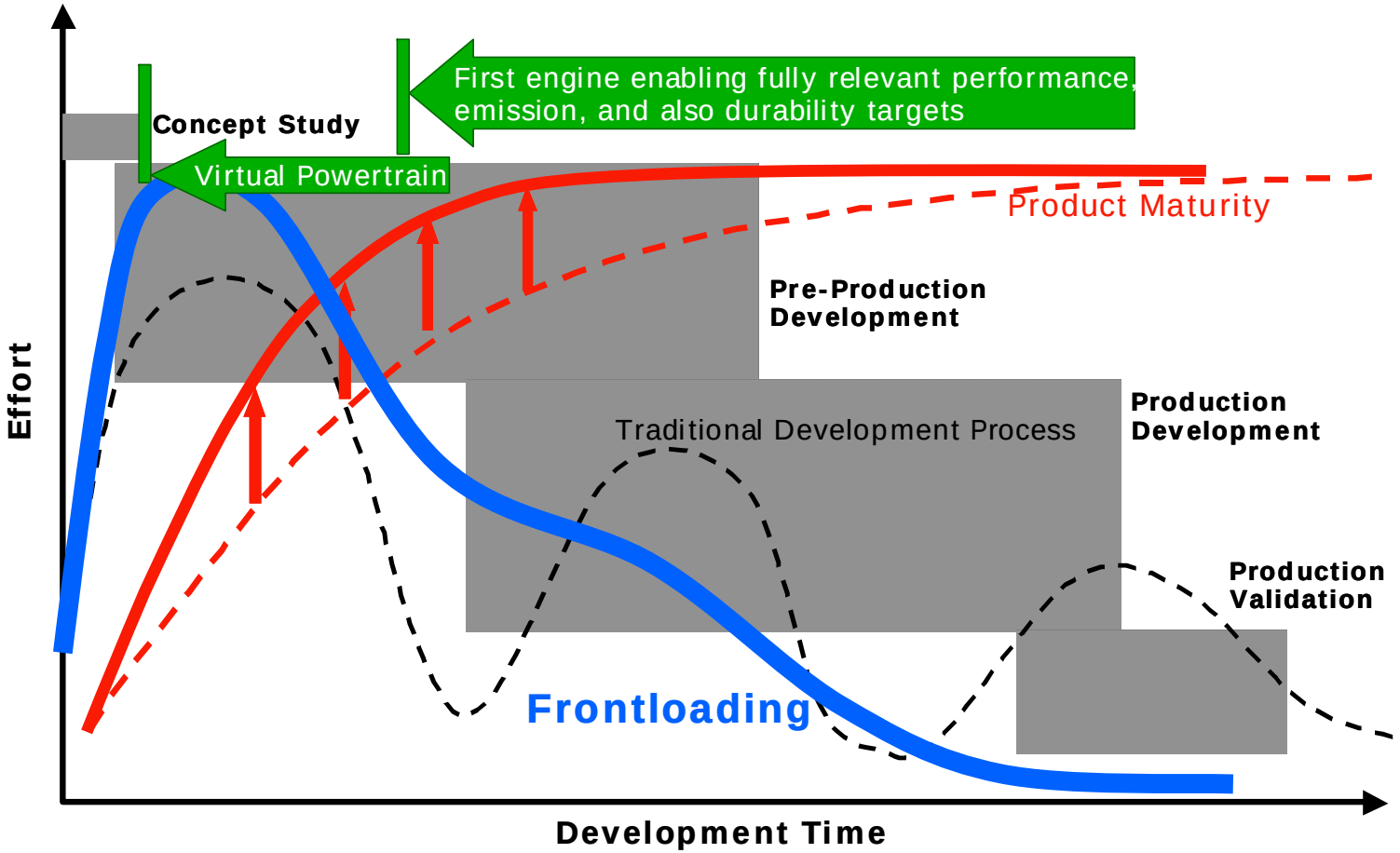
Definition of development tasks

Description of the logical links between the tasks

Optimisation of the technical data flow in an engine development project

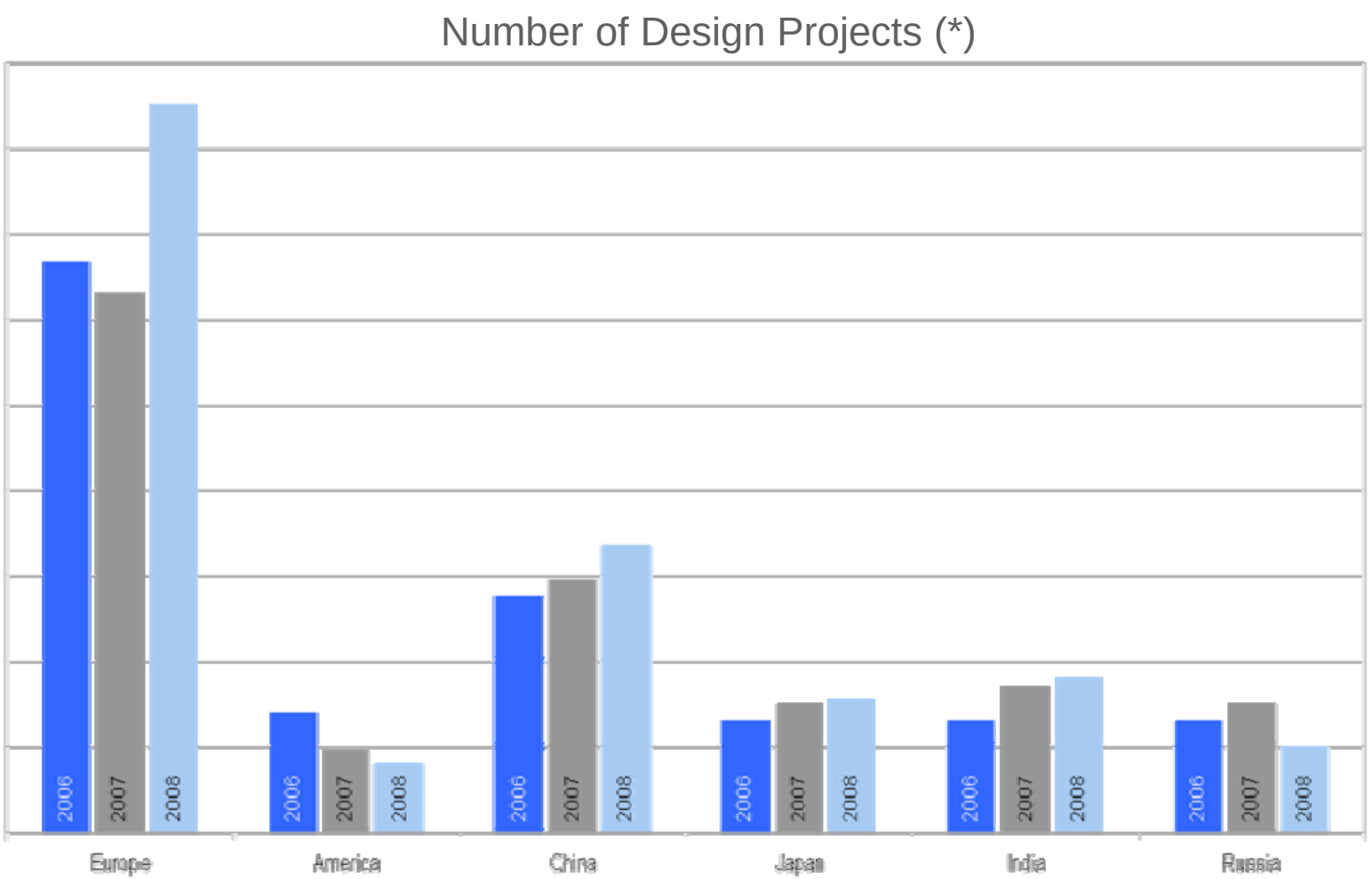
AVL's DESIGN CHALLENGES

AVL Frontloading Process for "First Time Right" product development



AVL's DESIGN CHALLENGES

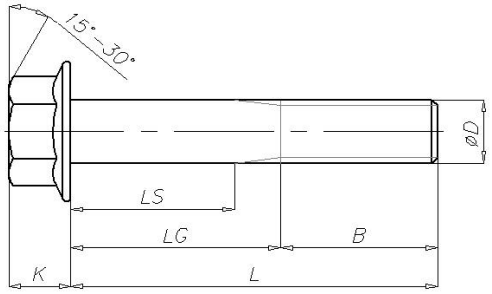
New Customers – New Markets



(*) executed in Headquarter Graz

AVL's DESIGN CHALLENGES

Multi Site & Global Solutions



Corresponds with …

Designation of screw thread (d)		M5	M6		M8		M10		M12
Type of hexagon part height Note (5)		–	N	L	N	L	N	L	–
Nominal No. of screw thread		05	06		08		10		12
Pitch		0.8	1.0		1.25		1.25		1.25
B	Basic dimension	8	10		12		14		17
	Tolerable deviation	0 −0.2	0 −0.2		0 −0.25		0 −0.25		0 −0.25
C	(min.)	8.9	11.1		13.3		15.5		18.90
D	(min.)	11.5	13.5	13.5	16.5	16.5	19	19.2	23
	(max.)	12.5	14.5	14.0	17.5	17.0	20	20	24
H	Basic dimension	4.9	5.7	5.6	7.5	7.0	9.3	8.3	10.8
	Tolerable deviation	0 −0.3	0 −0.35	0 −0.35	0 −0.5	0 −0.4	0 −0.5	0 −0.45	0 −0.5
h	(min.)	3.4	3.9	4.0	5.4	5.0	6.8	6.0	7.8
t	Basic dimension	0.7	0.8	0.8	1.0	1.0	1.2	1.2	1.4
	Tolerable deviation	±0.2	±0.2	±0.1	±0.2	±0.1	±0.25	±0.15	±0.25
r	(max.)	0.7	0.8	–	1.1	–	1.4	–	1.6
g	(min.)	2	2.3	2.8	3.2	3.5	4.1	4.2	4.7
d1	(min.)	4.36	5.22	5.15	7.04	7.0	9.04	9.0	11.03
R	(min.)	0.3	0.4		0.6		0.6		0.8
D2	(max.)	5.7	6.8		9.2		11.2		14.2
a–b	(max.)	0.3	0.3		0.4		0.4		0.5
Class1	f (Approx.)	0.8	1	–	1.2	–	1.5	–	2
	D1 (Approx.)	6.5	8.5	–	10.5	–	12.2	–	15.2
Class 1 &	r1 (Reference)	0.5	0.5		0.65		0.65		0.8
Class 3	D1 (min.)	10.8	12.8		15.6		18.1	18.3	21.8
Class 3	B1 (Approx.)	6.7	8.5	–	10.2	–	12	–	14.8
	f1 (Approx.)	0.8	1	–	1.2	–	1.5	–	1.8
	f2 (max.)	2.3	2.6	–	3.6	–	4.6	–	5.3

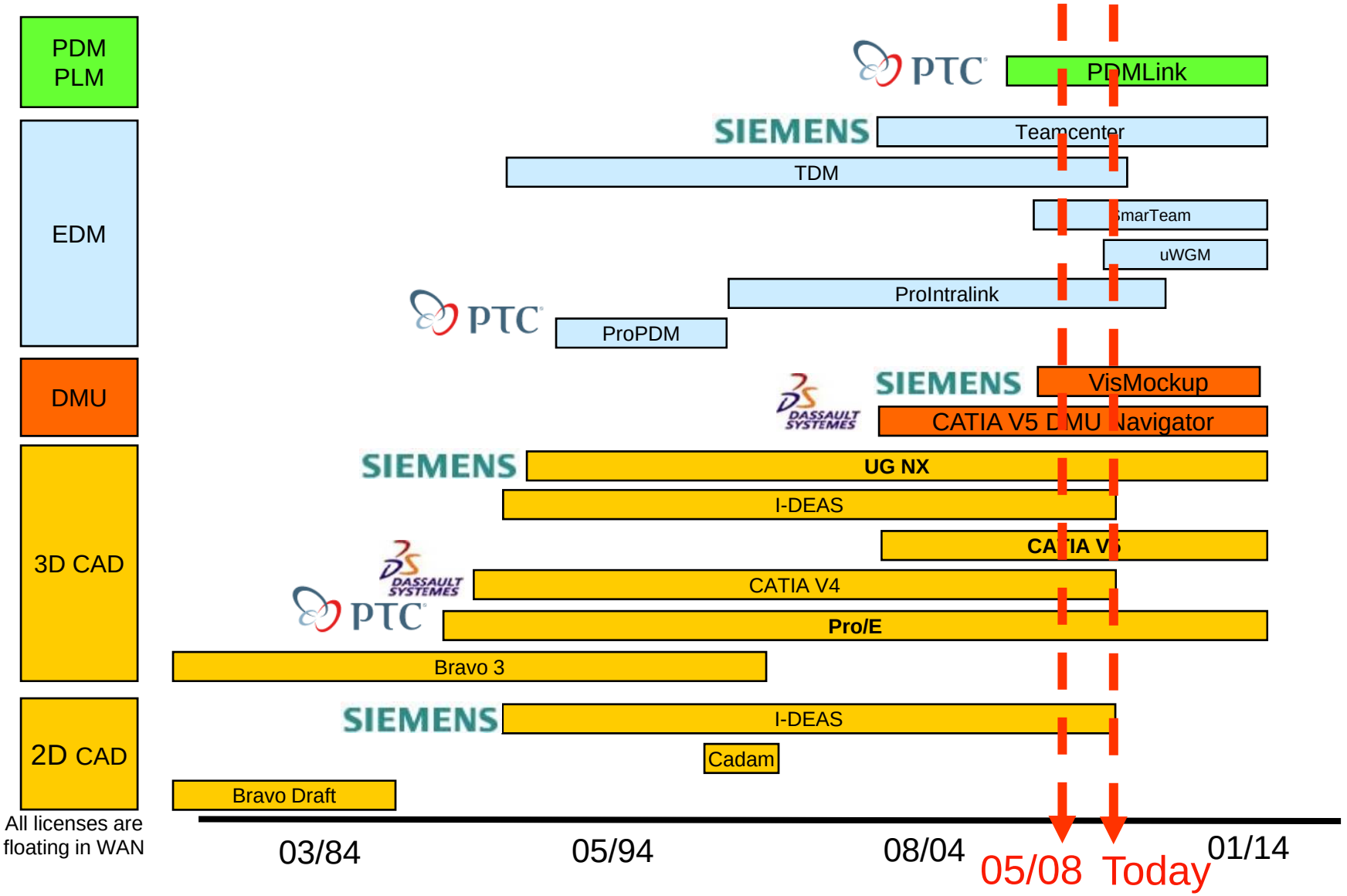
SES P 1202d - Hexagon Bolts with Flange

Gewinde (d)			M5	M6	M8	M10	M12
P [2]			0,8	1	1,25	1,5	1,75
b	Hilfsmaß	[3]	16	18	22	26	30
		[4]	—	—	28	32	36
		[5]	—	—	—	—	—
c		min.	1	1,1	1,2	1,5	1,8
d_a	Form	F max.	5,7	6,8	9,2	11,2	13,7
		U max.	6,2	7,5	10,0	12,5	15,2
d_c		max.	11,4	13,6	17	20,8	24,7
d_s		max.	5,00	6,00	8,00	10,00	12,00
		min.	4,82	5,82	7,78	9,78	11,73
d_v			5,5	6,6	8,8	10,8	12,8
d_w		min.	9,4	11,6	14,9	18,7	22,5
e		min.	7,59	8,71	10,95	14,26	17,62
k		max.	5,6	6,9	8,5	9,7	12,1
k_w		min.	2,3	2,9	3,8	4,3	5,4
l_f		max.	1,4	1,6	2,1	2,1	2,1
r_i		min.	0,2	0,25	0,4	0,4	0,6
r_2 [6]		max.	0,3	0,4	0,5	0,6	0,7

EN 1662 – Sechskantschrauben mit Flansch

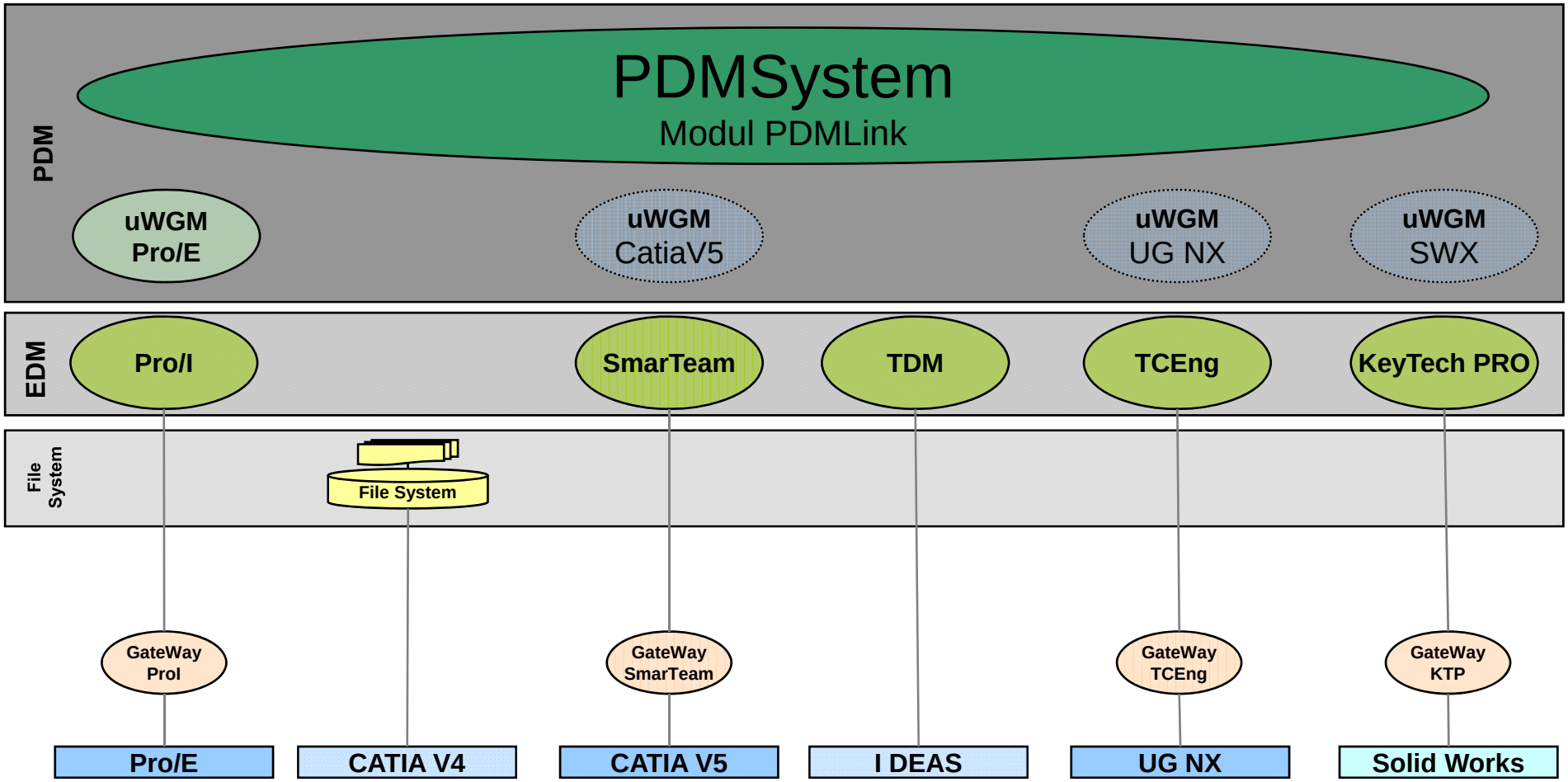
AVL's DESIGN CHALLENGES

Historical Overview of Tools for Product Development - Design



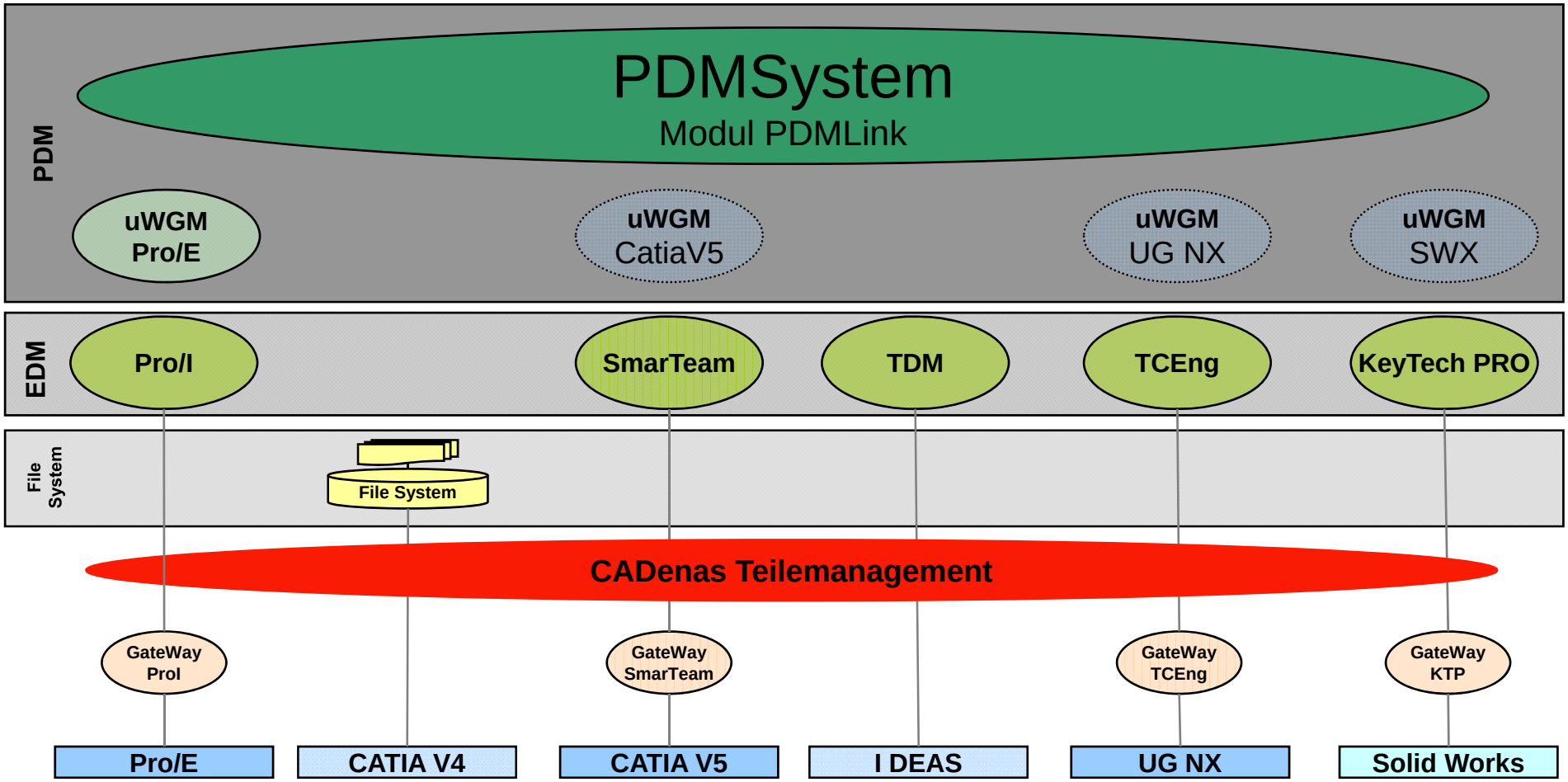
AVL's DESIGN CHALLENGES

Multi CAD & Multi TDM & Single PDM



AVL's SOLUTION APPROACH

Standardizing supports Innovation



CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

Implemented Solution

- **Overview: 4 CAD systems, 4 EDM systems, 2 PDM systems**
- **Installation type and update strategy**

Project's Organisation

Next Steps

Summary and Conclusion

AVL's SOLUTION – Situation in 2006

Major non-IT-targets: AVL Power Train

One solution for standard parts needed

→ CAD independent solution needed
→ EDM independent solution needed

PDM-Link as master required

Solution has to support PDM-Link as PDM (no new master system)
→ PDM/ERP independent solution needed

Easy to use

Especially with different OEM environments the solutions should be easy to use. (What is preferred and allowed this time?)

Major IT-targets: AVL Power Train

Manual process was “easiest” solution from IT point of view

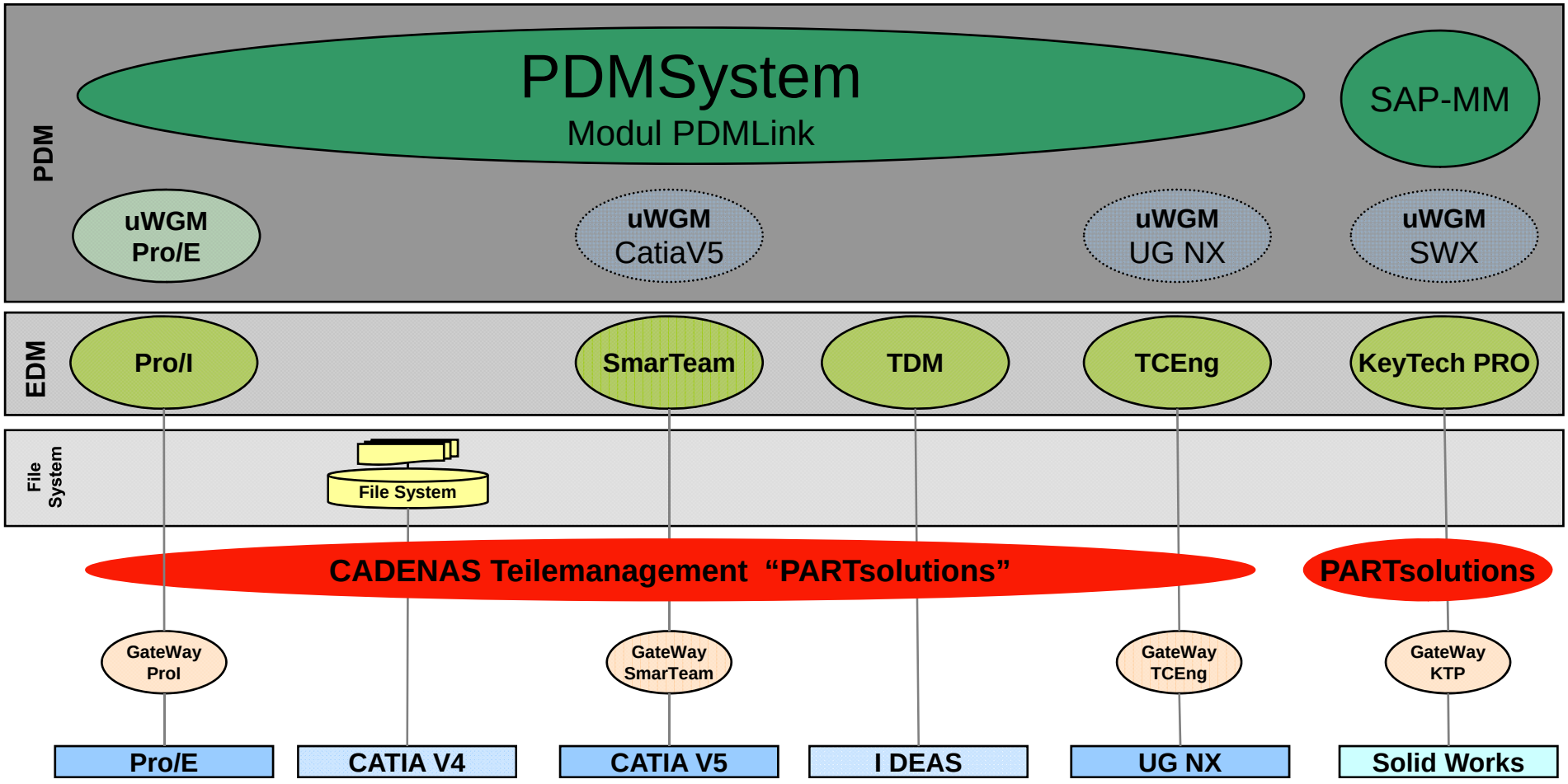
In the past: Processes were ignored very often. Everybody did what he wanted
→ lots of duplicates and wasted engineering recources
(remember the discussion at kickoff workshop)

Note: The new solution was mostly requested by the Key-Engineers!

06/2008:

PARTsolutions implementation starts
Project thread: IT solution will get too complex

AVL's SOLUTION – Situation in 2009



Basic EDM Workflow

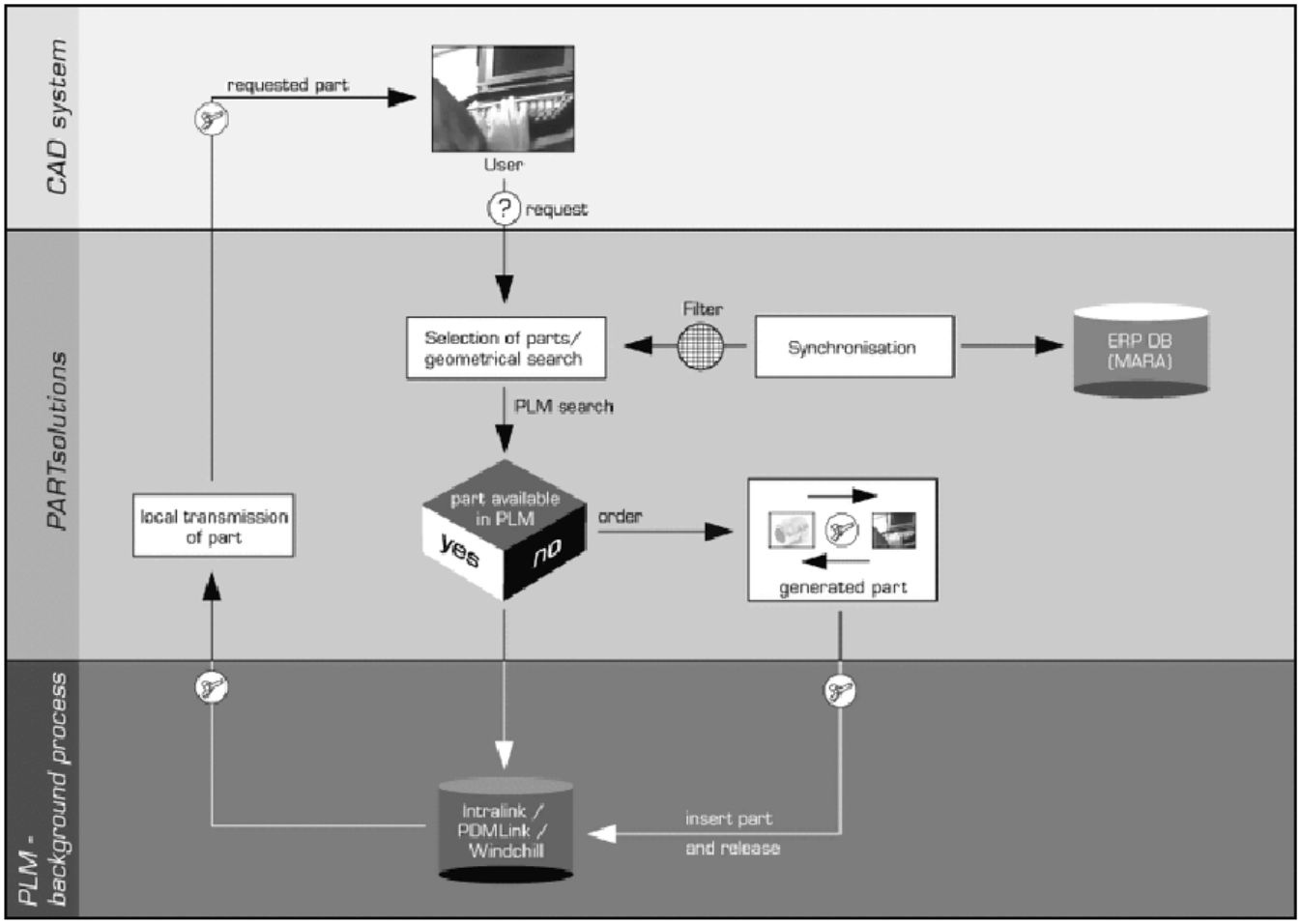
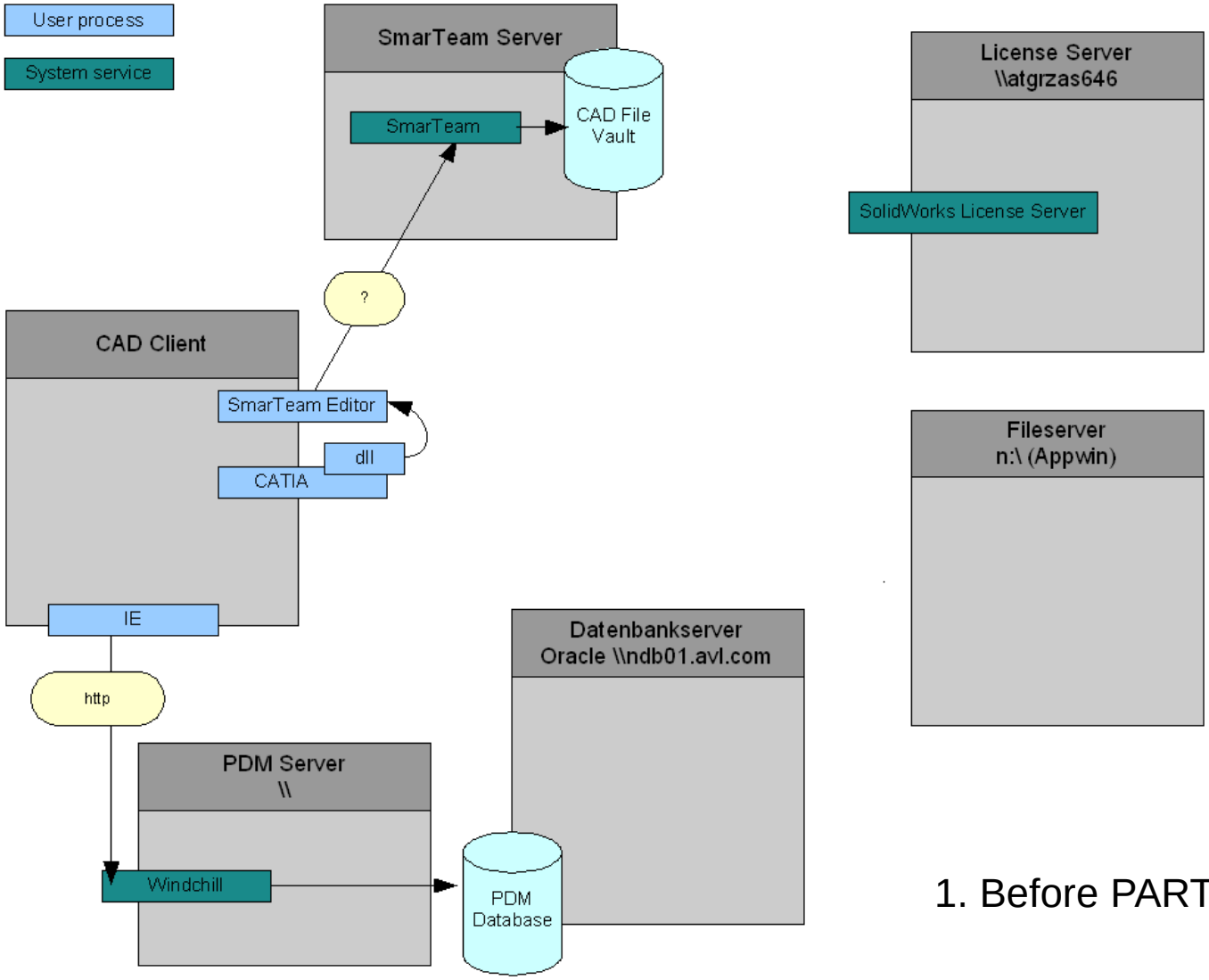


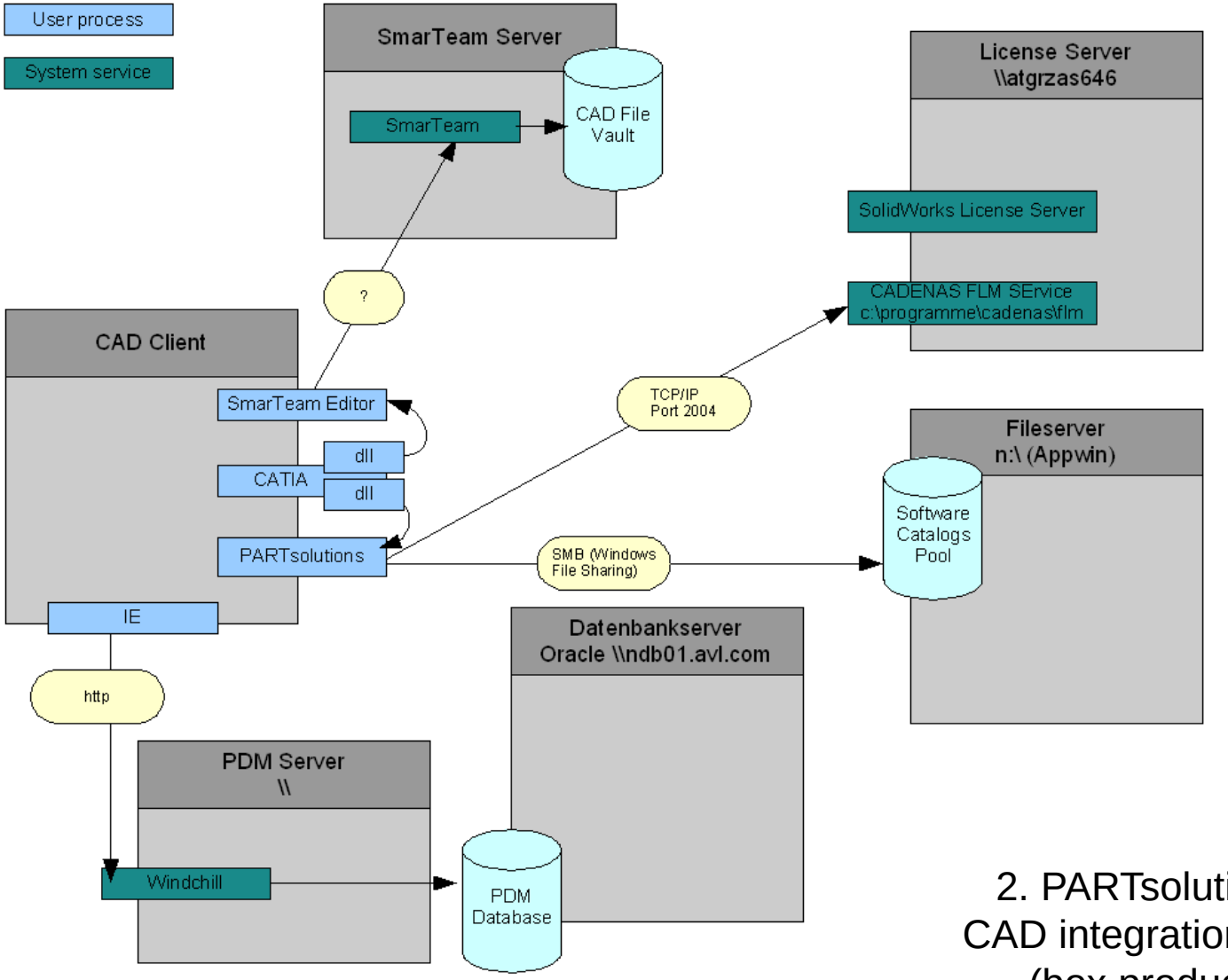
Fig.: Structural overview of CAD - PARTsolutions - PDM - ERP linking.

CADENAS installation – example SmarTeam/CATIA



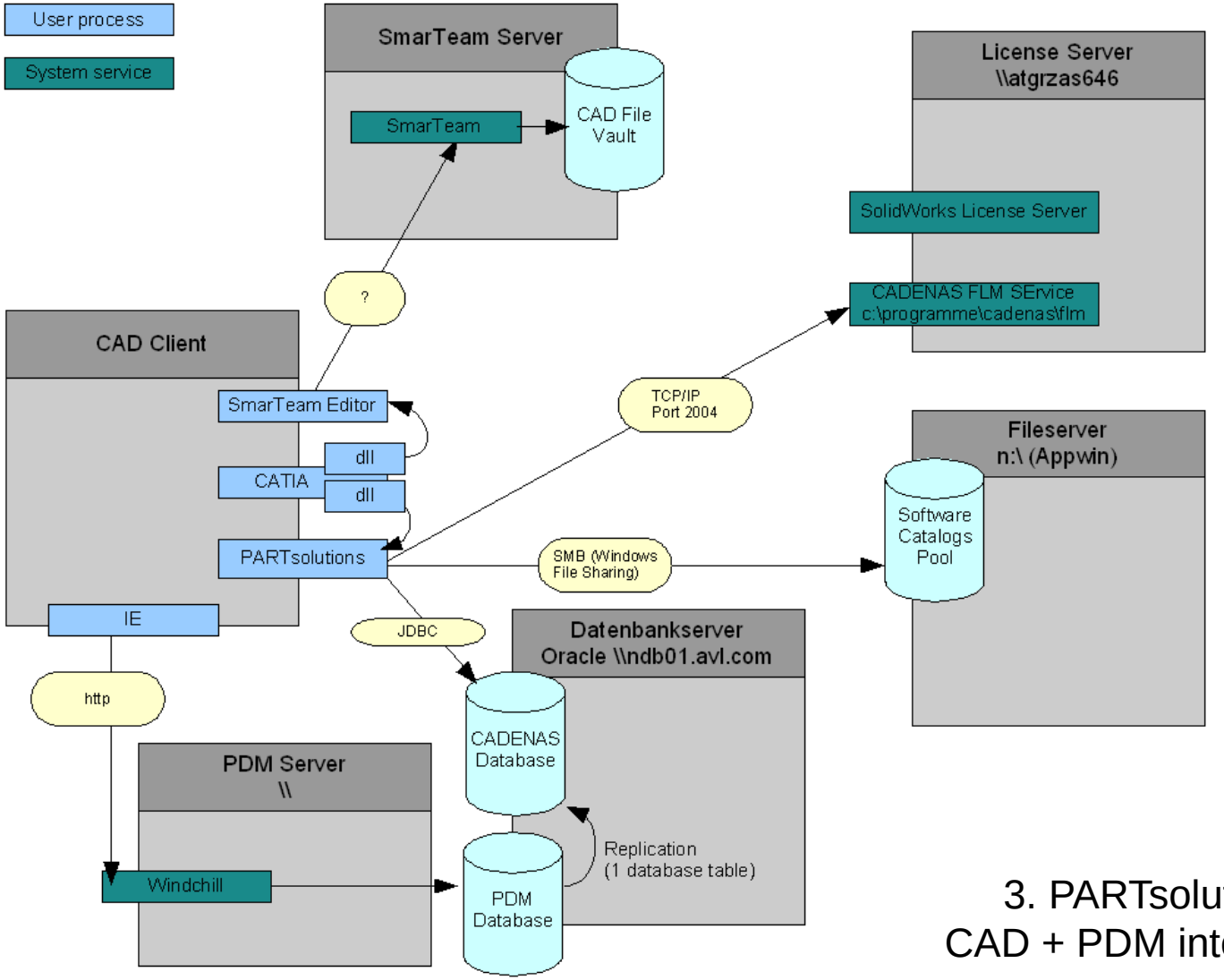
1. Before PARTsolutions

CADENAS installation – example SmarTeam/CATIA



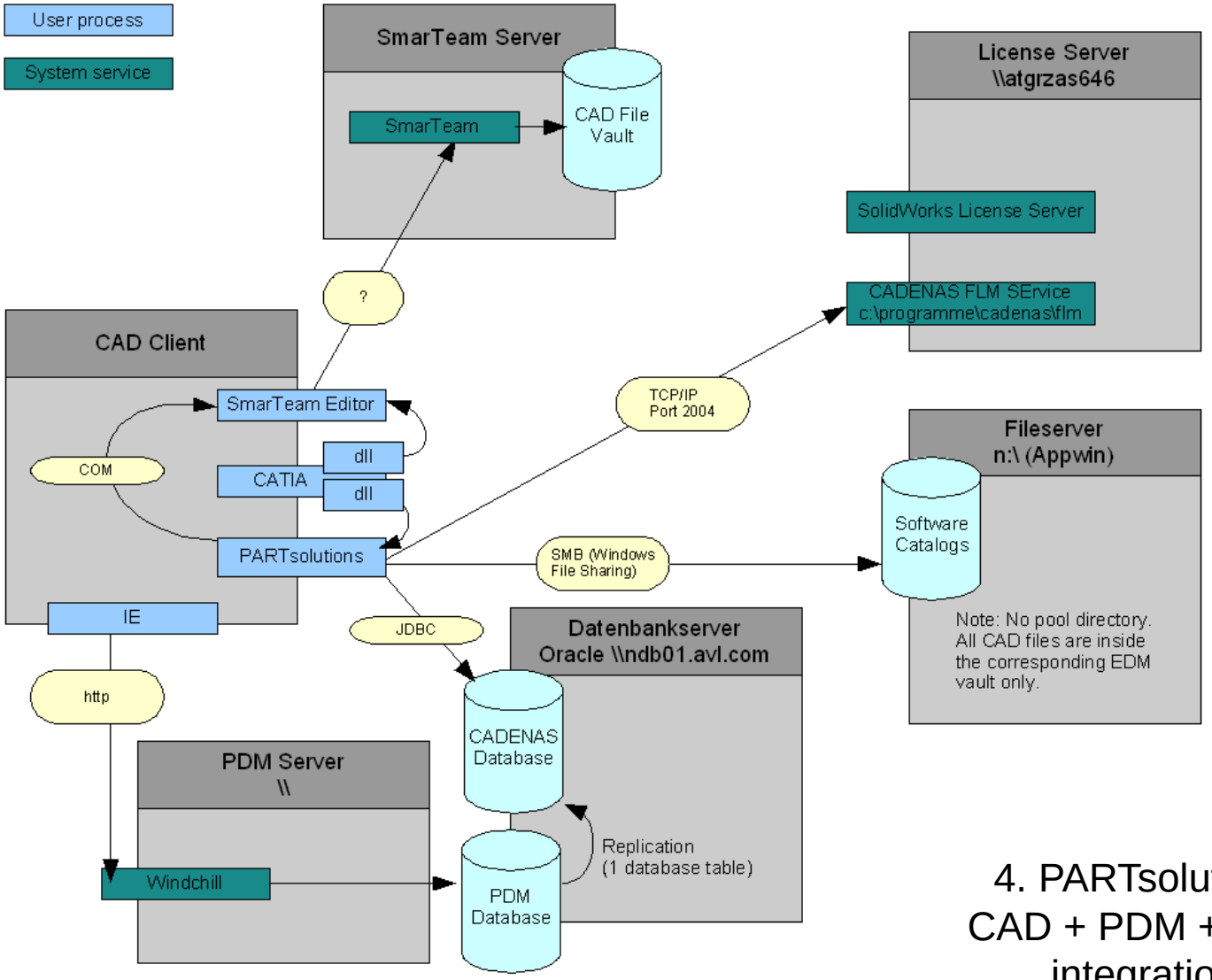
2. PARTsolutions
CAD integration only
(box product)

CADENAS installation – example SmarTeam/CATIA



3. PARTsolutions
CAD + PDM integration

CADENAS installation – example SmarTeam/CATIA



4. PARTsolutions
CAD + PDM + EDM
integration

PARTsolutions installation facts

No Client installation

To use PARTsolutions → just use the
start_CATIA_with_psol.bat, start_WF_with_psol.bat
Software binaries, configurations and catalogs are on a net-folder: n:\iparts\cadenas
→ no new server needed
→ Also an existing server replication is used (n:\ in Graz = \\hpsrv12, n:\ in other locations is a mirrored copy of hpsrv12)

→ One installations for all PowerTrain CAD/PDM systems

Clear update and rollout scenarios

Easy test vs. productive system handling
Rollout and update by just copying a file share

CAD / PDM handling

All CAD files are in the coresponding PDM system (no additional replication needed! → standard PDM processes)
none or only very few modifications in EDM and PDM systems done

CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

Implemented Solution

Project's Organisation

- **Team**
- **Deliverables**
- **Internal Effort**

Next Steps

Summary and Conclusion

PROJECT ORGANISATION

Team, Deliverables & approx. Effort (Internal)

Initial Phase (11/07 – 02/08)

- **2 Workshops with 12 CAD-Users & 2 Sys.-Admin (250h)**
- **Scope of Solution**
- **„4 Step“ Approach**

Commercial Phase (03/08 – 04/08)

- **PM & GF (30h)**

Implementation Phase (05/08 – 11/08)

- **3 CAD-Key User & 3 Sys.-Admin & 2 IT & 1 PM-PDM (300h)**
- **PM (100h)**
- **Roll-Out & Training Efforts (60h + 200 x 0,5h)**

CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

Implemented Solution

Project's Organisation

Next Steps

- **Optimization**
- **Roll-Out WorldWide**
- **„Phase 2“**

Summary and Conclusion

NEXT STEPS

Optimization

- PARTsolution replaces …
- SP-Part „Creator“ as a Role

Roll-Out WorldWide

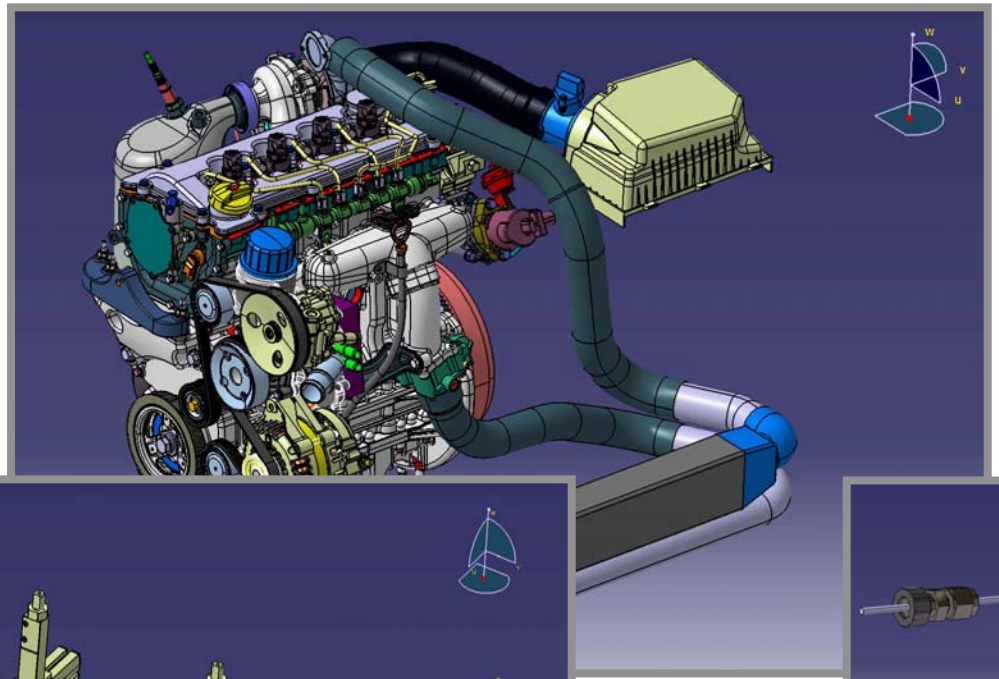
- Improve in STY & HTC
- Implement in USA
- Initiate in Asia (STC, ITC, …)

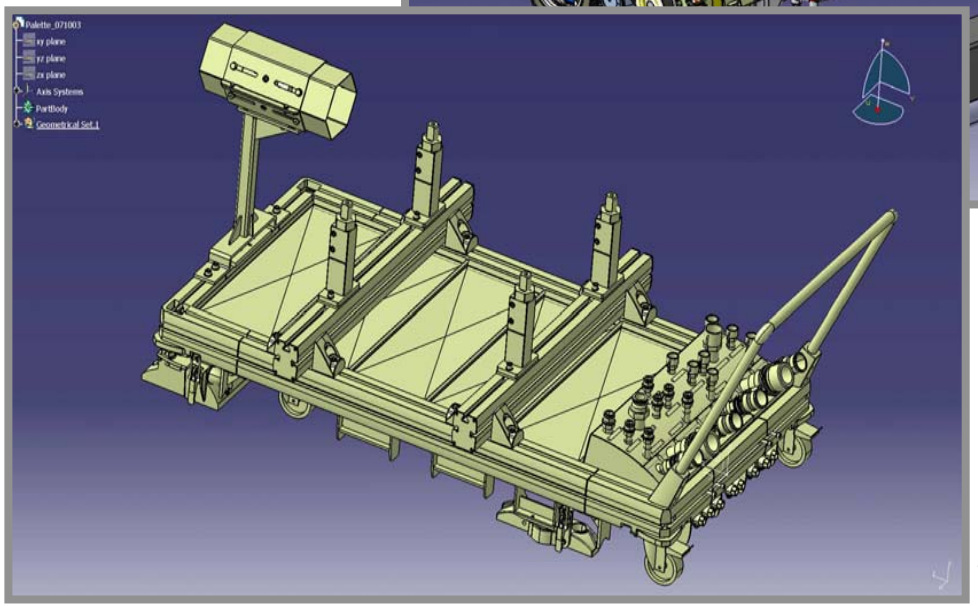
„Phase 2“

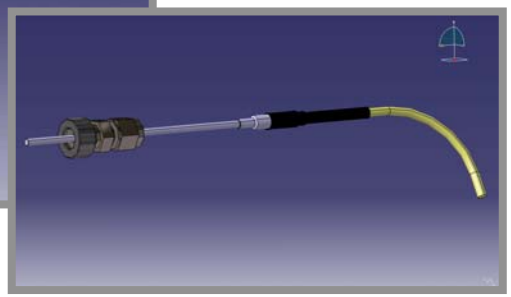
- Supplier Components (SCs)
- Support for „Prüfstands-DMU“ incl. Tools

NEXT STEPS

„Prüfstands-DMU“ (Virtual Engine Build-Up)



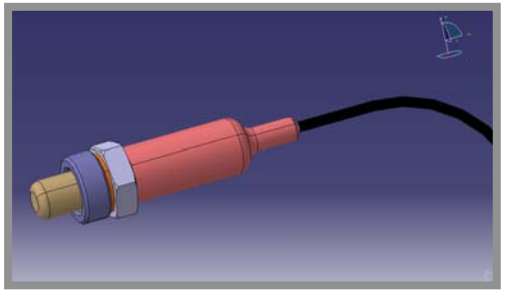




§ step

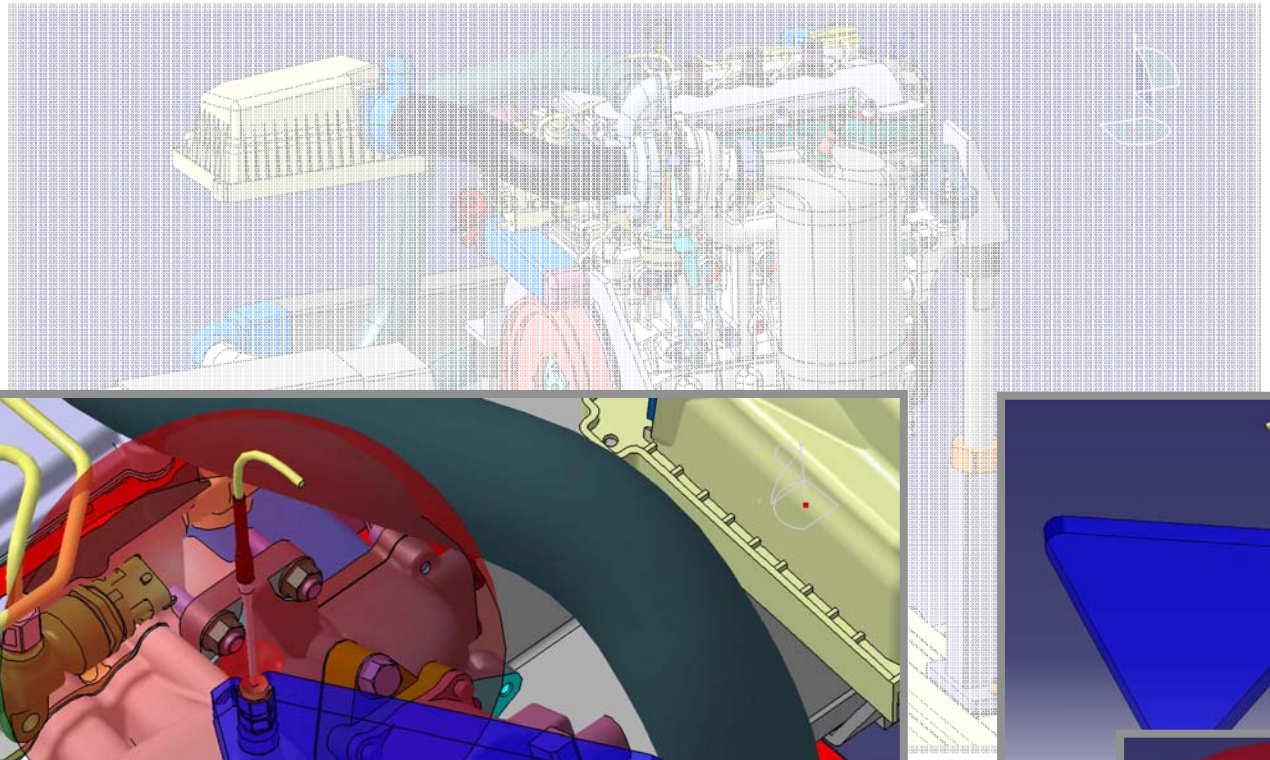
§ igs/iges

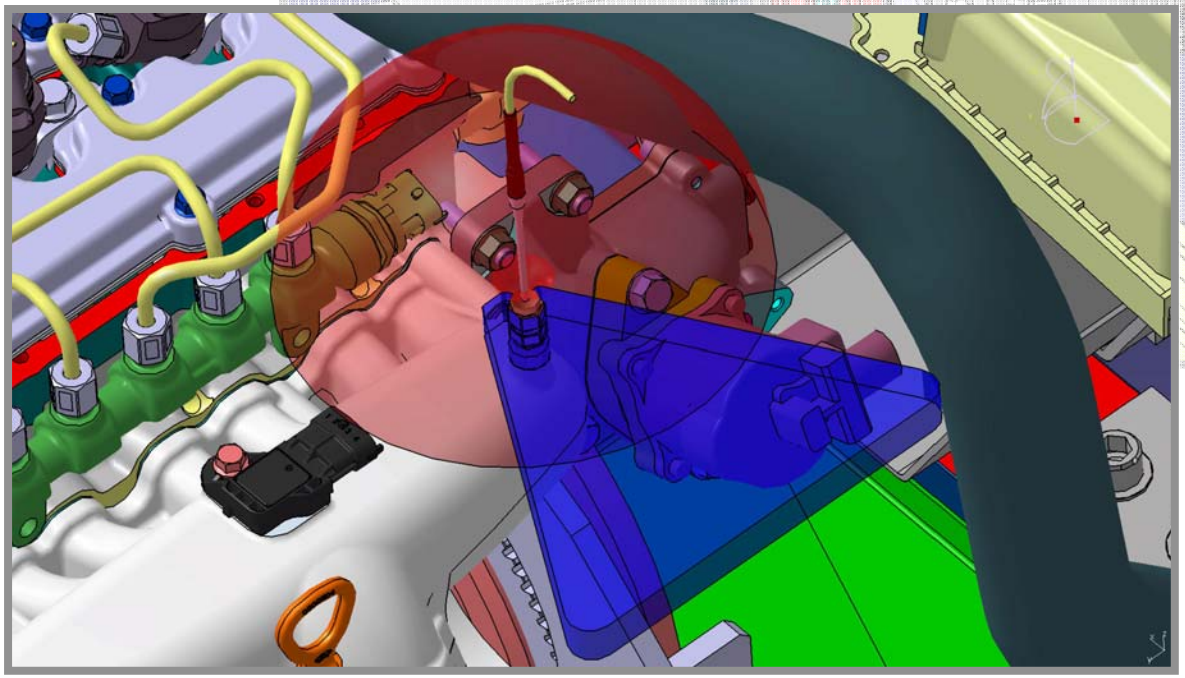
§ native CAD

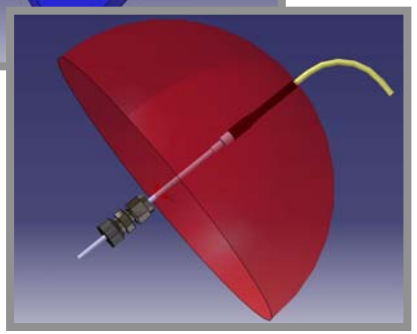


NEXT STEPS

„Prüfstands-DMU“ (Virtual Engine Build-Up)

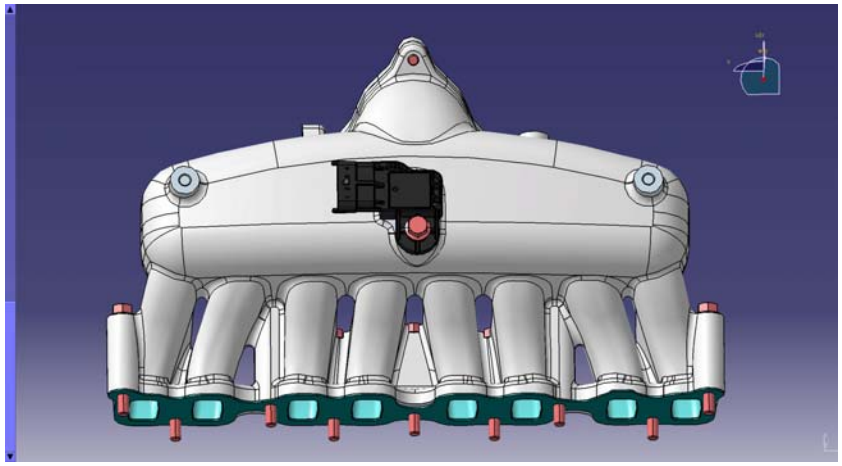




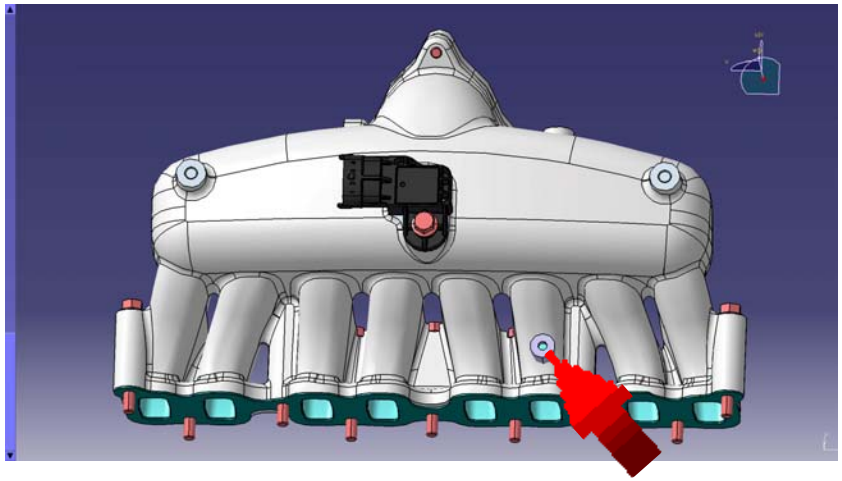


NEXT STEPS

„Prüfstands-DMU“ (Virtual Engine Build-Up)



⇨ Serial Part



⇨ Advanced Prototyp

CONTENT

AVL's Design Challenges – Business Drivers for Modern Solutions

Implemented Solution

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Summary and Conclusion

SUMMARY & CONCLUSION

Implementation Done for “Phase 1” (cw 49/08)

- **(nearly) in Time**
- **in Budget**

What else … Do‘s and Dont‘s

- **Implementation in steps – leading system defined by most experience**
- **Testing and Documentation by Key-User**
- **„Hang-Over“ Phase**
- **Holidays**
- **Roll-Out with enough licenses**
- **Don‘t focus on future dependencies**
- **Support from CAD-System Provider**
- **Early Wins and Hungry Designers**

AVL'S NEW LOGO IS VISION AND PROGRAM