



MAN TRUCK: A DIGITAL TRANSFORMATION JOURNEY

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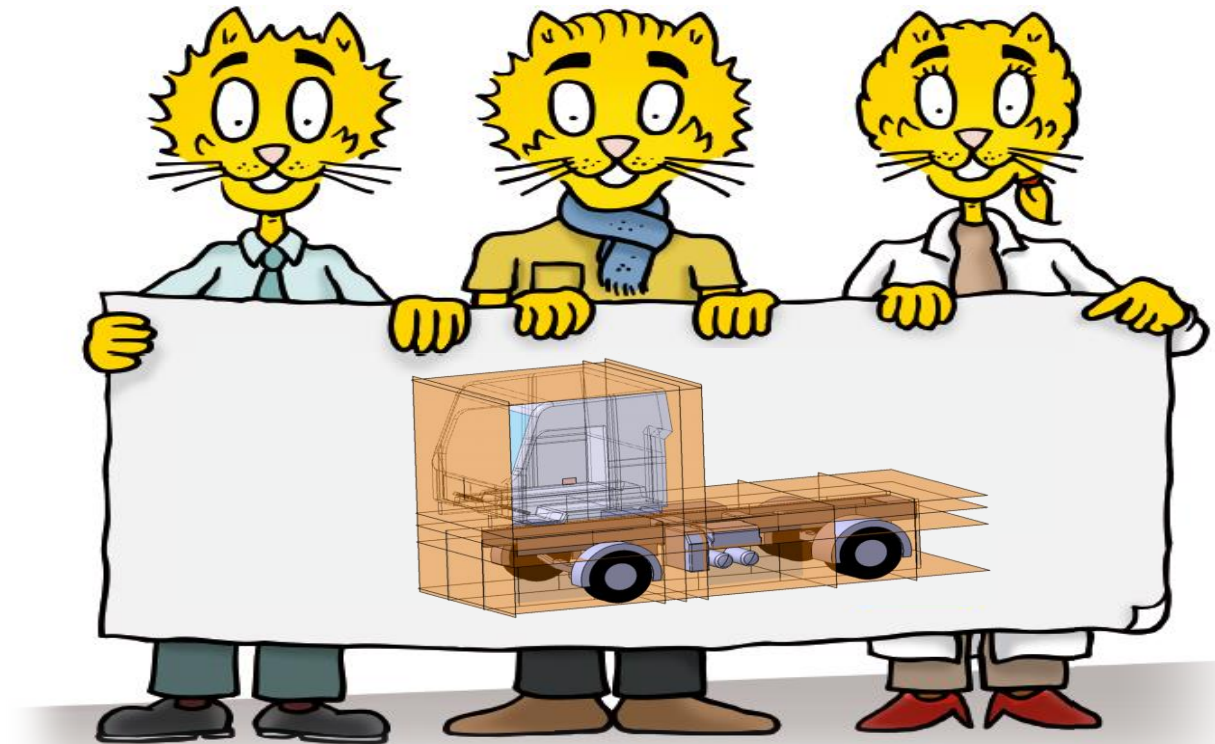


AGENDA

- ❑ Commercial Vehicle Business at MAN: The Business Need brings the Challenge
- ❑ Modularity as a Solution Approach: Sustainable Growth with a clear Focus on the Customer Needs
- ❑ PLM as the Big Picture: The Journey and its Path
- ❑ PLM in its current state of Implementation: Value and Conclusion

LET'S TALK TRUCKS AND BUSES

- Business Background
- Commercial Vehicle Portfolio of MAN



PRODUCT VARIANTS IN REAL LIFE

LIGHT DISTRIBUTION TRUCK



PRODUCT VARIANTS IN REAL LIFE

HEAVY-DUTY TRACTOR (APPROX 100 TONS GROSS WEIGHT)



PRODUCT VARIANTS IN REAL LIFE

CITY BUS



PRODUCT VARIANTS IN REAL LIFE

LONG-DISTANCE BUS



#LIVEWORX

MAN Truck & Bus AG

PRODUCT VARIANTS IN REAL LIFE

CITY CLEANING



PRODUCT VARIANTS IN REAL LIFE

HEAVY-DUTY OFFROAD TRUCK (8X8, 41 TONS)



PRODUCT VARIANTS IN REAL LIFE

DUMPER APPLICATION



PRODUCT VARIANTS IN REAL LIFE

FIRE BRIGADE APPLICATION



PRODUCT VARIANTS IN REAL LIFE

SNOW PLOW / SALT SPREADER APPLICATION



PRODUCT VARIANTS IN REAL LIFE

SPECIALIZED HAZARD APPLICATION



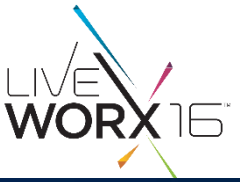
PRODUCT VARIANTS IN REAL LIFE

SOCCER TEAM BUS (AS EARTHLY AS IT GETS)



PRODUCT VARIANTS IN REAL LIFE

MAN'S CHRISTMAS CHARITY – AS HEAVENLY AS IT GETS



B2B VS. B2C BUSINESS

WHO ARE MAN'S CUSTOMERS?



„Means of transport“

„Means of mobility“



OEM



truck delivery



Company



transport task



Company



goods delivery



car delivery



Private End User

SMART COST / VALUE ENGINEERING

MAN TGX EFFICIENTLINE TO IMPROVE CUSTOMER BUSINESS



Efficiency package:

- Less aerodynamic drag
- Less rolling resistance
- Lightweight equipment
- Less auxiliary power required

1,34 l

0,40 l

0,10 l

0,76 l

Savings through technical measures:

2,60 l

+ MAN ProfiDrive® Economy Training

0,40 l

Total fuel saving/100km:

3,00 l

Total CO₂ saving/a:

12 t

Total cost saving/a:

~ 6.500 €

For comparison

- common truck driver
32 l / 100 km = 7.3 mpg
- “good” truck driver
28 l / 100 km = 8.4 mpg
- 1 l Diesel ≈ 1.40 EUR in Germany
(1 gallon ≈ 7.18 US\$)





INTERMEDIATE CONCLUSION

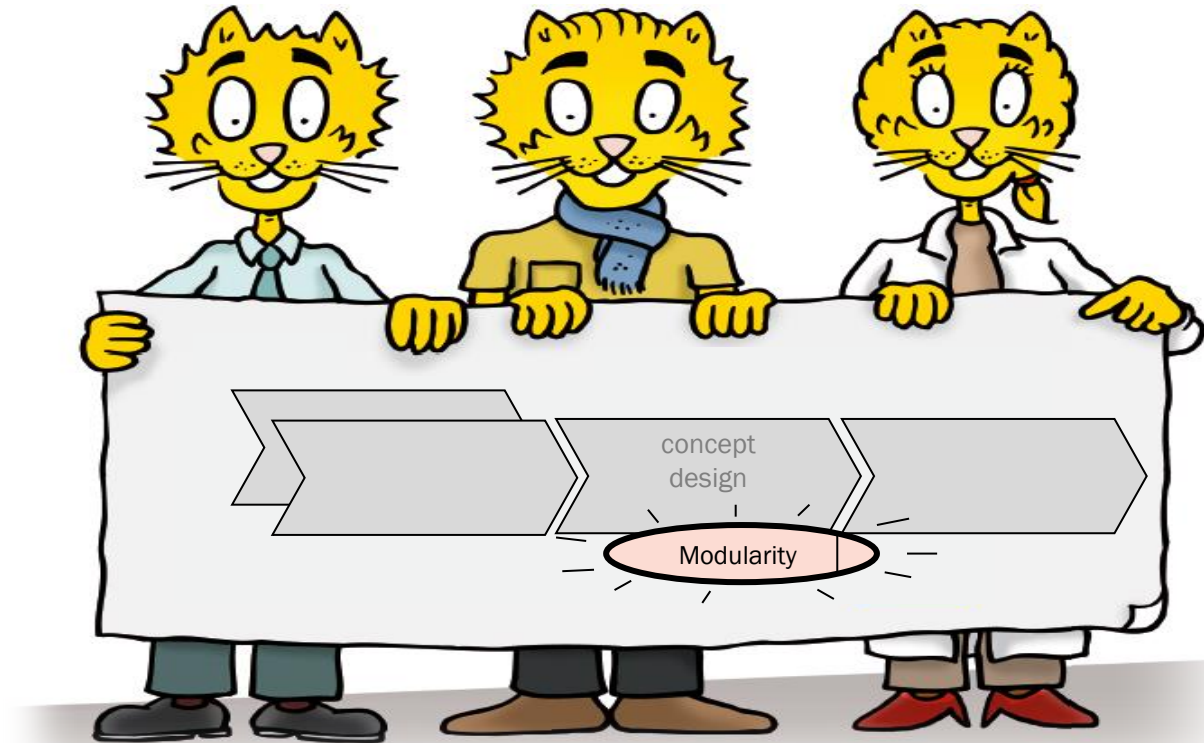
WHAT DOES THIS IMPLY?



- The product (i.e. the truck) caters for the customers' transport needs
- Products are highly specialized to improve on the customers' ROI
- Products are highly reliable
- Given the market sizes, production volumes per variant are low
- Modular design and Configure-to-Order are core factors to success

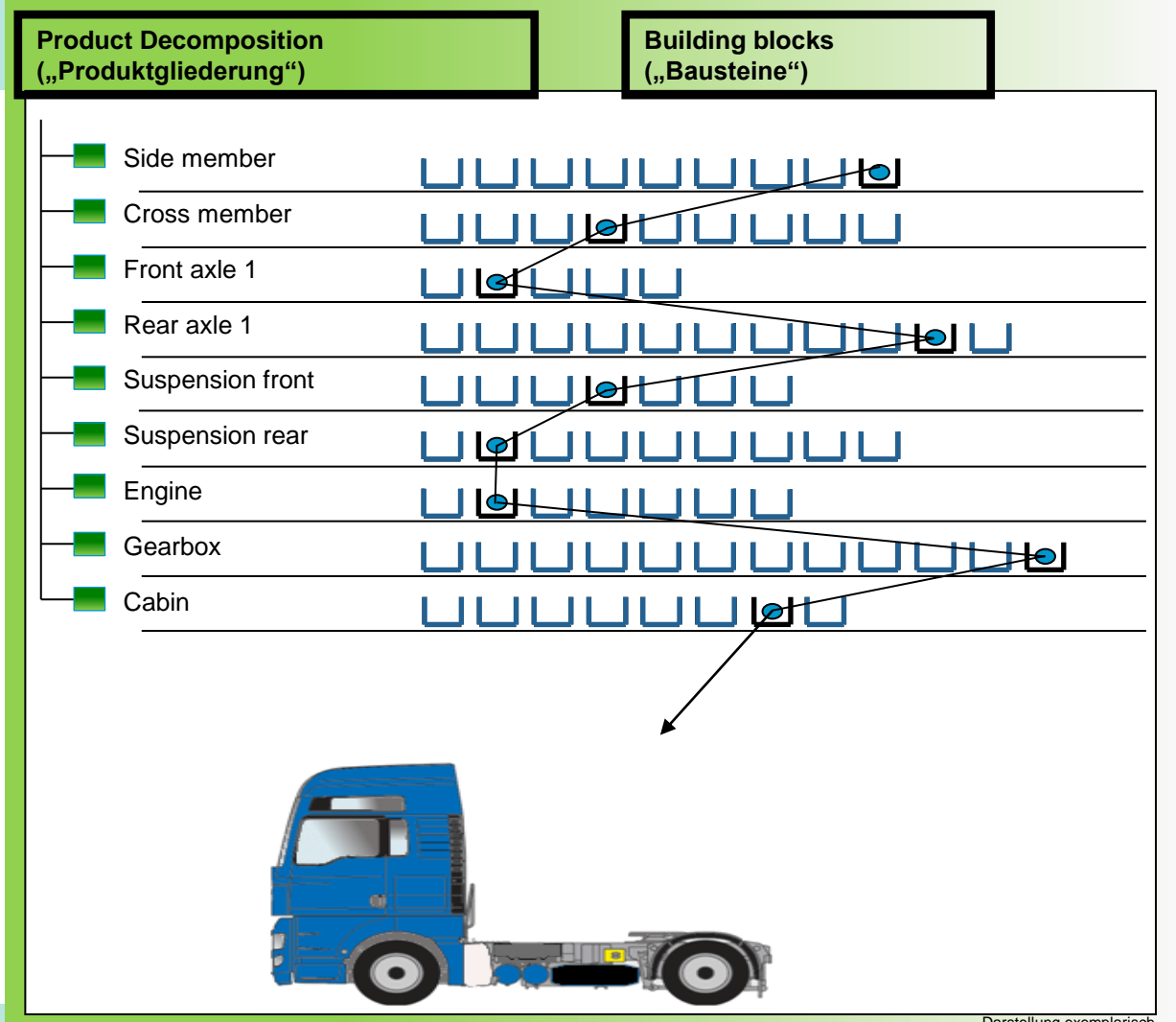
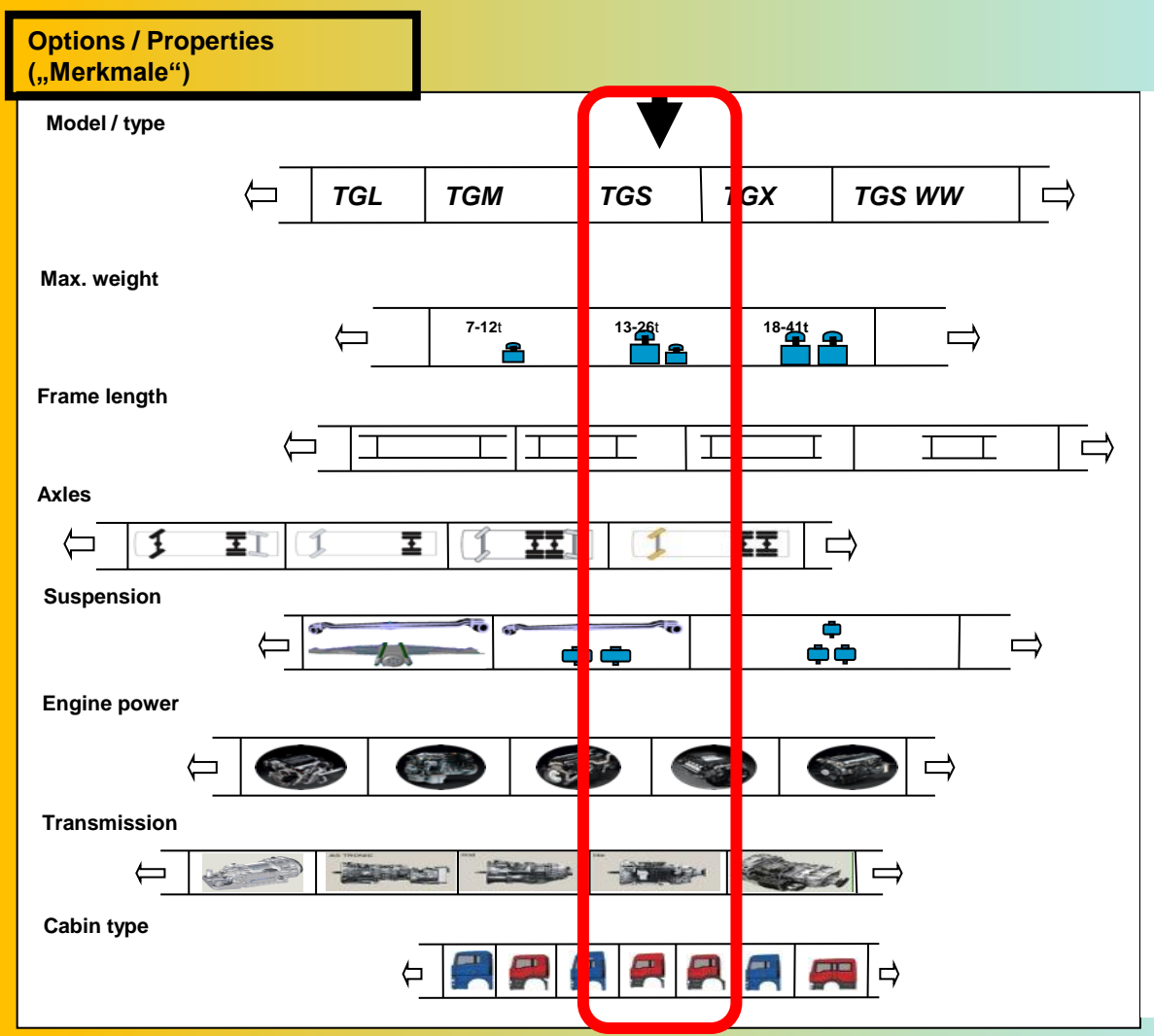
LET'S TALK DESIGN PROCESS PHILOSOPHY

- Focus of the Implementation
- Later: Content of what's in the PLM environment



MODULAR KIT TRUCK

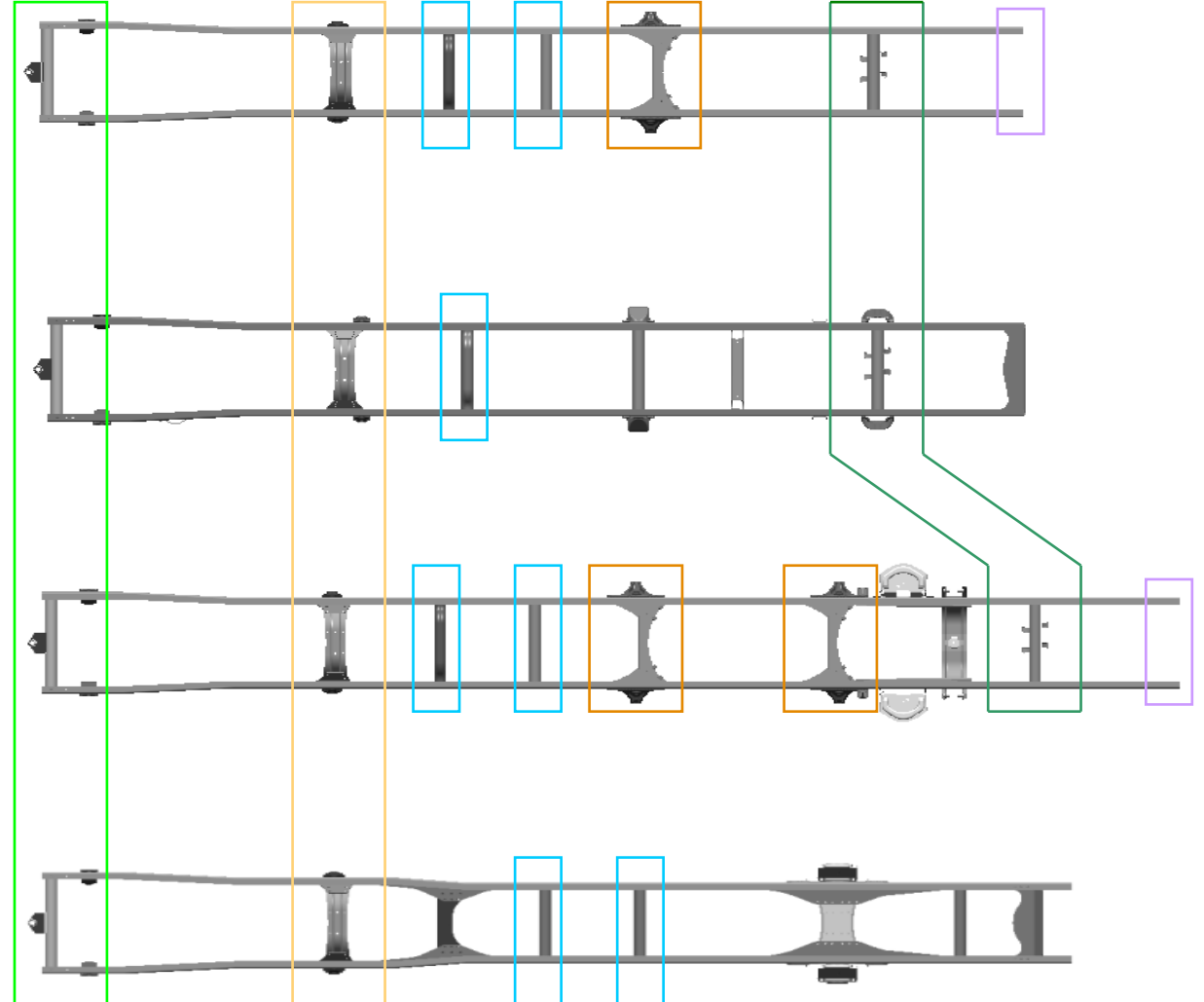
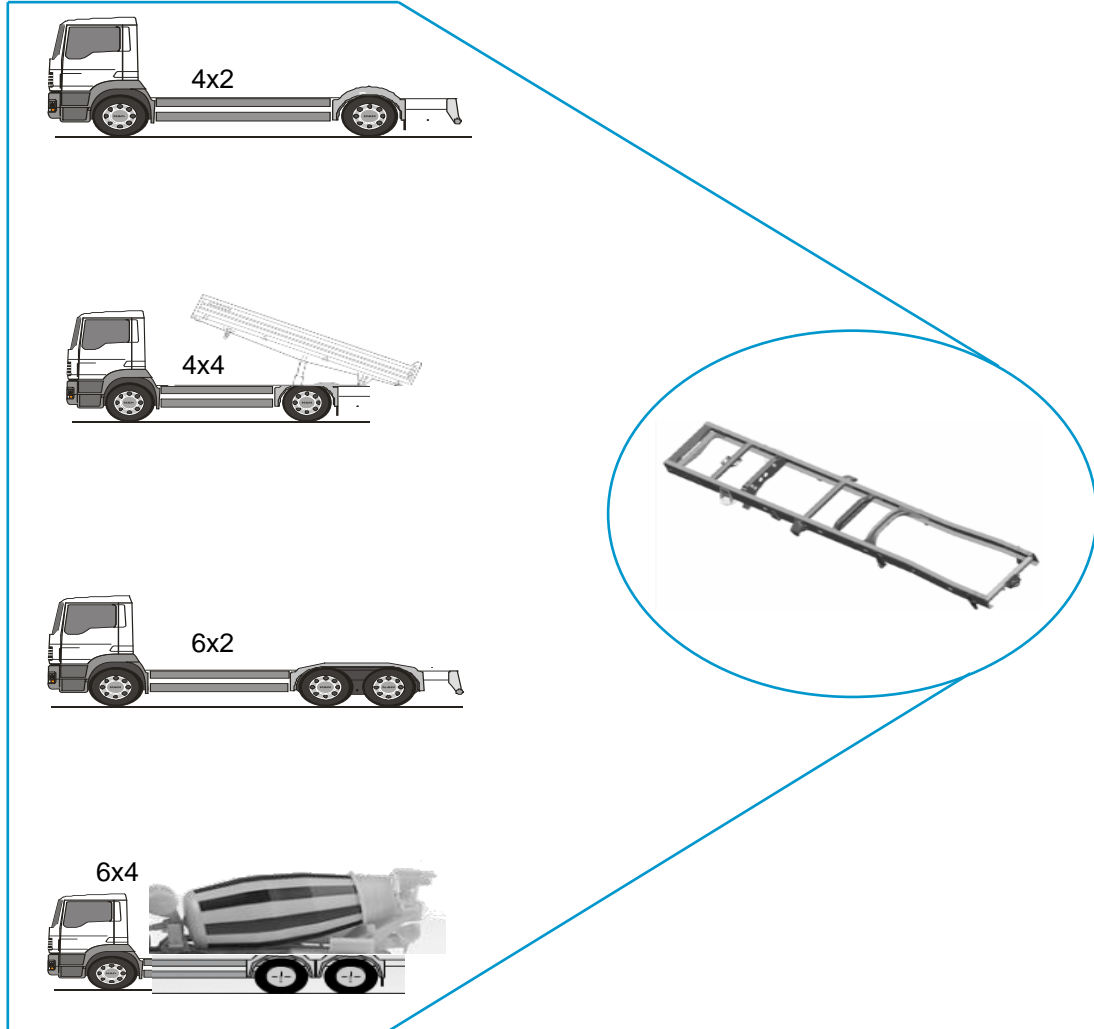
PRODUCT STRUCTURE IN DEVELOPMENT AND BOM



Darstellung exemplarisch

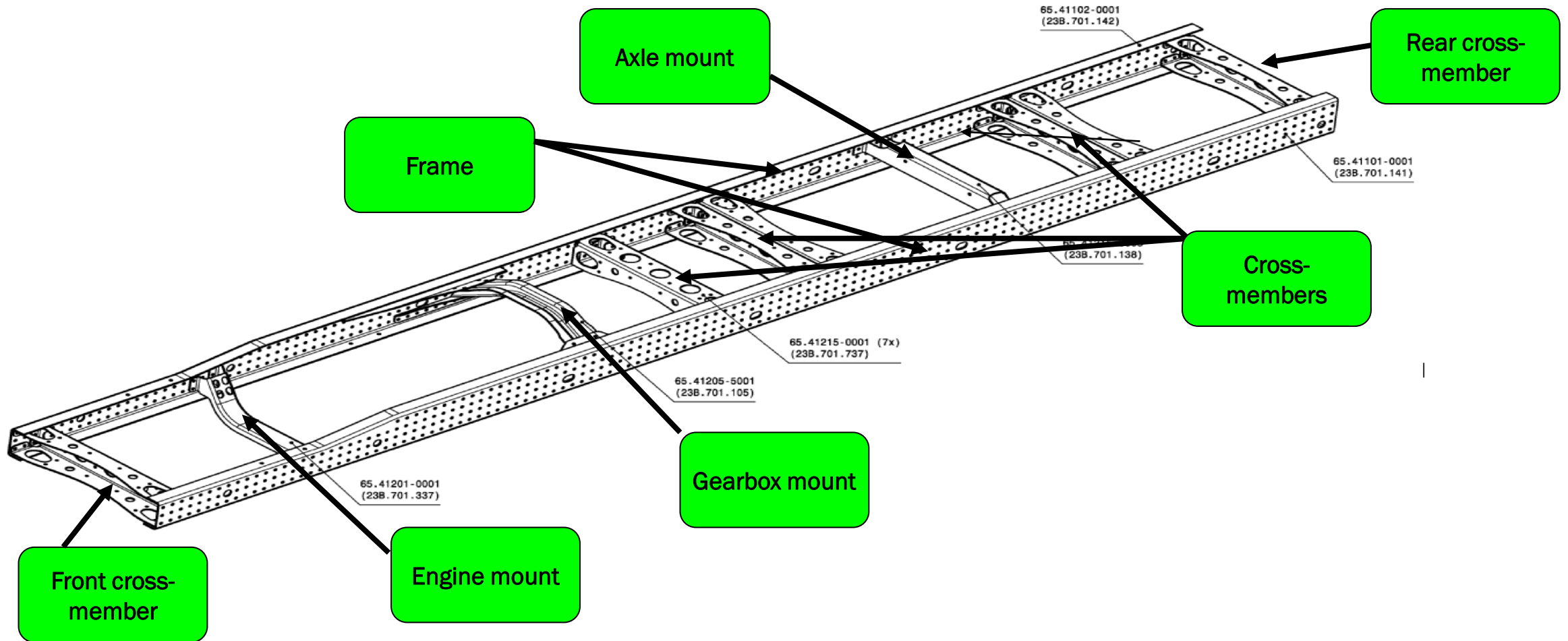
LADDER FRAME

OVERVIEW ON CONCEPT (LIGHT DUTY / MEDIUM DUTY TRUCKS)



MODULAR APPROACH TO DESIGN

GENERAL SETUP – EXAMPLE OF A TRUCK FRAME



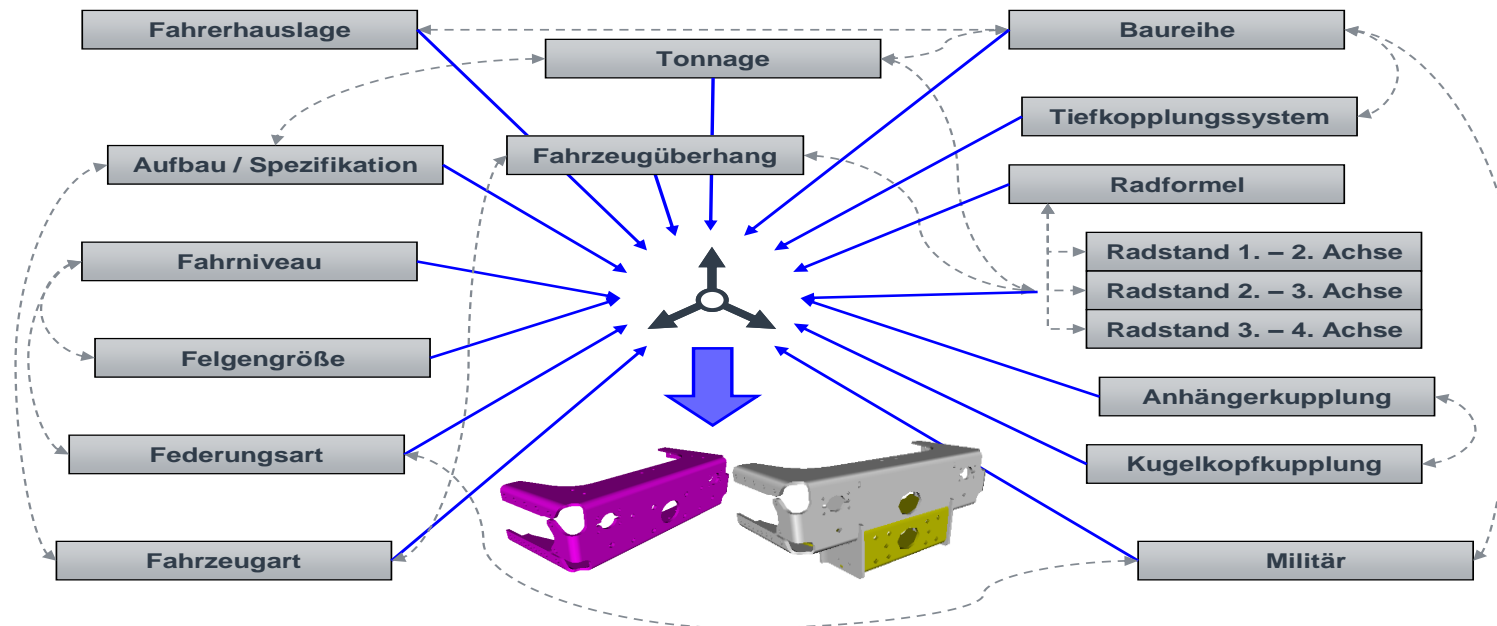
Illustrative representation – adapted for nondisclosure reasons

POSITIONAL VARIANTS

A VARIANT DRIVER INDEPENDENT OF THE BOM PERSPECTIVE



- Commercial vehicles have a an important number of positional variants
 - e.g. seen in the rear cross member, which depends among others on the wheel base
 - often selectable by the customer and directly driving the vehicle configuration, as the customer configures „space“ as added equipment



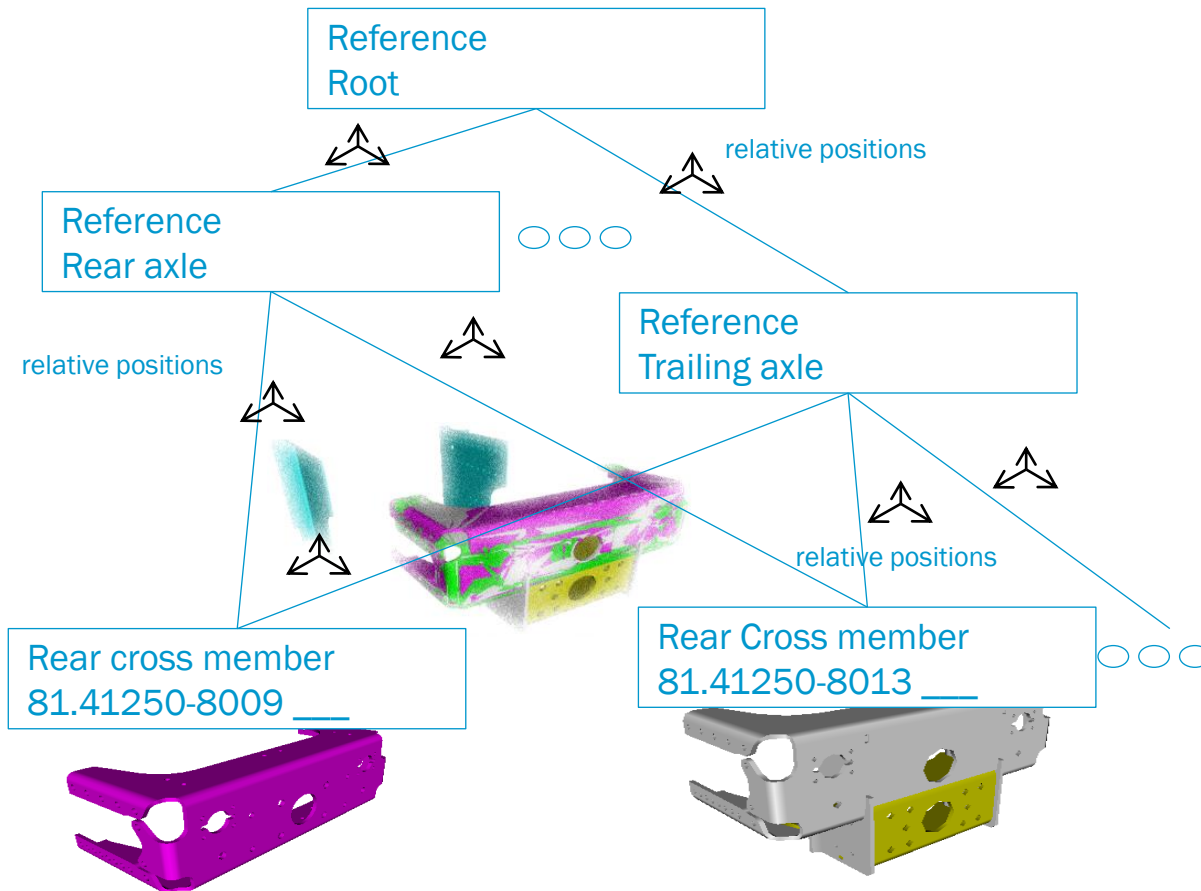
* illustrative example

POSITIONAL VARIANTS ARE LARGE IN NUMBERS

E.G. REAR CROSS MEMBER



- Each variant driver (i.e. an available option) can vary in the available option codes and thus drive the positioning



...up to six stacked reference coordinate systems

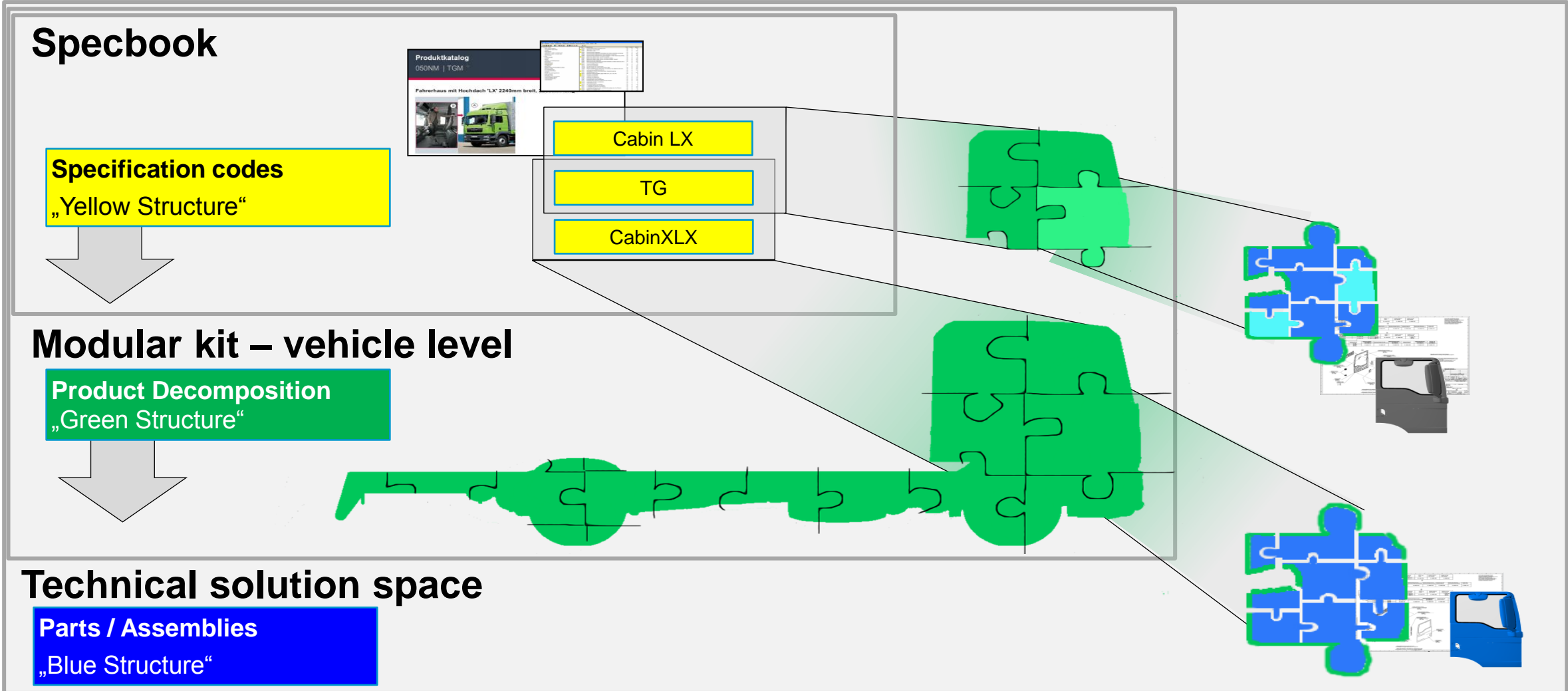
... approx. 1000 transformations from one reference to the next

... 9 different parts related

in total:
12.6 million absolute positions

ARCHITECTURE – THE BASIC PRINCIPLE

INTERPLAY: YELLOW, GREEN, BLUE STRUCTURE



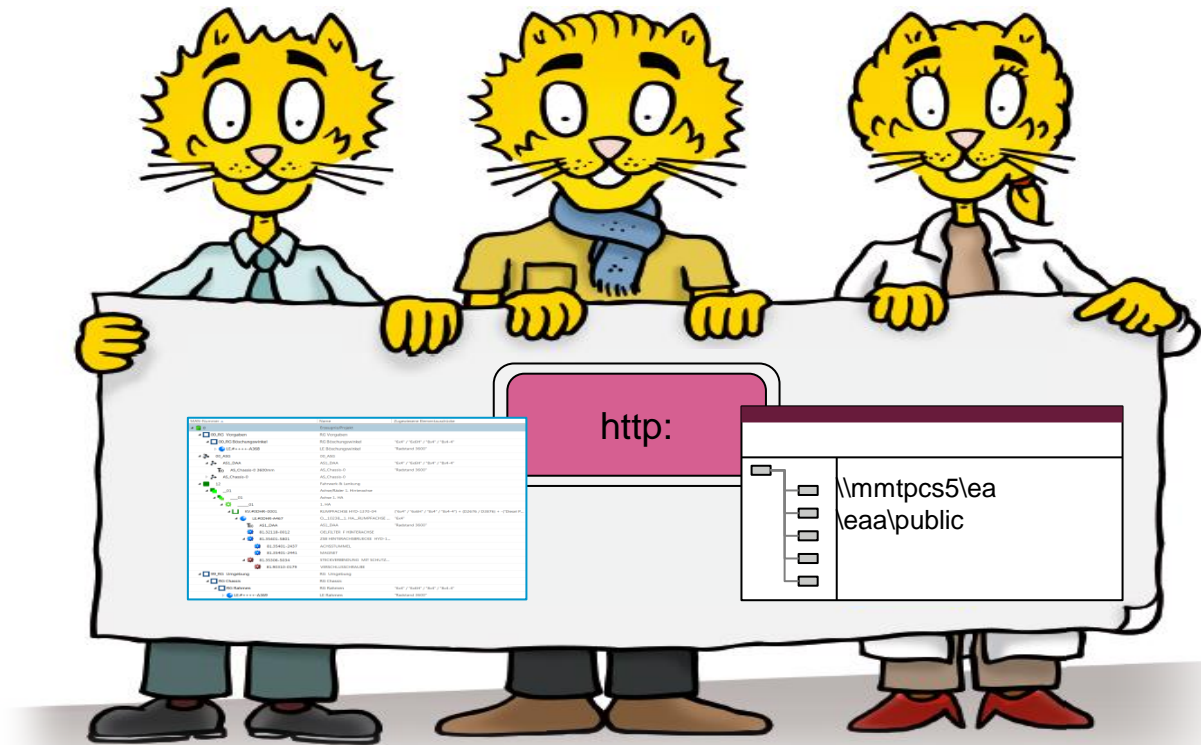
INTERMEDIATE CONCLUSION

WHAT DOES THIS IMPLY?

- Design process template focuses on modular design
- Early definition of customer perspective is the core driver of deriving needs for modularity
- Separation of variants: BoM perspective and topology perspective
- Concept of this process as a basis for the IT implementation

LET'S TALK PLM IMPLEMENTATION

- Implementation Approach
- Information Model
- Illustrative Example of the Implementation



INFORMATION MODEL

CORE DATA MODEL



Product Decomposition

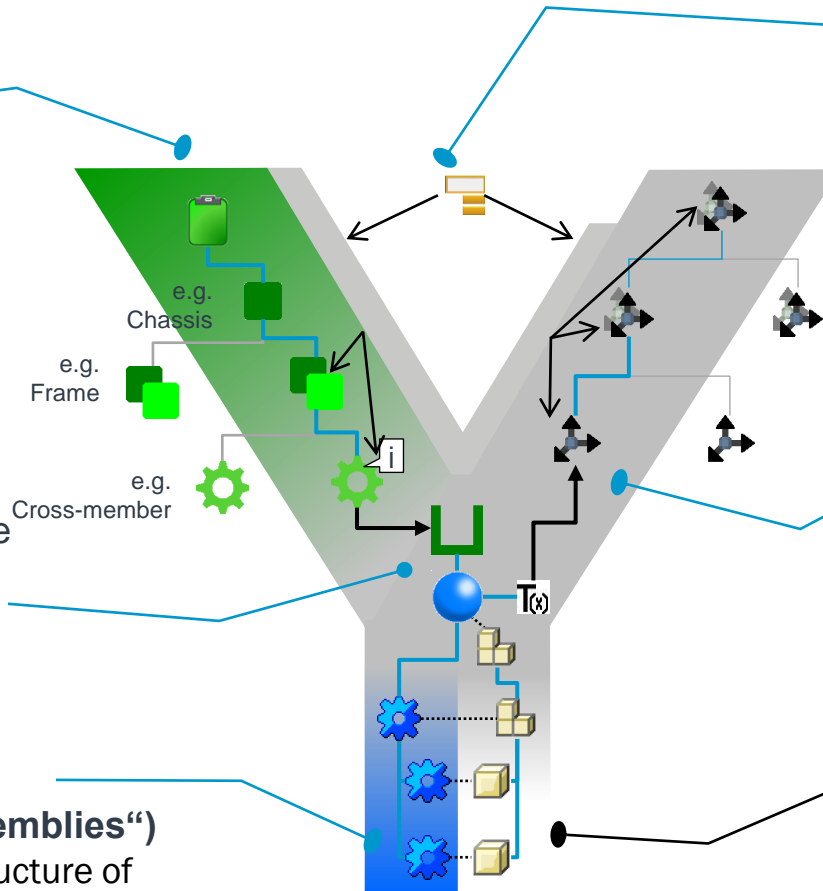
- Modular product structure

Component Variants (KVs)

- Invariant BoM elements that are modularized to enable maximum reuse and configurability

Solution Space („parts and assemblies“)

- Master data structure of BoM and related parts / assemblies



Options and Choices and Combinatorics

- Variant management with a market / customer perspective
- Close link to requirements management

Reference Coordinates and (generic) Transformations

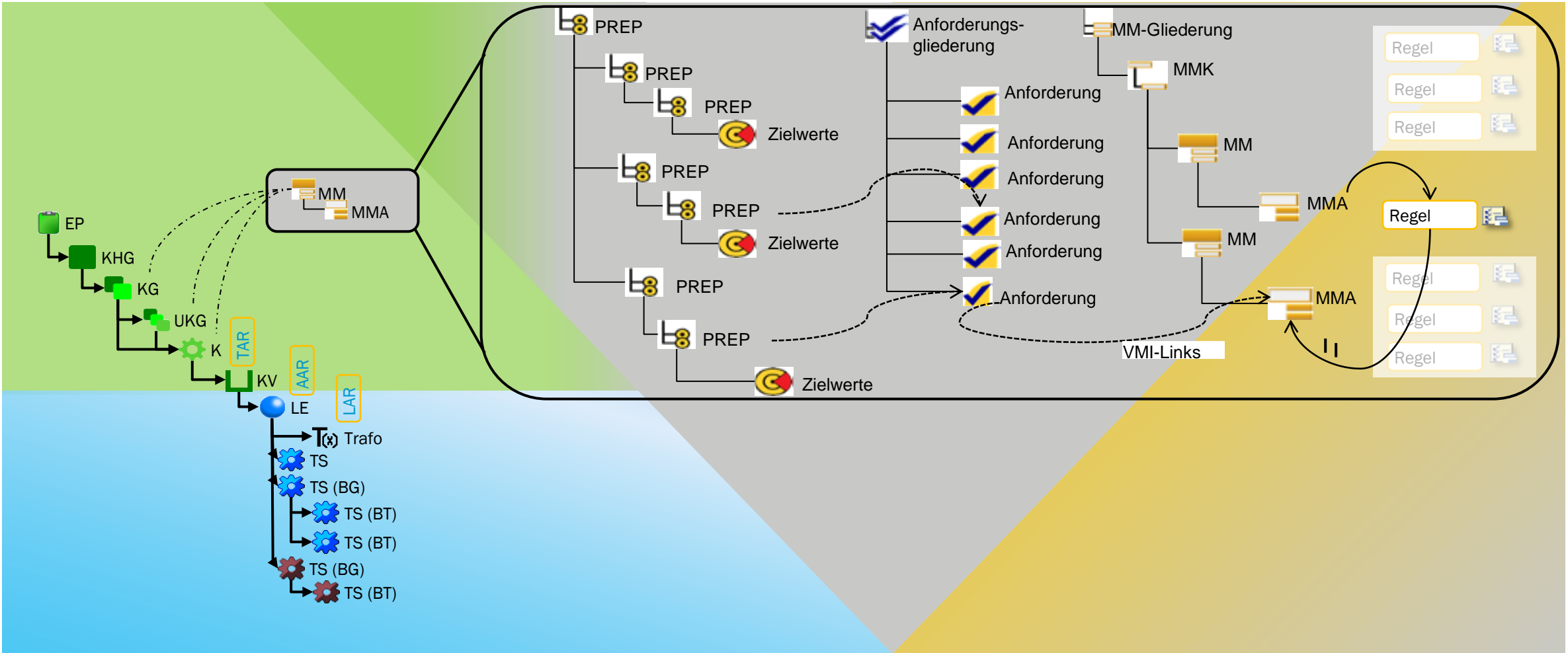
- Configurable references for positioning of component variants

CAD-Structure

- Virtual representations of parts and assemblies
- Independently controlled to represent e.g. alternative shapes

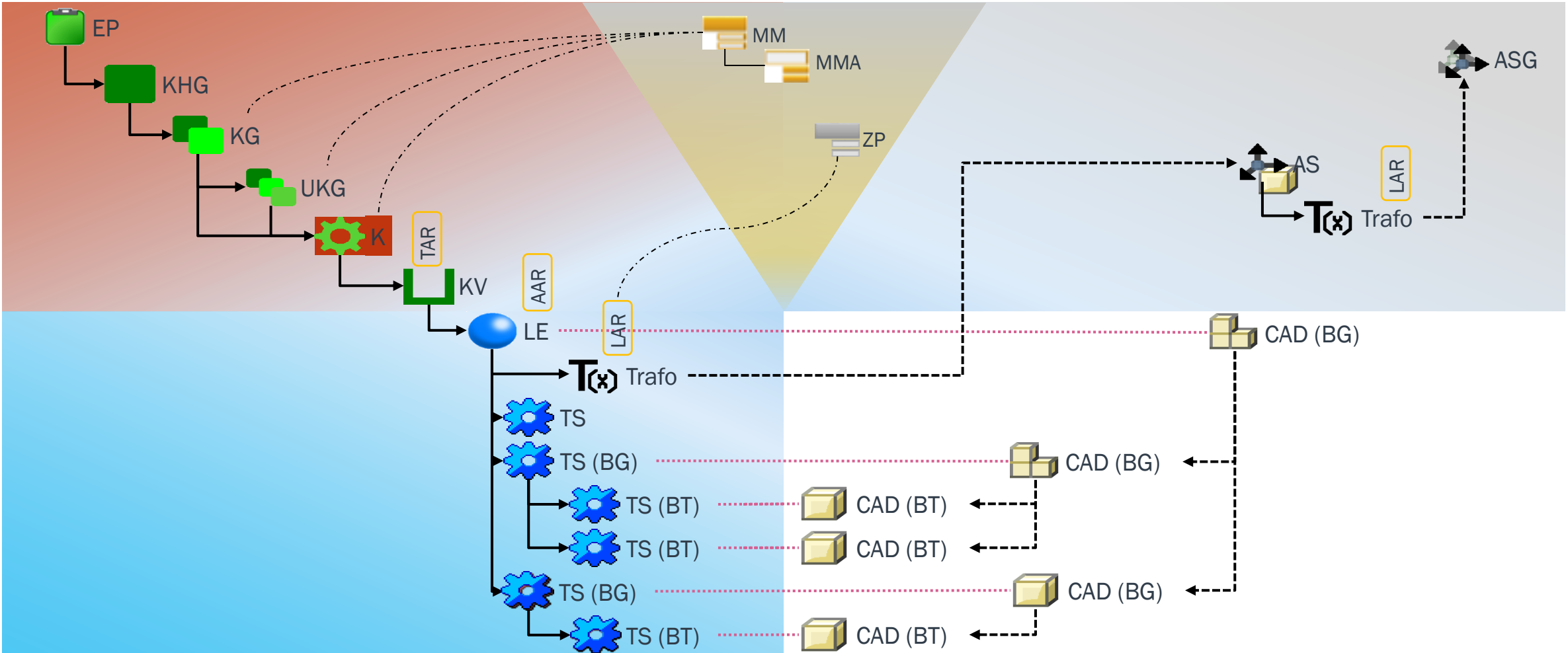
REQUIREMENTS MANAGEMENT

REQUIREMENTS AS AN INTEGRAL PART OF THE PLM ENVIRONMENT



CAD INTEGRATION

TOPOLOGY AND CAD DATA AS PART OF THE INFORMATION MODEL



VARIANT DESIGNATION

OVERVIEW OF SPREADSHEET BASED TOOL



PG-Id (1910 2)	Ebene	Typ	Nr	Benennung	optional 1. Abschätzung Umfang von NHMR [ja, nein, offen]	MUSE Verantwortliche Fachgruppe	MUSE Verantwortliches SET	Verantwortlicher in der Linie	Sachnummer / LGA-Nummer	KÜ
10472	3	K	05.04.07	Kühlerjalousie	Ja	Karosserie / FHS	SET Stoßfänger			
13164	2	KG	05.05	Kühlerschutz	Ja	Antriebsstrang	SET Kühlung			
10660	3	K	05.05.01	Kühlerschutz	Ja	Antriebsstrang	SET Kühlung			
11527	3	K	05.05.02	Fliegenschutzgitter, Steinschlag-Schutzgitter	+	Antriebsstrang	SET Kühlung			
13163	2	KG	05.06	Leitungen Kühlsystem	Ja	Antriebsstrang	SET Kühlung			
10022	3	K	05.06.01	Kühlwasserleitung Motor-Kühler		Antriebsstrang	SET Kü			
11428	3	K	05.06.02	Kühlwasserleitung Motor-Getriebe			SET K			
11429	3	K	05.06.03	Kühlwasserleitung Motor-Getriebe			SET K			
19000	3	K	05.06.04	Kühlwasserleitungen, Sekundär			SET K			
10493	2	KG	05.07	Zusatzheizung Batteriekasten			SET K			
13265	3	K	05.07.01	Wärmetauscher Batteriekasten			SET K			
13266	3	K	05.07.02	Heizleitung zu/von Batteriekasten			SET K			
13740	2	KG	05.08	Sensorik Kühlsystem	Nein	Antriebsstrang	SET Kühlung			
13741	3	K	05.08.01	Sensoren Kühlsystem	Nein	Antriebsstrang	SET Kühlung			
19011	3	K	05.08.02	Sensoren Sekundärkühlsystem	Nein	Antriebsstrang	SET Kühlung			
13742	3	K	05.08.03	Temperatursensor Kühlwasser	Nein	Antriebsstrang	SET Kühlung			
12430	1	KHG	06	Ansauganlage						
13153	2	KG	06.01	Ansaugschacht/Ansaugkasten	offen	Fahrwerk	nicht vorhanden			
13154	3	K	06.01.01	Ansaugschacht	offen	Fahrwerk	nicht vorhanden			
13154-XXXX		LE		P__Ansaugschacht__TGS L/R17 ohne Vorabscheider__AS_FHS		Fahrwerk			XX.LE#00-0036	
13154-XXXX_P		LE		P__Ansaugschacht__L/R44-49 ohne Vorabscheider__AS_FHS					XX.LE#00-0095	
13154-XXXX_P		LE		P__Ansaugschacht__TGS L/R 34-39 ohne Vorabscheider angehoben__AS_FHS					XX.LE#00-0099	
gelösch	gelösch	gelös	gelöschtes LE	gelöschtes LE	gelöschtes LE			gelöschtes LE	gelöschtes LE	g
12407	2	KG	06.02	Verrohrung Ansauganlage	offen					C
11430	3	K	06.02.01	Rohluftverrohrung (inkl. Faltenbälge)						C
11696	3	K	06.02.02	Beiluftverrohrung (inkl. Faltenbälge)						C

Product decomposition

Attributes per node

Variants for this node

THE SAME IN PLM

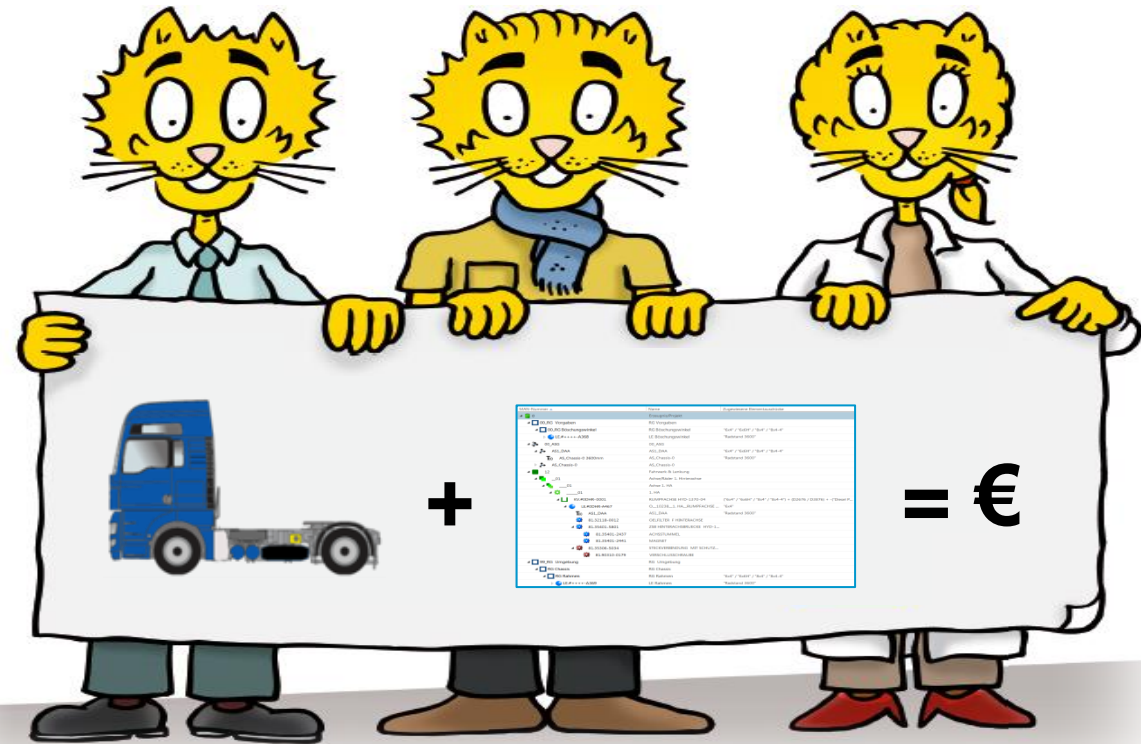
A REAL DATA EXAMPLE FROM OUR SYSTEM



MAN-Nummer ▲	Name	Zugewiesene Elementausdrücke
0	Erzeugnis/Projekt	
00_RG Vorgaben	RG Vorgaben	
00_RG Böschungswinkel	RG Böschungswinkel	"6x4" / "6x6H" / "8x4" / "8x4-4"
LE.#++++-A368	LE Böschungswinkel	"Radstand 3600"
00_ASG	00_ASG	
AS1_DAA	AS1_DAA	"6x4" / "6x6H" / "8x4" / "8x4-4"
AS_Chassis-0 3600mm	AS_Chassis-0	"Radstand 3600"
AS_Chassis-0	AS_Chassis-0	
12	Fahrwerk & Lenkung	
_01	Achse/Räder 1. Hinterachse	
_01	Achse 1. HA	
_01	1. HA	
KV.#0DHR-0001	RUMPFACHSE HYD-1370-04	("6x4" / "6x6H" / "8x4" / "8x4-4") + (D2676 / D3876) + -("Diesel P...
LE.#0DHR-A467	O_10238_1. HA_RUMPFACHSE ...	"6x4"
AS1_DAA	AS1_DAA	"Radstand 3600"
81.32118-0012	OELFILTER F HINTERACHSE	
81.35401-5801	ZSB HINTERACHSBRUECKE HYD-1...	
81.35401-2437	ACHSSTUMMEL	
81.35401-2441	MAGNET	
81.35306-5034	STECKVERBINDUNG MIT SCHUTZ...	
81.90310-0179	VERSCHLUSSCHRAUBE	
99_RG Umgebung	RG Umgebung	
RG Chassis	RG Chassis	
RG Rahmen	RG Rahmen	"6x4" / "6x6H" / "8x4" / "8x4-4"
LE.#++++-A369	LE Rahmen	"Radstand 3600"

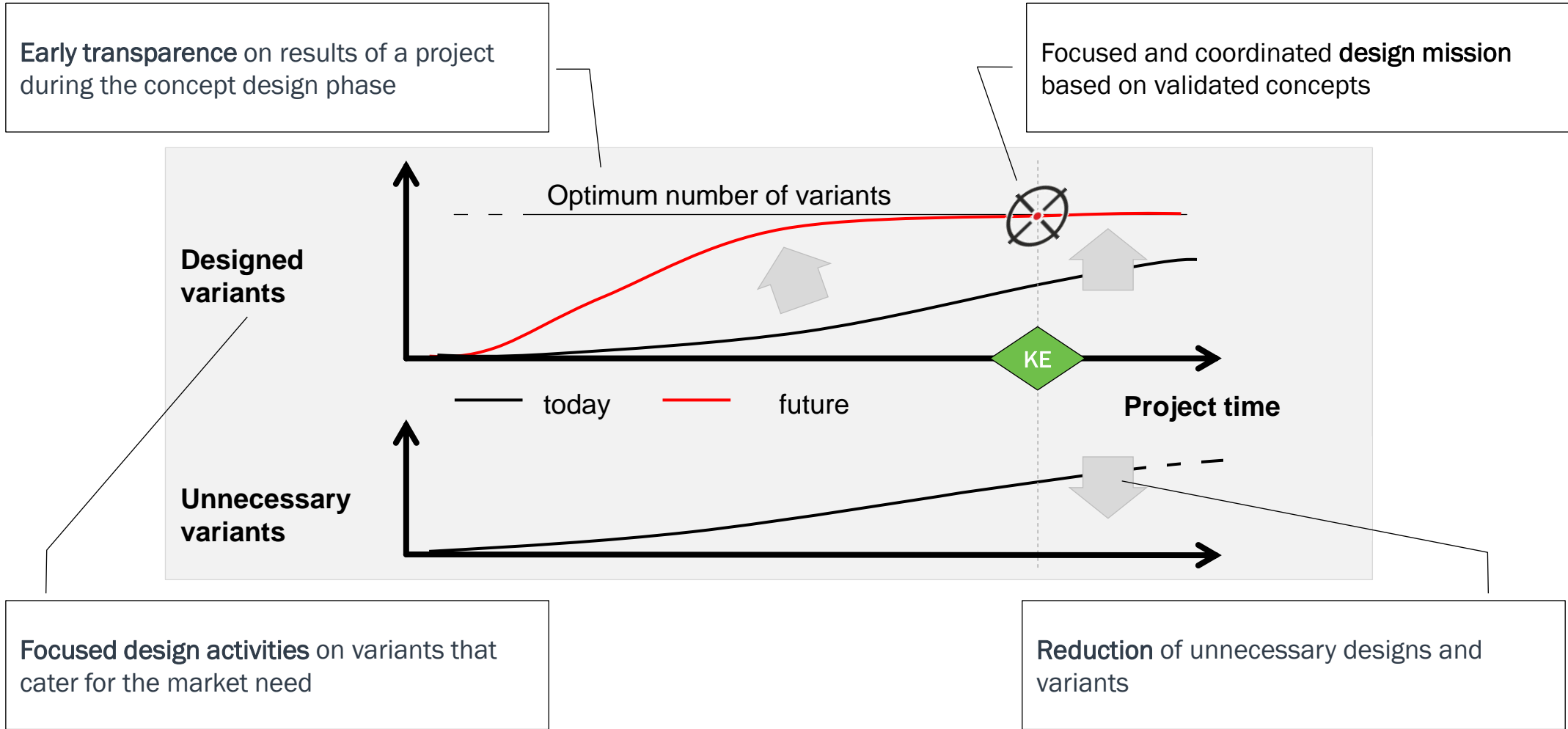
LET'S TALK BUSINESS VALUE

- Business Value
- Reflexion / Conclusion



THE VALUE OF PLM-BASED MODULAR ARCHITECTURE DESIGN

TRANSPARENCY AND FOCUSED DESIGN EFFORTS



The image features several colorful geometric shapes, including triangles and lines in shades of blue, green, yellow, and purple, scattered across the background. A large, multi-colored triangular shape is prominent on the right side. The text 'LIVE WORX 16' is centered, with 'LIVE' in a thin, outlined font and 'WORX 16' in a bold, solid black font. A small 'TM' trademark symbol is positioned to the upper right of the '6'.

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