THE CODE OF PLM OPENNESS
FROM COMMITMENT TO PRACTICAL APPLICATION.

Dr. Markus Fricke
BMW Group IT
IT Systems Research & Development
Current status @ BMW Group and in the initiative "Connected Engineering"

CPO: Overview and motivation @ BMW Group

Using CPO to support Connected Engineering objectives

CPO@ Bosch, Continental, Daimler and Volkswagen
Current status @ BMW Group and in the initiative "Connected Engineering"

CPO: Overview and motivation @ BMW Group

Using CPO to support Connected Engineering objectives

CPO @ AVL, Bosch, Conti, Daimler, Schaeffler and VW
VUCA – THE NEW NORMAL.

Volatile  Unpredictable  Complex  Ambiguous
THE BMW GROUP IT ORGANIZED IN A WORLDWIDE NETWORK.

60 Nationalities in 29 Countries
form the global BMW Group IT network in headquarters, in markets, in shared service centers and in innovation locations (tech offices).

230 products and a complete product orientation
optimize existing business processes and enable new business areas.

694 Locations
(Sales cooperation, offices, …) are connected through the global network infrastructure.

~12,200,000 Vehicles
are connected with the BMW Group ConnectedDrive Backend.

~1,000,000,000 Requests
to the BMW Group backend through ConnectedDrive are processed daily.
OUR ANSWER: FOCUSED IT STRATEGY AND 100% AGILE.

BMW GROUP IT Strategy

IT IN THE PRODUCT & IN SERVICES

DIGITALIZATION (IoT, O2O, D2C, CRM, B2B2C)
BUSINESS INNOVATION

CUSTOMER-CENTRIC IT SERVICE-DELIVERY

PEOPLE & CULTURE

#enjoyIT

FLEXIBILITY & SPEED

From plan-driven to value-driven software development

100% AGILE
100% AGILE IS NOT A BUZZ WORD FOR US. IT’S A HOLISTIC JOURNEY ALONG 4 CORE DIMENSIONS.
ACHIEVEMENTS THROUGH 100% AGILE IN VARIOUS DIMENSIONS SO FAR.

Hybrid environment *(Creative & Dynamic)*
with little restrictions to other systems
and loads of requirements that need to be fulfilled in a short period of time

Custom Software
implementation with high level of complexity for a huge number of worldwide users

TECHNOLOGY

PLM-Software
implementation with high level of complexity and interfaces to several core systems for a huge number of users

Standard Software
with deep integration and high operations / usability impact
CONNECTED ENGINEERING: FROM AGILE IT TO AGILE ENTERPRISE.

Knowledge Stream
→ Enterprise backbone to strengthen virtual, collaborative engineering

From V to I
→ Continuous, agile & virtual engineering

Virtual Product Experience
→ Handshake between engineer and AI
Current status @ BMW Group and in the initiative "Connected Engineering"

CPO: Overview and motivation @ BMW Group

Using CPO to support Connected Engineering objectives

CPO@ Bosch, Continental, Daimler and Volkswagen
CPO@BMW GROUP.
BMW GROUP’S ROLE WITHIN THE PROSTEP ASSOCIATION.

BMW Group demonstrates a long-term dedication in insisting on open PLM systems and supporting the development of PLM standards.

- As a founding member of the prostep association, BMW Group actively drives PLM standardization since >35 years
- BMW Group continues its engagement with prostep in current topics, e.g. SSB
- An open PLM architecture is a visible key element of BMW Group’s PLM strategy
- BMW Group initiated the CPO in 2012 and was the first enterprise to sign the CPO

1991: BMW Group initiates the ProSTEP project

CeBIT 2012: Approval of the CPO v1.0 by BMW Group CIO K. Probst (Photo: automotive Day 2012)

Prostep IViP Symposium 2018: CIO K. Straub underlines importance of CPO for being agile.

CeBIT 2012: Approval of the CPO v1.0 by BMW Group CIO K. Probst (Photo: automotive Day 2012)

CeBIT 2012: Approval of the CPO v1.0 by BMW Group CIO K. Probst (Photo: automotive Day 2012)
The CPO value potential has been confirmed in various initiatives at BMW Group:

**Optimization of business applications:**
- Best-in-class solutions regarding both functionality and TCO
- Speed and flexibility for process optimizations

**IT cost reduction for:**
- Integration of new applications/systems
- Releases, respectively version or system changes
- Maintenance and operations

**Better collaboration between vendors, integrators and users:**
- Common understanding and terminology regarding PLM openness
- Rules and agreements realization and adherence to openness
AGENDA.

Current status @ BMW Group and in the initiative "Connected Engineering"

CPO: Overview and motivation @ BMW Group

Using CPO to support Connected Engineering objectives

CPO@ Bosch, Continental, Daimler and Volkswagen
USING CPO TO SUPPORT CONNECTED ENGINEERING.

Focus of the initiative „Connected Engineering“

Engineering
- Flexible engineering structures
- Geometry and function combined
- Enabler for agile collaboration

PDM
- Master data
- E-BOM

Logistics / Production View
- M-BOM

Codex of PLM Openness: Base for cross-domain and cross-solution consistency
CPO IS A PREREQUISITE FOR ALL DATA MANAGEMENT SOLUTIONS IN THE CONTEXT OF CONNECTED ENGINEERING.

Initial strategy phase:
- Clear strategic vision
- Scoping, approach, setup
- Top mgmt commitment

Strategic guidelines for
- Process development
- Technical development

CPO has been established as prerequisite for standard software and hybrid scenarios.

---

Engineering
- Flexible engineering structures
- Geometry and function combined
- Enabler for agile collaboration

Data layer
- business / IT information model (geom. & funct. development)
MANIFESTATION OF CPO ADHERENCE IN GUIDELINES, APPROACH AND ORGANIZATION.

Manifestation of the CPO in vendor selection and solution design

Ongoing evaluation (KPI) and predefined actions in case of deviations

Bilateral contractual obligation to openness

Signed CPO / certified Vendor

CPO has been established as prerequisite for standard software and hybrid scenarios.

Initial strategy phase:
- Clear strategic vision
- Scoping, approach, setup
- Top mgmt commitment

Strategic guidelines for:
- Process development
- Technical development

BMW Group Target
BMW Group approach for standard software
Prerequisite

Level of Openness

3

2

1

Data layer
- business / IT information model (geom. & funct. development)
AGENDA.

Current status @ BMW Group and in the initiative "Connected Engineering"

CPO: Overview and motivation @ BMW Group

Using CPO to support Connected Engineering objectives

CPO@ Bosch, Continental, Daimler and Volkswagen
FROM COMMITMENT TO PRACTICAL APPLICATION

80 Committed CPO-Partners – but how does the practical application look like?

IT Customers
- Adient
- Airbus
- Altran
- BMW
- Bosch
- Continental
- Daimler
- Dräxler
- EDAG
- Ford
- Fuji Heavy Industries
- Hino Motors
- Honda R&D
- Isuzu Motors
- Küster
- Mazda Motor
- Mitsubishi Motor
- Nissan Motor
- Porsche
- Schaeffler
- Siemens
- SMP Group
- Suzuki Motor
- thyssenkrupp
- Toyota Motors
- Volkswagen
- Volvo AB
- Yamaha
- Yazaki
- ZF Friedrichshafen

IT Vendors
- Acta
- Aras
- Autodes
- AVL List
- Beta CAE Systems
- BOS
- Cimatron
- CONCEPT Software
- CNOAWEVER
- Dassault Systèmes
- dSPACE
- ECS
- Elysium
- ESI ITI
- Eurostep
- Gamma Technology
- MCA
- Mentor Graphics
- Modelon AB
- Müller-BBM
- Noesis Solutions
- PROSTEP
- PTC
- Rocket Software
- SAP
- Siemens PLM
- TechniaTranscat
- Theorem

IT Service Provider
- Atos
- CADFEM
- HCL
tenso managers
- InMediasP
- iqs Software
- M.E.B.
- MetaRatio
- NTT Data
- Seeburger
- SSC-Services
- T-Systems
- xPLM
FROM COMMITMENT TO PRACTICAL APPLICATION
An initiative of the prostep ivip association

Practical application of users presented at the prostep ivip symposium 2019

IT Customers
- Avid
- Airbus
- Audi
- Bosch
- Continental
- Daimler
- Donauwörth
- EDAG
- Ford
- Fuji Heavy Industries
- Hino Motors
- Honda R&D
- Isuzu Motors
- Kuster
- Mazda Motor
- Mitsubishi Motors
- Nissan Motor
- Porsche
- Schaeffler
- Siemens
- SMB Group
- Saab Motor
- thyssenkrupp
- Toyota Motor
- Volkswagen
- Volvo
- Yameha
- Yazaki
- ZF Friedrichshafen

Certified vendors presented at the prostep ivip symposium 2018

IT Vendors
- Actaris
- Aris
- Autodesk
- AVL List
- BETA CAE Systems
- BOS
- Coborn
- CONCISE
- CONTACT Software
- CONWEAVER
- Dassaault Systems
- dSPACE
- EDS
- Elysiun
- ES-ITI
- Eurostep
- Gemma Technology
- IBM
- IGPI Automotive
- ISD
- Intergraph
- MathWorks
- Mentor Graphics
- Modelon AB
- Miller-BBM
- Addo Solutions
- AVERTEP
- PTC
- necsoft Software
- SAP
- Siemens PLM
- Techniscan
- Theorem

IT Service Provider
- BEOS
- CADEEM
- EMS
- erp managers
- InMediap
- Ios Software
- M.E.B.
- MeshRatio
- NITRAS
- Schaefer
- SSC-Services
- T-Systems
- XLM
Strategic fields of action using CPO in business
CPO@INDUSTRY_IN_9/2018

Evaluation of the questionnaires (10 of 11 companies)

CPO Umsetzung (Werte von 0 bis 1)
CPO@BOSCH
STEP BY STEP IMPLEMENTATION OF CPO@BOSCH

06/2018 : CPO Announcement / Communication
  CPO continuously proposed as one of the decision making instruments for
  future engineering IT architecture and tool decisions

03/2019 : Preparation of HPLM Initiative.
  CPO defined as one of the guiding principles for the upcoming
  holistic PLM Architecture

07/2019 : Definition of Bosch required details, scope, setup of training material
  CPO will be announced to and trained with the organisation
  (Architects, Purchasing etc.)

01/2020 : Start of the HPLM program
  Continuous use of CPO in architecture / vendor decision of the
  HPLM program
Bitte decken Sie die schraffierte Fläche mit einem Bild ab.

(24,4 x 13,2 cm)

CONTINENTAL Codex of PLM Openness

www.continental-corporation.com
2.1 Interoperability
- IT customers shall be able to realize system integration, on their own or via third parties
- Customers shall have access to their data
- Therefore IT interfaces shall be provided by the IT vendors

2.2 Infrastructure
- The IT customer and the IT vendor shall share lifecycle planning

2.3 Extensibility
- IT vendors shall provide development environments
- In case of an IT system upgrade, IT vendors should endeavor that the application of extensions realized by IT customers (or by third parties commissioned by these IT customer) is unaffected

2.4 Interfaces
- IT vendors should offer the same IT interfaces to IT customers (or third parties commissioned by these IT customers) as those used internally by the IT vendors

2.5 Standards
- IT vendors should support relevant standards and document their usage. IT vendors shall provide a list of the standards that support openness

2.6 Architecture
- If applicable, the IT system shall have a clear and documented separation of the individual tiers

Source: dreiconsult.
DRIVING STANDARDS IS A SUCCESS STORY

- Continental is driving standardisation
  JT, ReqIF, Standardization Strategy Board

- Open Standards are the fundament for the Digitalization

- Standard format usage (*)
  JT, AP242-XML, ReqIF, PDF, ASAM …

- Interaction of open and standardized formats
  JT<-> ReqIF, JT<-> STEP-XML, JT<-> SysML

- Cross-discipline collaboration wherever, whenever

*) Excerpt of usage of standards
Code of PLM Openness
Introduction at IT4RD | Daimler AG
WHY IS CPO KEY FOR DAIMLER

The CPO is important for Daimler to ensure open PLM architectures, system landscapes and to enforce the usage of Engineering-IT standards | Aiming for efficient PLM processes

Conclusion

CPO is used on organisational level

CPO is used on application level

Member of CPO Coreteam

Usage & Benefits

Time

today
STEPWISE INTRODUCTION OF THE CPO AT IT4RD

**2018:** Existing **IT4RD Architecture Model** is the foundation; based on 5 Joint Priorities (DevOps&Cloud | Security&IAM | FOSS | API | People in IT)

**2019:** Daimler **Application Assessment** (DAA) is introduced; based on the CPO (open architectures | best integrability | based on Eng.-IT standards)

**2020:** Sourcing departments are informed and use this assessment for the sourcing of all new applications (beginning from 2020)

**Conclusion**

Beginning from 2020 the CPO criteria will be used for all new (sourced) Engineering-IT applications while using the tool specific CPO criteria in accordance to their development
CPO SOLL ZUKÜNFTIG BEI EINKAUFSENTSCHEIDUNGEN VON IT-SYSTEMEN ANGEWENDET WERDEN

Prüfung auf CPO-Zertifizierung vom TÜV

Ability to Execute Scorecard
- Code of PLM Openness (CPO)
- Technical Maturity Model (TMM)
- Standard Daten-austausch-formate

Completeness of Vision Scorecard
- Fit to Capability

Prüfung des CPOs an Hand technischer Qualitätskriterien

Vendor a

Vendor b
TECHNICAL MATURITY MODEL (TMM)
8 QUALITÄTSKRITERIEN FÜR NACHHALTIGE SOFTWARE

Relevant für CPO-Bewertung

- Integrationsfähigkeit
- Cloud-Fähigkeit
- Codequalität
- Deploybarkeit
- Testbarkeit
- Betreibbarkeit
- Sicherheit
- Open Source Compliance
<table>
<thead>
<tr>
<th>CPO Kriterium</th>
<th>Zusammenfassung Beschreibung aus CPO</th>
<th>Prüfung des CPO Kriteriums bei VW durch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interoperability</td>
<td>IT system has the ability to be integrated into different environments and that it has to communicate efficiently with various other IT systems.</td>
<td>TMM: Integrationsfähigkeit</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>IT system can be integrated into an existing or planned IT infrastructure environment from perspective of network and system platforms (hardware, OS).</td>
<td>TMM: Cloud-Fähigkeit</td>
</tr>
<tr>
<td>Extensibility</td>
<td>IT customers have the option of extending the functionality of an IT system in order to implement required process adaptations and to map their own know-how in the IT system.</td>
<td>TMM: Integrationsfähigkeit</td>
</tr>
<tr>
<td>Interfaces</td>
<td>IT customer need access to available, documented and performing IT interfaces.</td>
<td>TMM: Integrationsfähigkeit</td>
</tr>
<tr>
<td>Standards</td>
<td>The term “standard” as used here is synonymous with norm, standard, industry standard, vendor-specific standard. Standards are used as far as possible in all aspects of openness (interoperability, IT infrastructure and extensibility).</td>
<td>Use-Case spezifische Betrachtung der Standard-Formate (z.B.: ReqIF im Anforderungsmanagement)</td>
</tr>
</tbody>
</table>
| Architecture          | IT customers need access to the individual components so that:  
- they can create GUIs (clients) for specific user groups which leverage the capabilities of the different IT systems, and  
- administration and continued operation of the different layers (e.g. OS, DB, application and client) can be delegated to the appropriate internal organizations. | TMM: Integrationsfähigkeit + Cloud-Fähigkeit     |
| Partnership, IT customers, IT vendors, IT service providers | Third-party solutions are supported. Requirements of IT customers and their purchasing behavior influence the further development of the openness of marketable IT systems.                      | Aktuell nicht betrachtet                         |
„SCHNITTSTELLEN-HÖLLE“

**Ist-Stand**

- **IT-System 1**
  - Import: SOAP-Adapter 1, SOAP-Adapter 2, SOAP Adapter 1, MQ-Adapter 1, MQ-Adapter 2, RVS Adapter 1, RVS Adapter 2, Proprietär Adapter 1, Proprietär Adapter 2
  - Export: SOAP per ESB*, SOAP ohne ESB*, RVS (File-Transfer), MQ, SOAP per ESB*

- **IT-System 2**
  - Export: REST-API Adapter 1, REST-API, REST-API Adapter 2

- **IT-System 3**
  - Import: REST-API Adapter 3
  - Export: REST-API

- **IT-System 4**
  - Export: REST-API

**Vision**

- **IT-System 1**
  - Export: REST-API Adapter 1

- **IT-System 2**
  - Export: REST-API

- **IT-System 3**
  - Export: REST-API

- **IT-System 4**
  - Export: REST-API

*ESB = Enterprise Service Bus
BEWERTUNG DER INTEGRATIONSFÄHIGKEIT MIT TECHNICAL MATURITY MODEL

Richardson Level 3: Hypermedia Controls
- Selbsterklärende Namen
- Dokumentation (> 80%)
- Zugriff auf alle wichtigen Funktionen und Daten

Richardson Level 2: HTTP Verbs
- Automatisch generierte API-Dokumentation (z.B.: mit Open API Specification)

Richardson Level 1: Resources
- Selbsterklärende Namen
- Dokumentation (> 80%)
- Zugriff auf alle wichtigen Funktionen und Daten

oder

Richardson Level 0: XML-File-Transfer

Quellen:
- https://martinfowler.com/articles/richardsonMaturityModel.html
CPO@WORK - SUMMARY

practical application of the CPO:
• part of the PLM strategy
• used for PLM architecture planning
• considered in their purchasing processes
e.g. CPO certification of vendors
• used for interoperability management in large projects
• company specific openness requirements defined
CPO@WORK

CPO use cases as suggestions for active operational use of the CPO

UseCase 1: Development of an agile PLM strategy
The CPO is the basic building block for an agile PLM strategy. The strategic goals attached to the CPO are transferred to a company-specific PLM target picture. The implementation of the strategy is largely guided by the principles of openness.

UseCase 2: Design of an adaptive PLM architecture
The CPO supports the objective of a flexible and adaptive development. This is done on the basis of an n-tier architecture as well as interfaces and standards for integrating individual functional components. The process design and the required integrated network are strictly based on the rules of the CPO.

UseCase 3: Specifying openness criteria for system selection
The specifications on system openness defined by the CPO provide a reference for defining the requirements necessary for an open system. Self-defined KPIs help to make openness measurable and comparable.

UseCase 4: Integrating the CPO into the purchasing process
The compliance rate of CPO-relevant requirements, the CPO vendor commitment, and the CPO organization certificate are used as input values in the selection of suppliers.

UseCase 5: Set of CPO rules for PLM projects
The consistent compliance with CPO-based regulations by all employees and partner companies on a project team leads to a modular, open and standard-based solution.
CPO Workshop für Anwender und Systemanbieter
Dr. Dietmar Trippner, dreiconsult
Dipl.-Ing. Michael Hertwig, Fraunhofer IAO
THANK YOU FOR YOUR ATTENTION!
BACKUP
AUSGANGSSITUATION UND BEDEUTUNG DES CPO

PLM Kontext und Thesen

- Offene PLM Systeme und Bebauungsarchitekturen gewinnen in einem zunehmend dynamischen Markt noch mehr an Bedeutung da:
  - der Zugriff auf Informationen bzw. Daten über Systemgrenzen hinweg eine immer größere Bedeutung für die Digitalisierung und Neugestaltung der Geschäftsprozesse hat
  - eine schnelle Anpassungsfähigkeit der Prozesse und Systemfunktionen noch wichtiger wird
  - die Integrationsaufwände leistbar sein müssen und
  - die Gesamtkomplexität dabei beherrschbar bleiben muss

- Der Code of PLM Openness (CPO, DIN SPEC 91372) und die seit 4/2018 mögliche Zertifizierung der Systemanbieter leisten einen wichtigen Beitrag, diese Ziele zu erreichen:
  - wenn die Grundsätze des CPO zum festen Bestandteil einer PLM Bebauungsstrategie werden und
  - wenn Anwender und Systemanbieter darauf aufbauend technische, prozessuale und vertragliche Vereinbarungen vornehmen

Beispiel: CONWEaver and CPO

Business Perspective
- Application of Best-in-Class
- Agile and flexible process optimization

IT Perspective
- Sustainable cost reduction
  - Cross-x integration
  - Software changes
  - Maintenance
Überblick

- Die Initiative wurde vom prostep ivip Verein 2013 gestartet
- Ziel: Plug&Play bei der PLM Systembebauung
- Die Spezifikation umfasst nur 18 Seiten und ist seit März 2018 als DIN SPEC 91372-1 genormt

- Der CPO beschreibt Eigenschaften offener PLM Systeme. In ihm sind messbare Kriterien in Form von ‚muss‘, ‚soll‘ oder ‚kann‘ Bedingungen zu den Kategorien: Interoperabilität, Infrastrukturen, Erweiterbarkeit, Schnittstellen, Standards, Architekturen und Partnerbeziehungen festgelegt
- Das Bundesministerium für Wirtschaft ist Schirmherr des CPO und der CPO ist ein eingetragenes Markenzeichen
- Für PLM Systemanbieter besteht die Möglichkeit, sich beim TÜV Nord bezüglich der Einhaltung von Standards bei der Entwicklung und Vermarktung offener PLM Systeme zertifizieren zu lassen
CPO (DIN SPEC 91372-1)

Übersicht zu den Inhalten

Der Code of PLM Openness (CPO) **beschreibt Eigenschaften offener PLM Systeme**. In ihm sind messbare Kriterien in Form von ‚muss’, ‚soll’ oder ‚kann’ Bedingungen zu den Kategorien: Interoperabilität, Infrastrukturen, Erweiterbarkeit, Schnittstellen, Standards, Architekturen und Partnerbeziehungen festgelegt.

Mit der Unterzeichnung des CPO bringen Systemanbieter eine **Selbstverpflichtung** für die Einhaltung dieser Kriterien zum Ausdruck.

Auf Grundlage des CPO können auch **konkrete Vereinbarungen** zwischen Vendoren und Anwender definieren und festgehalten werden.
CPO USECASES

Use Case 1: Development of an agile PLM strategy

Scheme for a strategic development:

Vision, Direction and Goals
- Derive sub-goals, prioritize and build hierarchies
- Define strategic framework

Information
- Starting situation (own situation and environment), trends - procure, analyze, evaluate and form hypotheses

Approach
- Conceptualize, consider alternatives, evaluate, specify, reallocate, communicate, implement, adapt

Resources
- Analyze, plan (define scenarios), evaluate, apply

Time
- Short-term ↔ long-term

Strategic goals supported by the CPO
- Usage of best-in-class solutions with regards to functions and costs
- Speed and flexibility for process optimization
- Potential ad-hoc integration of new applications/systems
- Minimization of the use of resources for release, version or system changes
- Reduction/Control of process complexity (through modularization)

Strategy-related information
- CPO specification (DIN Spec 91372) and explanations [www.prostep.org/cpo](http://www.prostep.org/cpo)
- Overview of CPO-certified vendors [www.prostep.org/cpo/zertifizierung](http://www.prostep.org/cpo/zertifizierung)
- Vendor information on supported standards and CPO requirements

Approach:
- Identification of action fields and assessment of their potential
- Positioning of the CPO in the integration strategy
- Assignment of action fields with measures and implementation plan
- Developing process for application incl. checklist (also including e.g. purchasing)
- Specifying technical requirements for relevant systems
- Organizational and economic definitions

Resources:
- Architecture and development planning (Personal contribution and if necessary PLM service provider)
- Interface and standard expertise (generally through PLM service provider)

Example
"...HAF, IoT etc. move the industry without anybody knowing all the requirements and options today. I want to be able to respond rapidly and flexibly to changing requirements of the market in my own strategy and to use/integrate new technologies in my IT landscape."
Recommended architectures from the Statement of Principles
Theories on Future PLM (extracts)

1) Monolithic systems are outdated - Against the backdrop of increasing product and process complexity, monolithic solutions are no longer adequate. Nor is there only ONE system for all processes and participants in the product lifecycle. We need federated semantic networks, which link digital models distributed on different subsystems (e.g., data from the design phase, series development, and use of the product in the field).

2) PLM systems must become more open - Openness as defined by the Code of PLM Openness (CPO) is a necessary condition for the implementation of future PLM architectures and all built-in systems and components. This contrasts immensely with the self-contained applications of some IT technology providers. Successful PLM systems provide flexible configuration possibilities and open interfaces for data exchange and data linking.

3) Future PLM must be adaptable – Future PLM architectures must be based on consistent but expandable master and structural data but should provide functional components which are autonomously and flexibly adaptable to modified processes and organizational structures. They have to be dynamically adaptable because data models are modified on a regular basis and as the processes in the organization change so do the owners of the individual data objects.

4) Successful PLM implementation is more than a system change – New PLM architectures cannot be implemented by an exchange of systems but have to be adapted continuously to changing business models and business processes. Prerequisites for this are standardized services, cross-system integration layers, semantic networks for data links, and role-specific application functions.

5) Data linking instead of synchronizing – A modular IT architecture with best-of-breed solutions ensures a flexible and user-friendly work environment. Context information from third-party systems can be provided via persistent linked data layers across system boundaries, process boundaries, and company boundaries. This linked data layer is also a prerequisite for efficient MBSE processes.

The CPO defines substantial requirements for an adaptive PLM architecture

6.6 Architecture
The IT architecture comprises the components making up an IT system, the relationships between these components and the way in which they interact and have been integrated. IT customers need access to the individual components so that:
- they can create GUIs (clients) for specific user groups which leverage the capabilities of the different IT systems, and
- administration and continued operation of the different layers (e.g., OS, DB, application, and client) can be delegated to the appropriate internal organizations.

6.6.1. The IT system shall have a documented architecture, including all given tiers.

6.6.2. If applicable, the IT system shall have a clear and documented separation of the individual tiers (e.g., n-tier architecture, peer-to-peer, etc.).

6.6.3. If applicable, it should be possible to adapt the tiers independently of one another. This applies in particular to the presentation tier.
CPO UseCases

Use Case 3: Specifying openness criteria for system selection

Example of an assessment table on PLM openness for system selection

<table>
<thead>
<tr>
<th>Contractual Openness</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open user and innovation communities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development external applications/third-party solutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>License model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection of BMW investment</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Openness in System Lifecycle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal and binding development roadmaps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring requirements management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bug tracking/Quality management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability of interfaces and functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Open Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application architecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transparent documentation of functions deployed at BMW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO/Industry standards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standards in collaboration</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Open Interfaces</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexibility/Development performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stability and performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transparent interface documentation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

source: GAAG 29.1.2014
CPO USECASES

Use Case 4: Integrating the CPO into the purchasing process

On the basis of CPO openness criteria, agreements can be made in the procurement process between user companies and vendors, pertaining to financial arrangements in the case of fulfillment/non-fulfillment, and defining additional technical arrangements with regards to the availability of interfaces and standards.
Use Case 5: Set of CPO rules for PLM projects

In order to achieve as project result an open solution within the meaning of the CPO, it is useful to take the following points into account in project planning, implementation and controlling:

**Project organization** (only CPO relevant point are listed)
- Organization of subprojects according to the primary goals functionality and effect radius with demand for integration
- Creation of a project function: architecture, compatibility, & standards

**Requirements management for project solution** (only CPO relevant point are listed)
- Stability evaluation of requirements (in case of low stability, expandability and modifiability with higher priority have to be ensured)
- Evaluation of effect radiuses for individual functions (in case of a large effect radius generally especially high integration requirements do apply (Fig. 1))
- Derivation of requirements reg. demand for integration, flexibility, & expandability

**Solution concept** (only CPO relevant point are listed)
- Assignment requirements and application functions
- Clustering of functions according to effect radius and demand for openness

**Solution architecture** (only CPO relevant point are listed)
- Assignment of function cluster to possible solution components (in-house dev. and purchase)
- Orientation along CPO architecture principles, identification of necessary interfaces
- Identification and selection of solution-relevant standards (Fig. 2)
- Selection of purchase solutions according to functional requirements and CPO openness criteria reg. technology, partnership, release and version management
AGILE PLM STRATEGY
CPO – The Key Element to an Agile PLM Strategy

Example for a direction of strategy development:

- Model based Systems Engineering (with best-in-class solutions regarding functions and costs)
- Possibility of integration of new applications/systems
- Cross discipline configuration management (e.g. Interdisciplinary integration of ALM-PLM-ERP)
- “Digital Master” for end to end processes
- Supporting collaborative PLM processes
- Digital Workplace
- Reduction / control of the complexity (product/process)
- Speed and flexibility in the process optimization
- Robustness and security

Seize opportunities
- Using new Technologies
- Reduction of operating costs
- Process optimization
- …

Mitigate risk &
Master crisis e.g.:
- Vendors-insolvency
- System failures
- Loss of data
- …
THANK YOU.