

Inter@pera

Digitale Interoperabilität in kollaborativen
Wertschöpfungsnetzwerken der Industrie 4.0

Purchase-Teilmodelle Abschlusspräsentation 13.11.2023

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Ein Projekt gefördert vom



Durchgeführt von



Agenda



- Vorstellung des Projekts InterOpera
- Was ist die Verwaltungsschale / Asset Administration Shell?
- Ziele der Purchase-Teilmodellprojekte
- Umsetzung und Ergebnisse
- Zusammenfassung und Ausblick

InterOpera

Digitale Interoperabilität in kollaborativen
Wertschöpfungsnetzwerken der Industrie 4.0

Vorstellung des Projekts InterOpera

Projektkonsortium



Steinbeis Europa Zentrum (Verbundkoordinator)

- **Rolle:** Koordination und Netzwerkaufbau
- **Wesentlicher Beitrag:** Netzwerkentwicklung für Industrie 4.0 durch den Aufbau von Wertschöpfungsnetzwerken und Teilmodellprojekten



Fraunhofer IPA

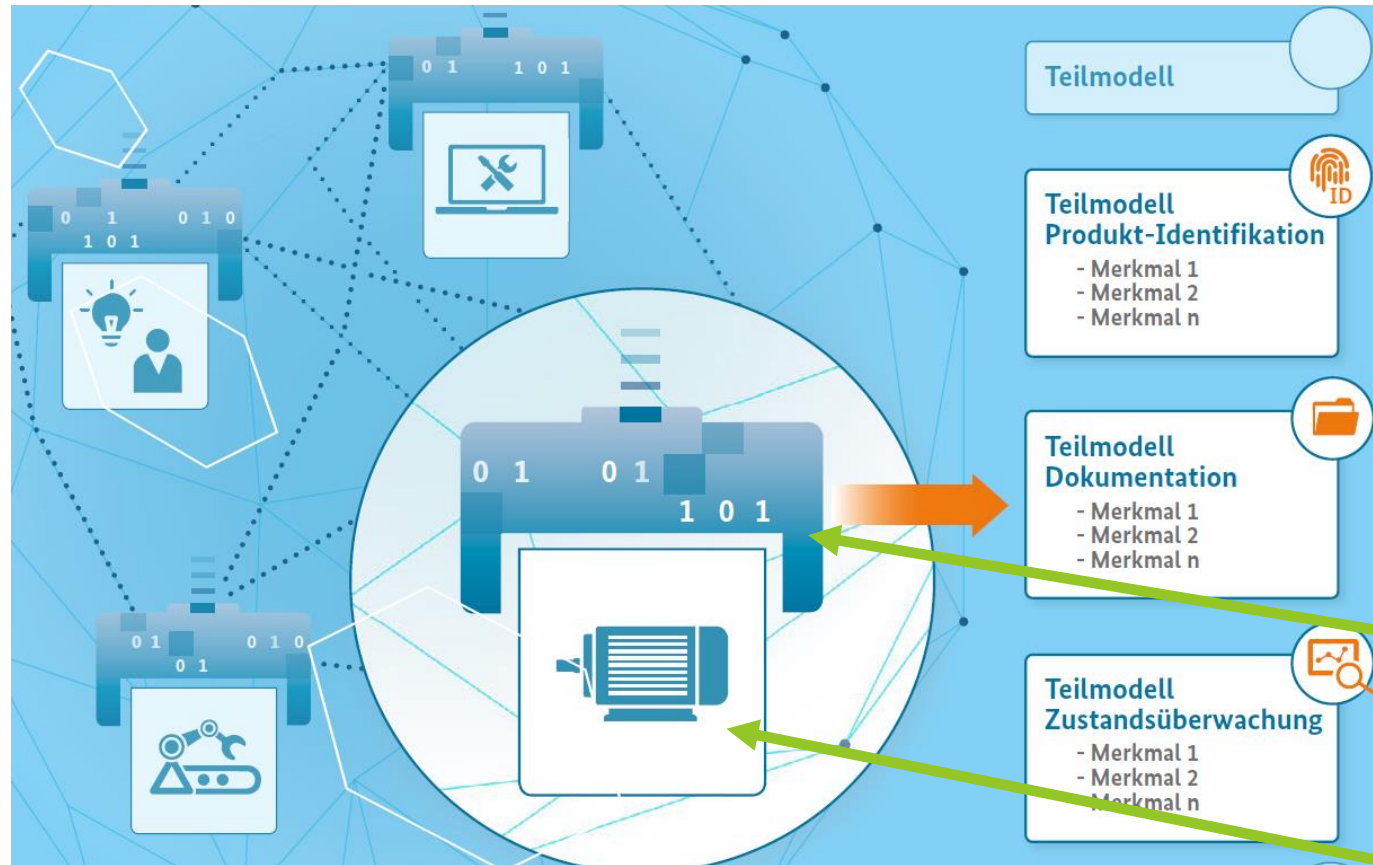
- **Rolle:** Wissenschaftliche Unterstützung
- **Wesentlicher Beitrag:** Validierung der Prozesse im Projekt als AAS-Expert*innen, starke Unterstützung bei der Auswahl der Ideenskizzen, Schnittstelle zur IDTA und anderen AAS-Stakeholdern



Standardization Council Industrie 4.0

- **Rolle:** Verknüpfung mit Standardisierungsaktivitäten
- **Wesentlicher Beitrag:** Implementierung, Rollout und Überführung in die Normung

Was ist die Asset Administration Shell?



Verwaltungsschale /
 Asset Administration Shell (AAS):
 Digitales Abbild einer physischen
 Komponente (Asset)

Asset, z.B. Maschinen-Komponente,
 Werkzeug, Bauteil

Quelle: BMWi Plattform Industrie 4.0: Verwaltungsschale in der Praxis

Weitere Informationen: <https://www.plattform-i40.de/IP/Redaktion/DE/Standardartikel/spezifikation-verwaltungsschale.html>

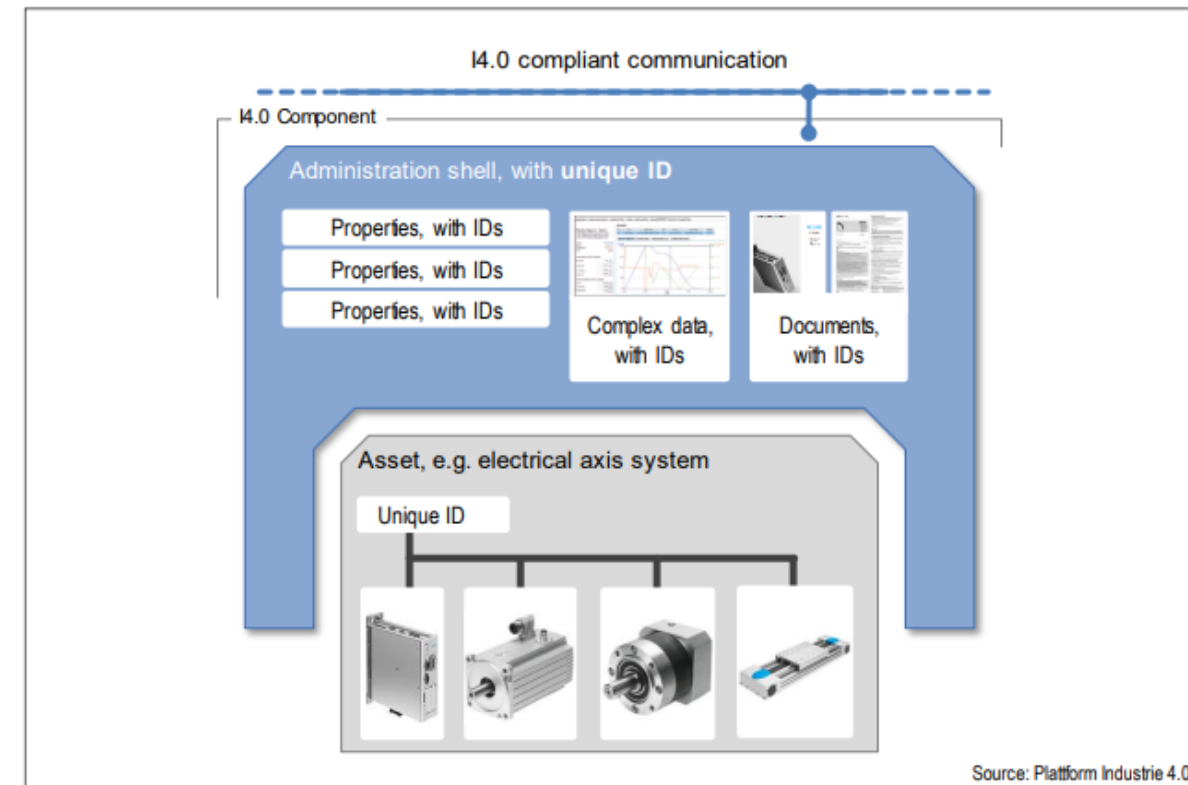
Was ist die Asset Administration Shell?

Eine **Verwaltungsschale = Asset Administration Shell** repräsentiert genau ein Asset mit einer eindeutigen Asset-ID.

Auch eine Reihe von Assets kann über eine AAS beschrieben werden, dann eine eindeutige ID für das zusammengesetzte Asset erstellt.

z.B.

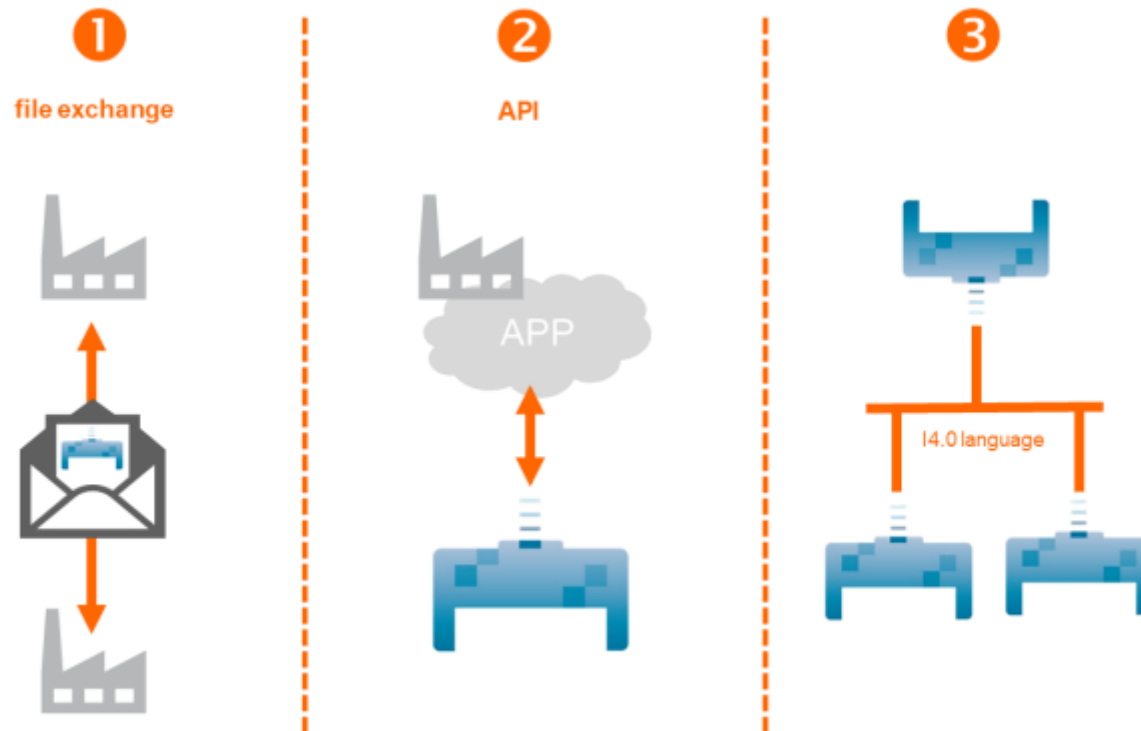
- Komponenten, die zu einer Maschine zusammengefügt werden
- Produzierte Bauteile können Einzel-Assets sein oder zu Produktionschargen als Assets zusammengeführt und die Charge als ein Asset verwaltet



Unterstützte globale identifikationstypen : IRDI, IRI, URI/URL

Information Exchange via ASS

Grundsätzlich können Informationen via Dateien (z.B. XML), standardisierte API und direkt zwischen den AAS ausgetauscht werden.



© Plattform Industrie 4.0

Formate, in welchen die AAS-Informationen zur Verfügung gestellt werden können:

Dateien:

- XML
- JSON
- RDF
- AutomationML

APIs/Schnittstellen:

- OPC UA
- HTTP/REST
- MQTT

Quelle: Plattform Industrie 4.0, [Part1: Details of the Asset Administration Shell](#)

Arbeitskreis



EXPO21XX.com



- bill-X GmbH, Osnabrück
- EXPO21XX GmbH, Hannover
- HARTING Stiftung & Co. KG
- Institut für Kunststoffverarbeitung, RWTH Aachen
- SAP, Walldorf
- Steinbeis-Beratungszentrum Technologische Transformation, Esslingen

Überblick Bestellabwicklung



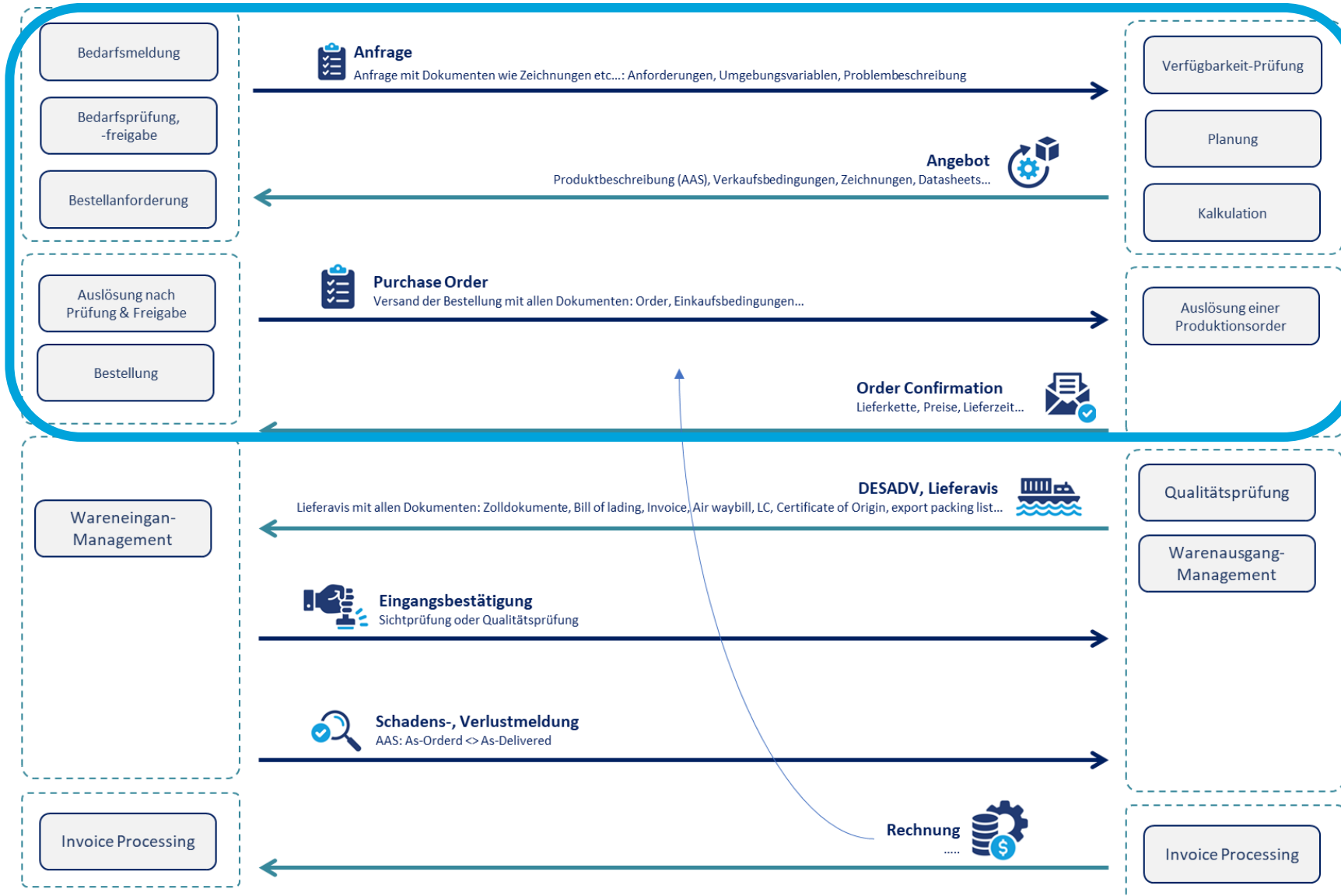
Kunde



Lieferant

Unsere Teilmodelle

Quelle: EXPO21XX GmbH



Teilmodelle



Purchase Request Notification

- Beschreibung einer **Bestellanfrage** durch den Kunden

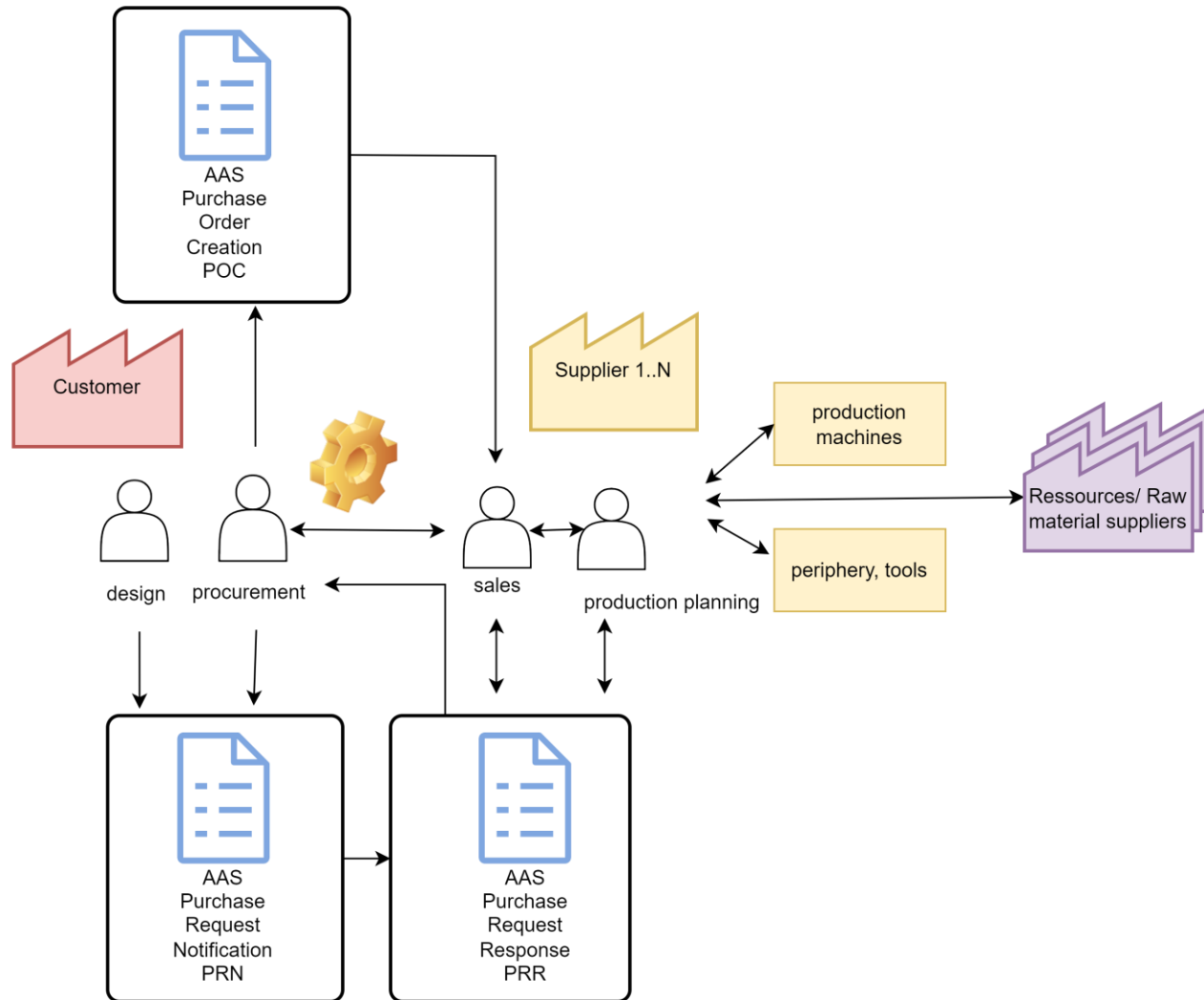
Purchase Request Response

- Rückmeldung des Lieferanten mit einem **Angebot**

Purchase Order Creation

- **Bestellung** durch den Kunden

Schematischer Überblick Purchase-Teilmodelle

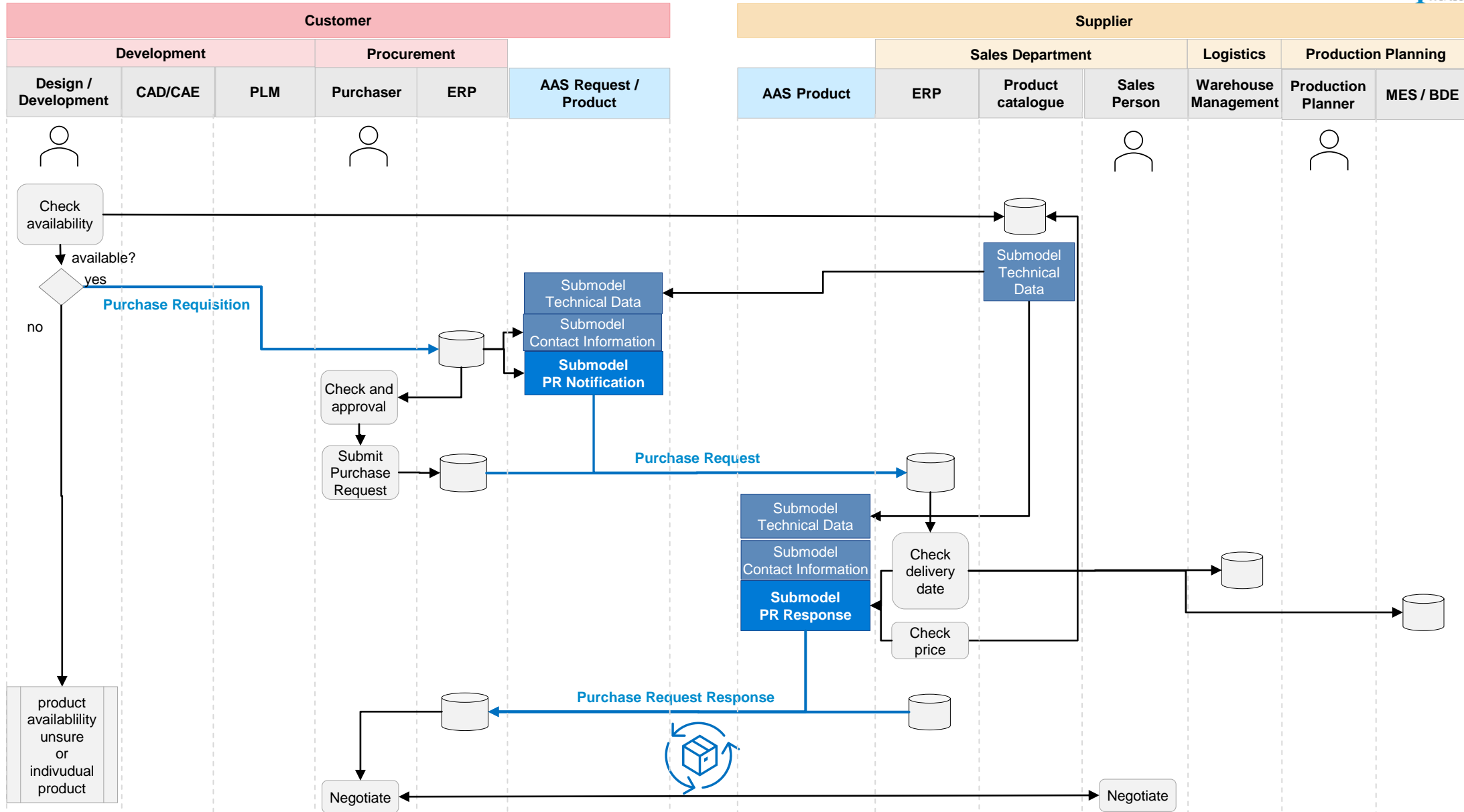


Levels

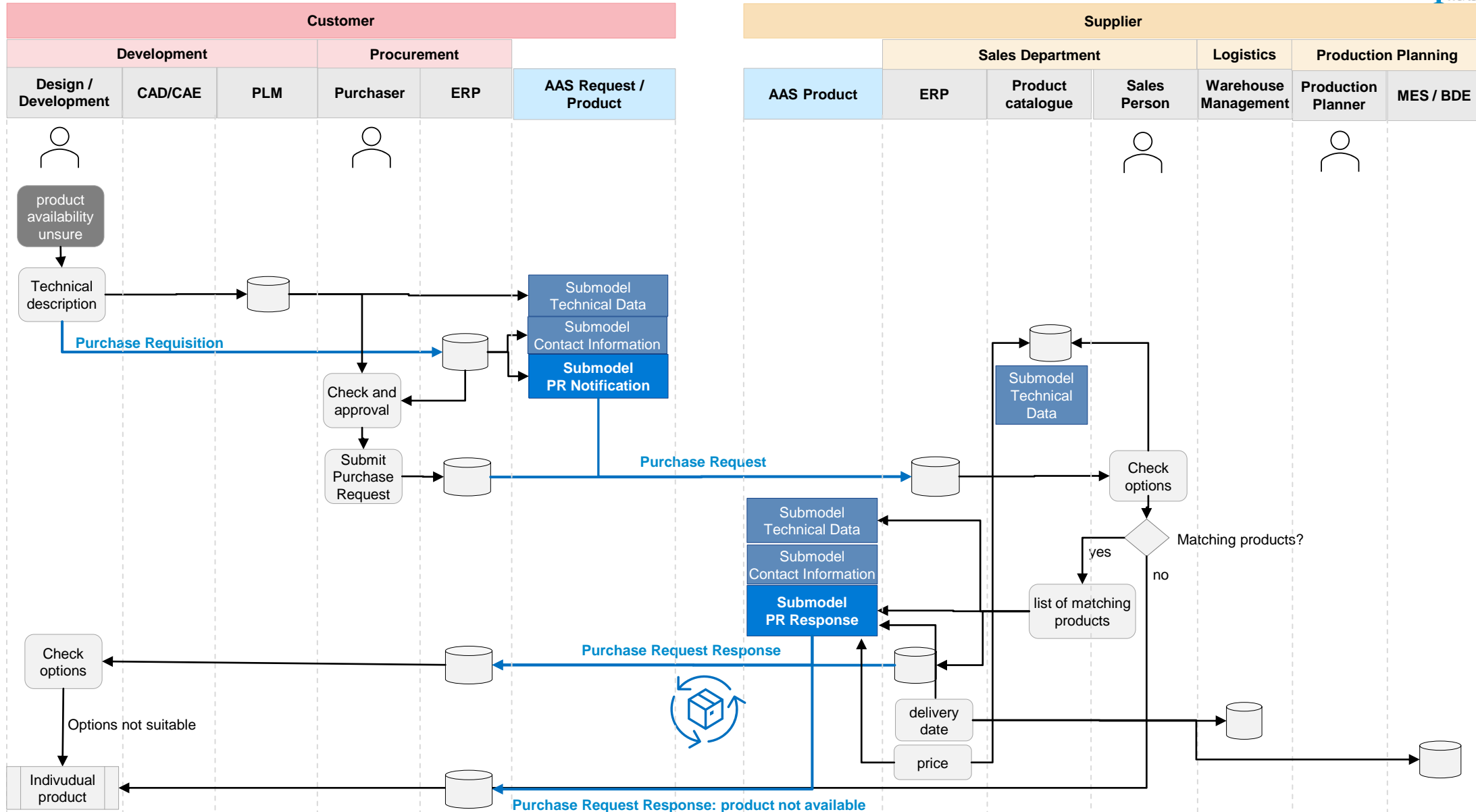


- Einzelnes Teil und Varianten davon (Out-of-Shelf)
- Allgemeine, noch unsichere Anfrage, mehrere Schleifen zur Festlegung welches konkrete Produkt tatsächlich benötigt wird
- Auftragsfertiger, die CAD-Zeichnung / STEP-Modell erhalten

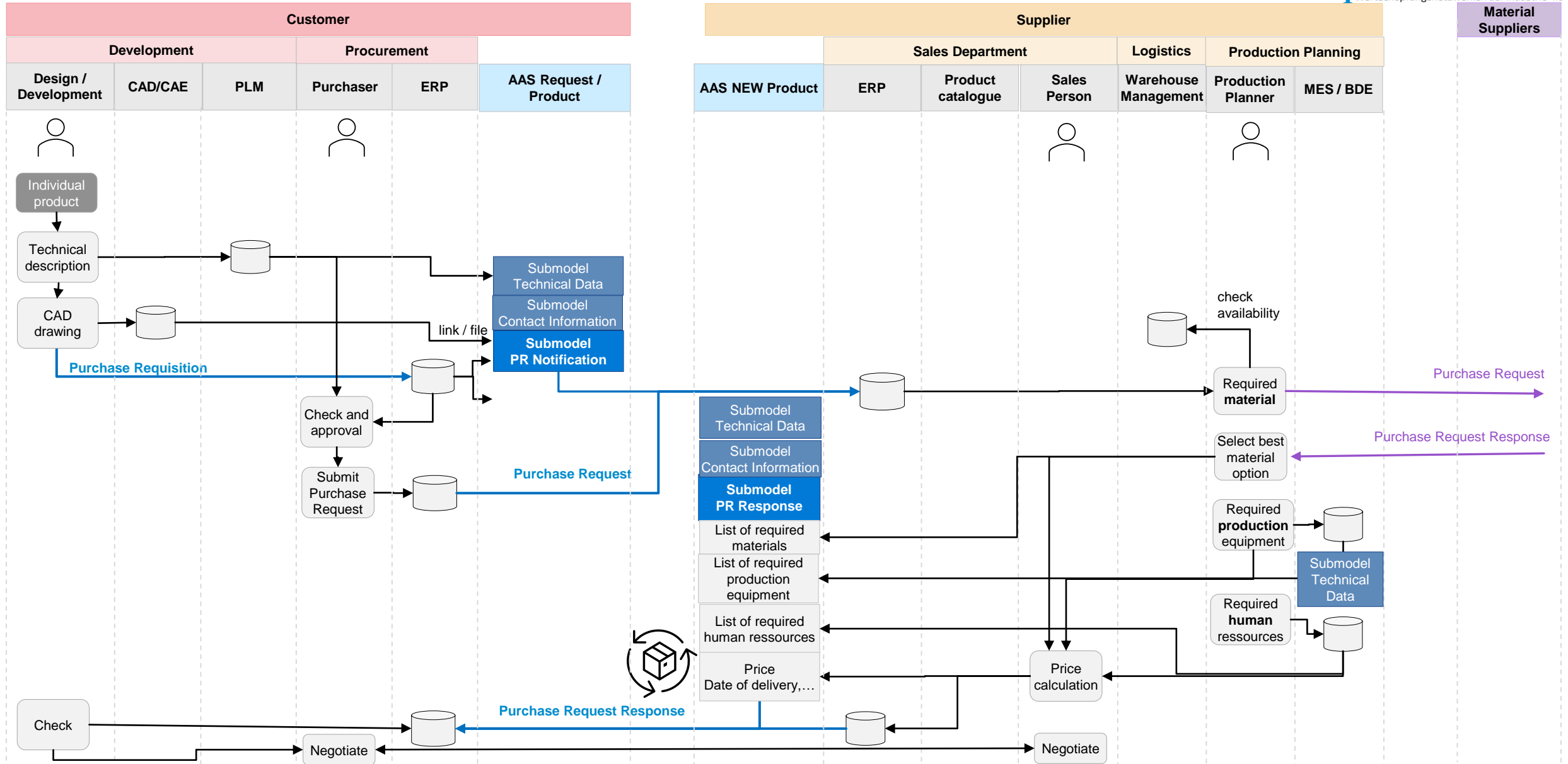
Prozesse – Out-of-shelf product



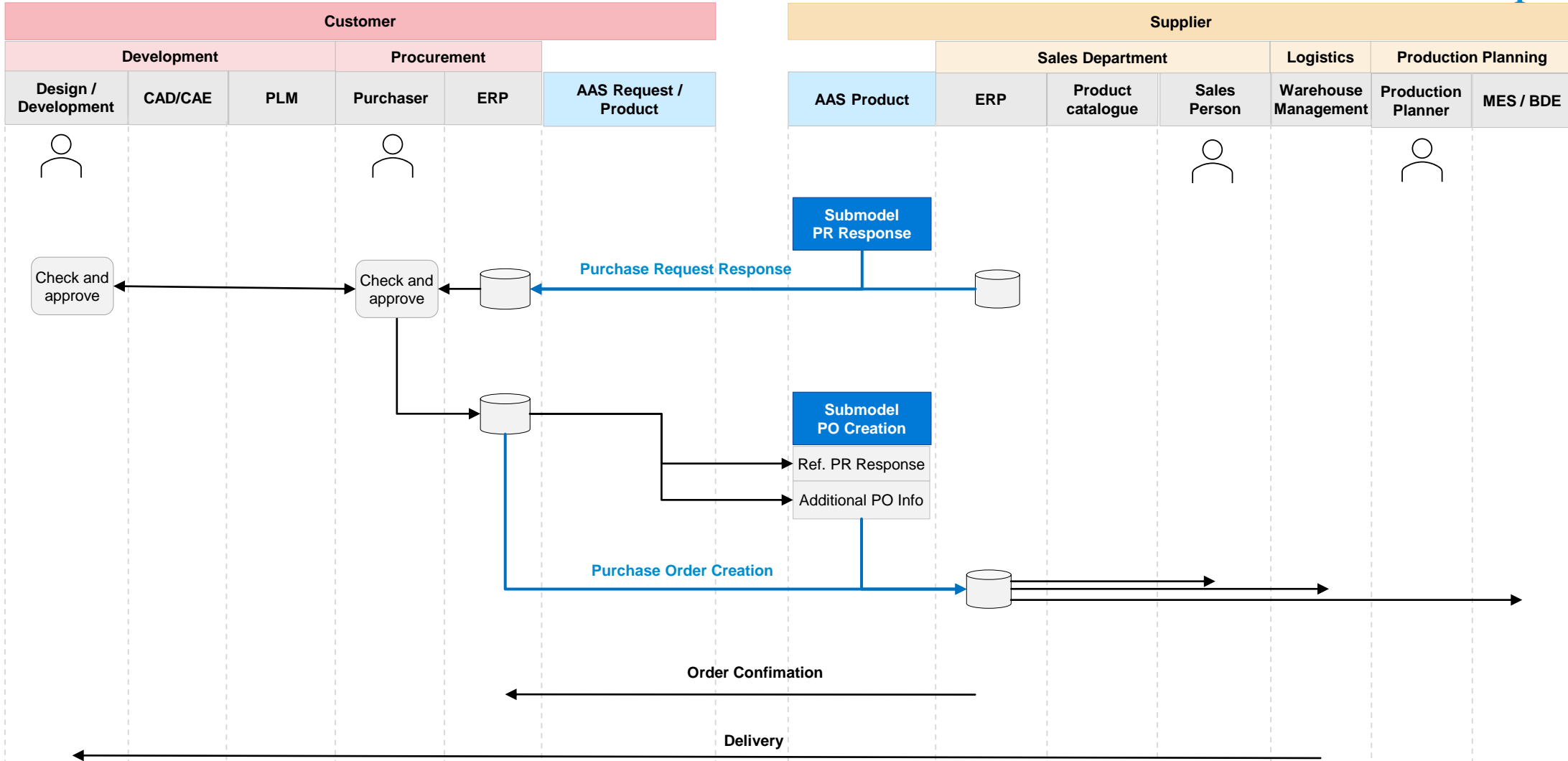
Prozesse – unsichere Anfrage



Prozesse – individuelles (neues) Produkt



Prozesse – Purchase Order Creation



Berücksichtigung bestehender Standards

- **VDA 4901**
<https://www.vda.de/de/aktuelles/publikationen/publication/vda-4901---grundbegriffe-zum-datenaustausch-in-der-lieferkette-v1.0-2019-12>
- **UN/EDIFACT**
<https://unece.org/trade/uncefact/introducing-unedifact>
- **OpenTRANS**
<https://www.digital.iao.fraunhofer.de/de/publikationen/OpenTRANS21.html>
- **cXML Ariba**
https://xml.cxml.org/schemas/cXML/1.1.009/cXMLUsersGuide_de.pdf
- **SAP 4/HANA**
<https://www.sap.com/germany/products/erp/s4hana.html>

Überblick Teilmodell AASX-Datei

- ▶ **SM** <T> "PurchaseRequestNotification" [https://example.com/ids/sm/7173_1152_9032_7113]
 - ▶ **SMC** "RequestInformation" (24 elements) @{{SMT/Cardinality=One}}
 - ▶ **SMC** "DeliveryDateList" (1 elements) @{{SMT/Cardinality=One}}
 - ▶ **SMC** "CatalogueReferenceList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "ModeOfPaymentList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "IncotermsList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "InternationalRestrictionsList" (1 elements) @{{SMT/Cardinality=ZeroToMany}}
 - ▶ **SMC** "CertificationsList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "SpecialTreatmentClassList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "InvolvedPartiesList" (1 elements) @{{SMT/Cardinality=One}}
 - ▶ **SMC** "CostCentersList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "AttachedMediaList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▶ **SMC** "RequestItemList" (1 elements) @{{SMT/Cardinality=One}}
- ▶ **SM** <T> "PurchaseRequestResponse" [https://example.com/ids/sm/2473_1152_9032_6244]
- ▶ **SM** <T> "PurchaseOrderCreation" [https://example.com/ids/sm/2083_1152_9032_0003]

Überblick SMC RequestInformation

Header ähnlich für alle drei
Teilmodelle

SMC	"RequestInformation" (24 elements) @{{SMT/Cardinality=One}}
Prop	"RequestNumberBuyer" @{{SMT/Cardinality=One}}
Prop	"RequestNumberSeller" @{{SMT/Cardinality=ZeroToOne}}
Prop	"RequestNumberAgent" @{{SMT/Cardinality=ZeroToOne}}
Prop	"RequestDate" @{{SMT/Cardinality=One}}
Prop	"LastChangeDateTime" @{{SMT/Cardinality=ZeroToOne}}
Prop	"Version" @{{SMT/Cardinality=One}}
Prop	"RequestType" @{{SMT/Cardinality=ZeroToOne}}
Prop	"LatestRegistrationDate" @{{SMT/Cardinality=ZeroToOne}}
Prop	"OpenDate" @{{SMT/Cardinality=One}}
Prop	"CloseDate" @{{SMT/Cardinality=One}}
Prop	"BindingPeriodEndDate" @{{SMT/Cardinality=One}}
Prop	"Language" @{{SMT/Cardinality=One}}
Prop	"Currency" @{{SMT/Cardinality=One}}
Prop	"TermsAndConditions" @{{SMT/Cardinality=ZeroToOne}}
Prop	"PartialShipmentAllowed" @{{SMT/Cardinality=One}}
Prop	"Description" @{{SMT/Cardinality=ZeroToOne}}
Prop	"Remark" @{{SMT/Cardinality=ZeroToMany}}
Prop	"RQFName" @{{SMT/Cardinality=ZeroToOne}}
Ref	"CatalogueRef" @{{SMT/Cardinality=ZeroToOne}}
Ref	"BusinessPartyRef" @{{SMT/Cardinality=ZeroToMany}}
Ref	"IncotermsRef" @{{SMT/Cardinality=ZeroToOne}}
Ref	"InternationalRestrictionsRef" @{{SMT/Cardinality=ZeroToMany}}
Ref	"SpecialTreatmentClassRef" @{{SMT/Cardinality=ZeroToMany}}
Ref	"MediaRef" @{{SMT/Cardinality=ZeroToMany}}

Überblick SMC DeliveryDate und CatalogueReference, ModeOfPayment

- ▲ **SMC** "DeliveryDateList" (1 elements) @{{SMT/Cardinality=One}}
 - ▲ **SMC** "DeliveryDate" (5 elements) @{{SMT/Cardinality=OneToMany}}
 - Prop** "DeliveryStartDate" @{{SMT/Cardinality=One}}
 - Prop** "DeliveryEndDate" @{{SMT/Cardinality=One}}
 - Prop** "FixedDeliveryDate" @{{SMT/Cardinality=One}}
 - Prop** "OpeningHoursStart" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "OpeningHoursEnd" @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "CatalogueReferenceList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "CatalogueReference" (4 elements) @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "CatalogID" @{{SMT/Cardinality=One}}
 - Prop** "CatalogVersion" @{{SMT/Cardinality=One}}
 - Prop** "CatalogName" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "AASCatalogReferenceID" @{{SMT/Cardinality=ZeroToOne}}

- ▲ **SMC** "ModeOfPaymentList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "ModeOfPayment" (10 elements) @{{SMT/Cardinality=ZeroToMany}}
 - **SMC** "CardPayment" (6 elements) @{{SMT/Cardinality=One}}
 - **SMC** "BankAccount" (5 elements) @{{SMT/Cardinality=One}}
 - Prop** "Debit" @{{SMT/Cardinality=One}}
 - Prop** "Check" @{{SMT/Cardinality=One}}
 - Prop** "Cash" @{{SMT/Cardinality=One}}
 - Prop** "CentralRegulation" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "PaymentTerms" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "PaymentDays" [d] @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "DiscountPercent" [%] @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "DiscountDays" [d] @{{SMT/Cardinality=ZeroToOne}}

Überblick SMC Incoterms, InternationalRestrictions, Certifications, SpecialTreatmentClasses, InvolvedParties

- ▲ **SMC** "IncotermsList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "Incoterms" (5 elements) @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "Incoterm" @{{SMT/Cardinality=One}}
 - Prop** "Location1" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "Location2" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "TransferLocation" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "TransportRemark" @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "InternationalRestrictionsList" (1 elements) @{{SMT/Cardinality=ZeroToMany}}
 - ▲ **SMC** "InternationalRestrictions" (5 elements) @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "RestrictionType" @{{SMT/Cardinality=One}}
 - Prop** "CountryCodeEmbargoImposing" @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "CountryCodeEmbargoTarget" @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "RegionCodeEmbargoImposing" @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "RegionCodeEmbargoTarget" @{{SMT/Cardinality=ZeroToMany}}

- ▲ **SMC** "CertificationsList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - ▲ **SMC** "Certification" (2 elements) @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "CertificationType" @{{SMT/Cardinality=One}}
 - Prop** "CertificationRegulation" @{{SMT/Cardinality=One}}
 - ▲ **SMC** "SpecialTreatmentClassList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "SpecialTreatmentClass" @{{SMT/Cardinality=ZeroToMany}}
 - ▲ **SMC** "InvolvedPartiesList" (1 elements) @{{SMT/Cardinality=One}}
 - ▲ **SMC** "Party" (6 elements) @{{SMT/Cardinality=OneToMany}}
 - Prop** "PartyRole" @{{SMT/Cardinality=One}}
 - Prop** "ReferenceID" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "OrganisationIRI" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "InvolvedInDocumentExchange" @{{SMT/Cardinality=One}}
 - **SMC** "Address" (21 elements) @{{SMT/Cardinality=OneToMany}}
 - **SMC** "ContactDetails" (1 elements) @{{SMT/Cardinality=OneToMany}}

Überblick SMC CostCenters, AttachedMedia

- ▲ **SMC** "CostCentersList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
- ▲ **SMC** "CostCenter" (10 elements) @{{SMT/Cardinality=OneToMany}}
 - Prop** "CostCenterCode" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "CostCenterName" @{{SMT/Cardinality=One}}
 - Prop** "CostReasonCode" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "CostReasonName" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "CostCarrierCode" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "CostCarrierName" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "ProjectNumber" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "ProjectName" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "BillingCenterCode" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "BillingCenterName" @{{SMT/Cardinality=ZeroToOne}}
- ▲ **SMC** "AttachedMediaList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}
- ▲ **SMC** "Media" (4 elements) @{{SMT/Cardinality=ZeroToMany}}
 - Prop** "File" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "MimeType" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "MimeTypePurpose" @{{SMT/Cardinality=ZeroToOne}}
 - Prop** "Comment" @{{SMT/Cardinality=ZeroToOne}}

Überblick SMC RequestedItem

4 SMC "RequestItemList" (1 elements) @{{SMT/Cardinality=One}}

4 SMC "RequestedItem" (37 elements) @{{SMT/Cardinality=OneToMany}}

Prop "ItemID" @{{SMT/Cardinality=One}}

Ref "AASItemReference" @{{SMT/Cardinality=ZeroToOne}}

Prop "ParentItemID" @{{SMT/Cardinality=ZeroToOne}}

Prop "ItemClassification" @{{SMT/Cardinality=ZeroToOne}}

Prop "ItemType" @{{SMT/Cardinality=ZeroToOne}}

Prop "ItemStatus" @{{SMT/Cardinality=ZeroToOne}}

Prop "ItemStockStatus" @{{SMT/Cardinality=ZeroToOne}}

Prop "ServiceType" @{{SMT/Cardinality=ZeroToOne}}

Prop "OrderQuantity" @{{SMT/Cardinality=One}}

Prop "OrderQuantityUnit" @{{SMT/Cardinality=One}}

Prop "ContentQuantity" @{{SMT/Cardinality=ZeroToOne}}

Prop "ContentQuantityUnit" @{{SMT/Cardinality=ZeroToOne}}

Prop "NumberOfContentUnitsPerOrderUnit" @{{SMT/Cardinality=ZeroToOne}}

Prop "ContentQuantityInContentUnits" @{{SMT/Cardinality=ZeroToOne}}

Prop "UnitOfContentQuantityInContentUnit" @{{SMT/Cardinality=ZeroToOne}}

▷ SMC "ProductPrice" (12 elements) @{{SMT/Cardinality=One}}

Prop "NetPrice" @{{SMT/Cardinality=ZeroToOne}}

Prop "GrossPrice" @{{SMT/Cardinality=ZeroToOne}}

Prop "PartialShipmentAllowed" @{{SMT/Cardinality=ZeroToOne}}

Prop "TermsOfDelivery" @{{SMT/Cardinality=ZeroToOne}}

Prop "Agreement" @{{SMT/Cardinality=ZeroToMany}}

Prop "Remarks" @{{SMT/Cardinality=OneToMany}}

Ref "CatalogueRef" @{{SMT/Cardinality=ZeroToOne}}

Ref "IncotermsRef" @{{SMT/Cardinality=ZeroToOne}}

Ref "BusinessPartyRef" @{{SMT/Cardinality=ZeroToMany}}

Ref "InternationalRestrictionsRef" @{{SMT/Cardinality=ZeroToMany}}

Ref "SpecialTreatmentClassRef" @{{SMT/Cardinality=ZeroToMany}}

Ref "MediaRef" @{{SMT/Cardinality=ZeroToMany}}

Ref "CostCenterRef" @{{SMT/Cardinality=ZeroToMany}}

▷ SMC "DeliveryDateList" (1 elements) @{{SMT/Cardinality=One}}

▷ SMC "ScanCodesList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}

▷ SMC "ProductID" (10 elements) @{{SMT/Cardinality=ZeroToOne}}

▷ SMC "ExcludedIngredientsList" (1 elements) @{{SMT/Cardinality=ZeroToOne}}

Prop "ProductName" @{{SMT/Cardinality=One}}

Prop "ProductShortDescription" @{{SMT/Cardinality=One}}

Prop "ProductDescription" @{{SMT/Cardinality=One}}

Ref "ProductCapabilitiesRef" @{{SMT/Cardinality=ZeroToMany}}

Überblick SMC ProductPrice

SMC "ProductPrice" (12 elements) @SMT/Cardinality=One

Prop "Price" @SMT/Cardinality=One

Prop "MinPrice" @SMT/Cardinality=ZeroToOne

Prop "MaxPrice" @SMT/Cardinality=ZeroToOne

Prop "PriceQuantity" @SMT/Cardinality=ZeroToOne

Prop "PriceUnitValue" @SMT/Cardinality=One

Prop "PriceUnit" @SMT/Cardinality=One

Prop "PriceUnitFactor" @SMT/Cardinality=ZeroToOne

Prop "CostsIncluded" @SMT/Cardinality=ZeroToMany

Prop "AllowancesAndCharges" @SMT/Cardinality=ZeroToOne

Prop "Shipping" @SMT/Cardinality=ZeroToOne

Prop "ShippingTax" @SMT/Cardinality=ZeroToOne

SMC "TaxDetails" (8 elements) @SMT/Cardinality=ZeroToMany

SMC "DeliveryDateList" (1 elements) @SMT/Cardinality=One

SMC "DeliveryDate" (5 elements) @SMT/Cardinality=OneToMany

Prop "DeliveryStartDate" @SMT/Cardinality=One

Prop "DeliveryEndDate" @SMT/Cardinality=One

Prop "FixedDeliveryDate" @SMT/Cardinality=One

Prop "OpeningHoursStart" @SMT/Cardinality=ZeroToOne

Prop "OpeningHoursEnd" @SMT/Cardinality=ZeroToOne

SMC "ScanCodesList" (1 elements) @SMT/Cardinality=ZeroToOne

SMC "ScanCodes" (2 elements) @SMT/Cardinality=ZeroToMany

Prop "CodeType" @SMT/Cardinality=One

Prop "Code" @SMT/Cardinality=One

SMC "ProductID" (10 elements) @SMT/Cardinality=ZeroToOne

Prop "GTIN" @SMT/Cardinality=ZeroToOne

Prop "upc" @SMT/Cardinality=ZeroToOne

Prop "SupplierSpecific" @SMT/Cardinality=ZeroToOne

Prop "BuyerSpecific" @SMT/Cardinality=ZeroToOne

Prop "AgentSepcific" @SMT/Cardinality=ZeroToOne

Prop "DelivererSpecific" @SMT/Cardinality=ZeroToOne

Prop "ProductID" @SMT/Cardinality=ZeroToOne

Prop "ManufacturerID" @SMT/Cardinality=ZeroToOne

Prop "Materialnumber" @SMT/Cardinality=ZeroToOne

SMC "ListProductIDsBusinessPartners" (1 elements) @SMT/Cardinality=ZeroToOne

SMC "ExcludedIngredientsList" (1 elements) @SMT/Cardinality=ZeroToOne

Prop "ExcludedIngredient" @SMT/Cardinality=ZeroToMany

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Digitale Interoperabilität in kollaborativen
Wertschöpfungsnetzwerken der Industrie 4.0

Abschlussdiskussion und Ausblick

Nächste Schritte



- Reviews des Teilmodells und Veröffentlichung über InterOpera (<https://interopera.de/teilmodellprojekte/>) und IDTA (<https://industrialdigitaltwin.org/content-hub/teilmodelle>)
- **Anwendung in Unternehmen!**



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Danke für Ihr Kommen!

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 [@InterOpera Interoperabilität in Industrie 4.0](https://www.linkedin.com/company/interopera)

Ein Projekt gefördert vom



Durchgeführt von

