ISO/TC 184/SC 4/WG 15
Digital manufacturing

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ISO CD 23247-4 Collated Comments Final Response LA

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Background:	For discussion during conference call on 11/20 or 11/21 depending on time zone - 7PM Eastern USA 11/20
Committee URL:	https://isotc.iso.org/livelink/livelink/open/tc184sc4wg15

MB/ NC[1]	Line number (e.g. 17)	Clause/ Subclause (e.g. 3.1)	Paragraph/ Figure/ Table/ (e.g. Table 1)	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
FR **-001**				ge	The documents of the ISO 23247 series circulated as CD do not reflect the outline of the proposed project NWIP (ISO/TC 184/SC 4/WG 15 N 17). The intended scope of the project as stated in the NWIP was "The Digital Twin is a virtual representation of manufacturing elements such as personnel, products, assets and process definitions."	Align the project on the NWIP.	***Identical to Part 1-003.*** **Accepted in principle.** The personnel, products, and process are mentioned in the CD. Assets are not specifically mentioned; however, equipment and facility are included as types of assets.
FR **-002**				ge	The documents of the ISO 23247 series circulated as CD do not reflect the outline of the proposed project NWIP (ISO/TC 184/SC 4/WG 15 N 17). The NWIP standards gap analysis listed and summarized: - IEC 62264 Enterprise-control system integration, - IEC 62832 Digital factory framework - ISO 16400 Equipment behaviour catalogues for virtual production system. These standards are not considered in documents of the ISO 23247 series circulated as CD.	Consider the current normative landscape.	***Identical to Part 1-004.*** **Acknowledged.** IEC 62264 is informatively referenced and listed in bibliography of Part 3. IEC 62832 and ISO 16400 have been determined not to be referenced in ISO 23247, however they can be listed in bibliography during DIS development if necessary.
FR				ge	These considerations are irrelevant at the	Leave these considerations to industrial network	**Acknowledged**

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-003					information level of ISO/TC 184/SC 4 where there is no expertise in this field.	standards bodies such IEC/SC 65C.	This document identifies technical requirements on information exchange to support digital twin for manufacturing. It does not define any communication protocols. This scope is within SC 4.
US -004	0	TITLE		Ge	The title is not clear nor grammatically correct.	Change title to, "Automation systems and integration – Digital twin framework for manufacturing – Part 4: Information exchange"	***Identical to Part 1-001.*** **Accepted** To be updated during DIS ballot process "Digital Twin framework for manufacturing"
US -005	0	WHOLE DOCUMEN T		Ge	See CD 23247-1 Comment US-08 to remove "Digital Twin Representation"	Change "digital twin representation" to "digital twin" throughout entire document	***Identical to Part 2-010.*** **Accepted**
US -006	0	WHOLE DOCUMEN T		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin" throughout entire document	***Identical to Part 2-011.*** **Accepted in principle** Changed to "Digital Twin for manufacturing". See US-004
US -007	0	WHOLE DOCUMEN T		Ge	See US-01.	Change "digital twin manufacturing framework" to "digital twin framework for manufacturing" throughout entire document.	***Identical to Part 2-012.*** **Accepted in principle**

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							Changed to "Digital Twin framework for manufacturing"
JP01(A.O) **-008**		A comment common to four proposed documernts		Ge	To say "Digital Twin", consistency management between physical objects and their digital representations shall be a core concern. In other words, how to relate a physical object with its digital representation and how to keep consistency between the two in the circumstances where the physical object is constantly changing shall be a keen concern. Imagine the case of removal machining for creating a die. There are many physical objects including work piece, machining tool, etc. During machining, the shape and material characteristics of the work piece will constantly change. It is the same for the machining tool caused by fatigue. How to capture those changes and how to reflect the changes into their digital counterparts shall be a core concern for digital twin manufacturing. But, no specification is defined in the proposed four documents concerning how to relate a physical object and its digital representation, and how to keep consistency between the two. The phrases " detailed modelling" and "dynamic modelling" appear with no clear definitions、which is extremely inappropriate.. There will be changes which can be captured and those which are difficult to capture. Therefore, it is understood that clear statements	Regenerate the document from scratch.	***Identical to Part 1-006.*** **Accepted in principle** The Digital Twin framework for manufacturing describes framework how to relate physical object to digital representation. Specific technologies that are to be used to perform the synchronization are not prescribed by this standard and left by users to select. Use cases are to be developed in future reports and they will recommend technologies to achieve the qualities described by the framework in the context of specific processes.

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					of in scope issues and out of scope issues should be possible. But, current scope statement says almost nothing. In order to get support from industries, clear answers to the issues raised above is critically important.		
JP02(A.O) **-009**		A comment common to four proposed documernts		Ge	The title of the series of standards is digital twin manufacturing framework but no manufacturing specific terms appear. There are many types of manufacturing including removal machining for creating automotive dies. What types of manufacturing is in scope and what types are not shall be clearly described.	Clear statements required.	***Identical to Part 1-007.*** **Accepted in principle** Following has been added to introduction for clarification: All types of manufacturing should be supported including discrete and continuous manufacturing for individual parts, assemblies or continuous processes. However, the actual types of manufacturing that can be supported by an instance of the framework will depend on the technologies selected to implement its functional elements.
JP03(A.O) **-010**		A comment common to four proposed documernts		Ge	It is very hard to imagine how to effectively use proposed standards, which is a key requirement to stimulate manufacturing industry.	It is recommended to include real-life examples on how to effectively use proposed standards/	***Identical to Part 1-008.*** **Accepted in principle** Following has been added to introduction for clarification: All types of manufacturing should be supported including discrete and

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							continuous manufacturing for individual parts, assemblies or continuous processes. However, the actual types of manufacturing that can be supported by an instance of the framework will depend on the technologies selected to implement its functional elements. Technical Reports will follow on use cases.
JP 04 (K.D) **-011**	125	1		ge	"information exchange within the Digital Twin manufacturing framework" sounds strange, because "Digital Twin manufacturing framework" is defined as "conceptual guidelines to support implementation of Digital Twin in manufacturing". Information exchange within conceptual gudelines doesn't make sence. ISO/TC 184/SC 4 N 3224 (NWIP) states as follows. Part 4: Information exchange Identifies technologies such as network protocols, APIs, description languages, etc., <u>for information synchronization, exchange and management of digitally represented manufacturing twins</u>. The document seems specifying requirements for information exchange: between Digital Twin User Entity (DTUE) and Digital Twin Representation Entity (DTRE)	Make the scope text consistent with the scope text in the NWIP, by replacing "within the Digital Twin manufacturing framework" with "between entities of the Digital Twin manufacturing reference model".	**Accepted** Changes have been made to the scope of Part 4.

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					among three sub-system entities within the DTRE between the DTRE and Data Collection and Device Control Entity (DCDCE) between DCDCE and Physical Manufacturing Element (PME)		
JP 05 (K.D) **-012**	125	1		ge	Specifying requirements for exchanging information between functions like entities of the Digital Twin manufacturing reference model seems out of scope of ISO TC184/SC4, but it seems under scope of ISO TC184/SC5 which is titled with “Interoperability, integration, and architectures for enterprise systems and automation applications”.		**Acknowledged** This document is to identify technical requirements on information exchange to support digital twin for manufacturing. The current scope is within SC 4. Also, it is better to develop framework series in single standard organization to alignment, management of the framework series. Any requirements identified should be addressed by ISO TC184/SC 5.
JP 06 (K.D) **-013**	140			ge	There is no requirement that is stated with “shall” in the document.		**Accepted** The “shall” be added to the requirements that can be changed as appropriate
CN		1		TE	The overall feeling is that the standard is conceptual and framed, and we should refine the		**Accepted in principle**

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-014					content to support the application.		Use cases for Digital Twin framework for manufacturing are to be developed in future technical reports and they will recommend technologies to support application.
CN **-015**		4		TE	Add information interaction requirements for network Bandwidth		**Accepted in principle** Requirements for bandwidth are application dependent. Bandwidth will be addressed by the use cases documented in the technical reports.
CN **-016**		4		TE	Add information interaction requirements for network Mobility		**Accepted in principle** Requirements for mobility are application dependent. Mobility will be addressed by the use cases documented in the technical reports.
US **-017**	86	Introduction		Ge	Duplicated text from CD 23247-1 is not consistent.	Ensure consistency between CD 23247-1 and -4 Introductions.	***Identical to Part 2-014.*** **Accepted.** Introduction is changed to align with part 1.
KR	96, 105	Introduction		ed	Use a consistent term with other parts.	Change “physical manufacturing elements” with	**Accepted in principle.**

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01 **-018**						"observable manufacturing elements".	Introduction is changed to align with part 1. See **US-017** for this comment.
KR 02 **-019**	141-143	4		te	This document defines information exchange in entity-based Digital Twin manufacturing reference model. So, "functional view for the Digital Twin manufacturing reference architecture" is incorrect.	Change to read: ISO 23247-2 defines a functional view of Digital Twin manufacturing reference model. Each entities and observable manufacturing elements in the reference model are peers of information exchange. This document specifies four types of information exchange between entities and observable manufacturing element as shown in Figure 1. In addition, this document defines requirements for each type of information exchange that the functional entities should provide.	**Accepted in principle.** Digital Twin manufacturing has been changed to Digital Twin for manufacturing (**US-007**).
DE **-020**	144			ge	Why is there no interface between two DTRE?	Please clarify	**Acknowledged** Peer DT is one of the users (DTUE) of DTRE. Communication between DTREs are made through IE-A. Thus, there is no need for separate interface between DTREs.
KR 03 **-021**	144	4	Figure 1	te	ISO 23247-1 use OME, not PME. Use a consistent term with ISO 23247-1.	Change "Physical Manufacturing Element (PME)" with "Observable Manufacturing Element (OME)".	**Accepted**
KR 04	144	4	Figure 1	te	ISO 23247-2 use presentation FE, not visualization FE	Change to "presentation FE".	**Accepted**

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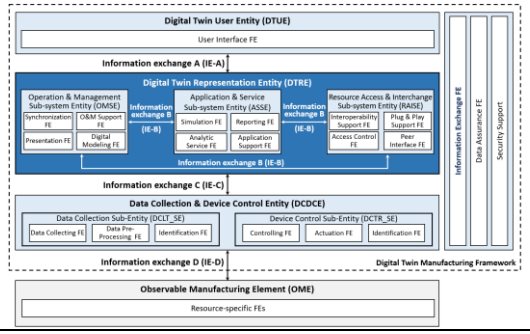
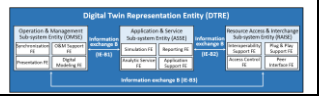
-022							
KR 05 **-023**	144	4	Figure 1	te	If ISO 23247-2's CD comment KR-24 (Figure 3) is accepted, change DCDCE with 2 sub-entities.	Change Figure 1 as follows. 	**Accepted in principle** DTRE has been changed to Digital Twin entity (**US-005**). Also, IE-B has been changed to IE-B1, IE-B2, IE-B3(**DE-024**).
DE **-024**	149		IE-B		Either the three subsystems are really different, then why is the interface between ASSE and OMSE the same as between ASSE and RAISE? OMSE is not allowed to communicate with RAISE?	Please clarify	**Accepted in principle** 1. The interface between ASSE and OMSE and interface between ASSE and RAISE are same in terms of its usage for exchanging information for providing digital twin services. If there is a need to differentiate IE-Bs, it is possible to use IE-B1, IE-B2, IE-B3, as shown in the figure. 

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							If the figure is agreed, Figure 1, Figure 3, and description of IE-B will be changed. 2. Please make a note of the line (IE-B) between OMSE and RAISE. Note, DTRE has been changed to Digital Twin entity (**US-005**).
KR 06 **-025**	155-156	4		te	Use a consistent term with other parts.	Change “Physical Manufacturing Element (PME)” with “Observable Manufacturing Element (OME)”.	**Accepted**
DE **-026**	160	5.1		ge	Typo	Through	**Accepted**
KR 07 **-027**	160-161	5.1		ed	Editorial correction and enhancement.	Change to read: The IE-A is an interface between DTUE and DTRE, in which DTUE uses services and applications provided by OMSE, ASSE and RAISE as shown in Figure 2.	**Accepted**
CN **-028**		5.2		TE	should specify the method for data exchange		**Accepted in principle** Method for data exchange is application dependent. Use cases for Digital Twin framework for manufacturing are to be developed in future

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							technical reports and they will recommend technologies to specify the method for data exchange.
DE **-029**	187ff		IE-B		Very difficult to understand because OMSE, ASSE and RAISE were not yet mentioned before (only in part 3)	Explain shortly tasks of MSE, ASSE and RAISE	**Accepted.** OMSE, ASSE, and RAISE are defined in ISO 23247-2. However, for better understanding of this document, short description will be added.
KR 08 **-030**	190-191	6.1		ed	Editorial correction and enhancement.	Change to read: Through IE-B, OMSE, ASSE, and RAISE exchange information for the DTRE to provide Digital Twin manufacturing services as shown in Figure 3.	**Accepted in principle** Digital Twin manufacturing has been changed to Digital Twin for manufacturing (**US-007**). Also, DTRE has been changed to Digital Twin entity (**US-005**).
KR 09 **-031**	192	6.1	Figure 3	ed	ISO 23247-2 use presentation FE, not visualization FE	Change to “presentation FE”.	**Accepted.**
KR 10 **-032**	197-199	6.2	NOTE	ed	Use a consistent term with other parts. Editorial enhancement.	Change to read: NOTE Through IE-C, DTRE collects data from observable manufacturing elements. DTRE may use artificial intelligence to analyse the collected data. Based on data analytics, DTRE can reproduce the past, diagnose the present, and plan for the future.	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).

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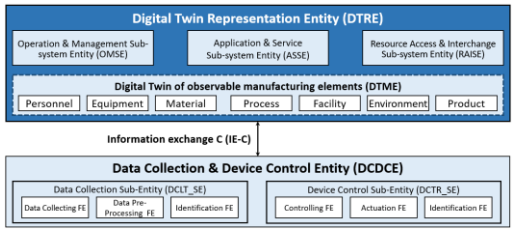
KR 11 **-033**	208-209	7.1		ed	Use a consistent term with other parts. Editorial correction and enhancement.	Change to read: The IE-C is an interface between DTRE and DCDCE, in which the DTRE collects information from observable manufacturing elements and controls devices in observable manufacturing elements as shown in Figure 4.	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).
KR 12 **-034**	210-211	7.1	NOTE 1	te	Use a consistent term with other parts. Editorial correction and enhancement.	Change to read: NOTE 1 DCDCE interacts with OME(s). DCDCE monitors, senses, and in some cases, DCDCE performs actuation on OME(s) or controls OME(s). DTRE uses DCDCE as a mediator to retrieve information of the OME(s) or to control OME(s).	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).
KR 13 **-035**	212-213	7.1	NOTE 2	ed	Editorial correction and enhancement.	Change to read: NOTE 2 Annex A.4 shows some examples on how the DTRE and DCDCE are configured using various protocols for collecting and controlling data.	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).
KR 14 **-036**	214	7.1	Figure 4	te	If ISO 23247-3's CD comment KR-04 (Figure 1) is accepted, add DTME to DTRE. The reason is, clause 7.5 talks about digital model which is related to DTME. This part should describe the use of DTME, especially in clause 7.5	Change Figure 4 to align with ISO 23247-3.  Also add description as follows. The DTRE maintains Digital Twin of observable manufacturing element (DTME) which is defined in	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).

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						ISO 23247-3.	
KR 15 **-037**	216-222	7.2	NOTE	ed	Editorial correction and enhancement.	Change to read: NOTE Multiple devices (including sensors, manufacturing elements) will be participating in the Digital Twin services. The devices can be connected and disconnected any time during the Digital Twin services. Since a device are controlled by the DCDCE, DTRE will need to handle the join/leave activities of the multiple DCDCEs with plug-and-play support.	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).
DE **-038**	220		DTRE		Does DTRE describe 1 Twin or the handling of all twins of a system?	Please clarify	**Acknowledged** ISO 23247-2 describes the details of DTRE supporting a large number of twins. Clause 7.7 describes synchronization of multiple twins which implies handling of multiple twins. DTRE can support multiple digital twin instances. For example, one DTRE can handle one or more twins. Note, DTRE has been changed to Digital Twin entity (**US-005**).
CN **-039**		7.3		TE	If we ca give specific method exchanging data		**Accepted in principle** Method for exchanging data is application dependent.

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							Use cases for Digital Twin framework for manufacturing are to be developed in future technical reports and they will recommend technologies to specify the method on exchanging data.
KR 16 **-040**	225	7.3		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted.**
KR 17 **-041**	229	7.4		te	Use a consistent term with other parts.	Change “manufacturing element” with “observable manufacturing element”.	**Accepted.**
KR 18 **-042**	230-233	7.4	NOTE	te	Use a consistent term with other parts. Editorial correction and enhancement regarding KR-14.	Change to read: NOTE There can be Digital Twin for multiple observable manufacturing elements in the DTRE. There should be an identification scheme to map the observable manufacturing elements with the corresponding Digital Twin. In some cases, the sensors or the actuators are not represented by the Digital Twin, however, they need to provide sensing data or actuation results to the DTRE. For this reason, DTRE will need to identify the sensors and the actuators of observable manufacturing elements.	**Accepted in principle.** DTRE has been changed to Digital Twin entity (**US-005**).
KR 19 **-043**	235	7.5		te	Relationship of digital model and digital twin is not clear.	Add sentence. The DTME is generated from digital model through synchronization with observable	**Accepted**

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						manufacturing elements.	
KR 20 **-044**	236	7.5		te	Use a consistent term with other parts.	Change “manufacturing element” with “observable manufacturing element”.	**Accepted**
CN **-045**		7.7		TE	About "Synchronization", Whether the certainty of information exchange can be added to the requirements		**Accepted in principle.** The certainty of information exchange is dependent on the use case/application. Use cases for Digital Twin framework for manufacturing are to be developed in future technical reports and they will recommend technologies to specify the requirement for the certainty of information exchange.
DE **-046**	247	7.7		ge	spelling and grammar	Can consist	**Accepted**
KR 21 **-047**	247-249	7.7	NOTE	ed	Editorial enhancement.	Change to read: NOTE Multiple devices such as production line can consists of multiple Digital Twins. A change in Digital Twin of a single device can have effect on the other related Digital Twin.	**Accepted**
KR 22 **-048**	250, 252	7.7		te	Use a consistent term with other parts.	Change “manufacturing element” with “observable manufacturing element”.	**Accepted**

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KR 23 **-049**	255-258	7.8		te	Use a consistent term with other parts.	Change “manufacturing element” with “observable manufacturing element”.	**Accepted**
DE **-050**	260	7.8		ge	spelling and grammar	Should provide methods or should provide a method	**Accepted** “should provide a method”
CN **-051**		7.10		TE	About "Near-real time communication",Whether the requirements can be further specified		**Accepted in principle** The requirements for near-real time communication is dependent on the use case/applications. Use cases for Digital Twin framework for manufacturing are to be developed in future technical reports and they will recommend technologies to specify the requirement for the certainty of information exchange.
KR 24 **-052**	282, 285, 292, 293	7.11		te	Use a consistent term with other parts.	Change “manufacturing element” with “observable manufacturing element”.	**Accepted**
DE **-053**	261	7.11		ge	spelling and grammar	Data generated from manufacturing elements and various IoT devices is private	**Accepted**
DE	295	7.11		ge	spelling and grammar	Provide methods	**Accepted**

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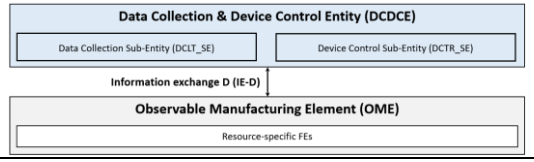
-054							
KR 25 **-055**	299-301	8.1		ed	Use a consistent term with other parts. Editorial correction and enhancement.	Change to read: The IE-D is an interface between DCDCE and OME. The IE-D may not be necessary, if the OME supports direct interface with DTRE by physically attached or integrated DCDCE to the OME.	**Accepted in principle** DTRE has been changed to Digital Twin entity (**US-005**).
KR 26 **-056**	302	8.1	Figure 5	te	Use a consistent term with other parts.	Change Figure 5 as follows 	**Accepted**
DE **-057**	307	8.2		ge	spelling and grammar	Many manufacturing equipments	**Not accepted** There is no plural form for equipment.
DE **-058**	309	8.2		ge	spelling and grammar	Many factories establish a local network	**Accepted**
KR 27 **-059**	313-314	8.3		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
DE **-060**	315	8.3		ge	spelling and grammar	Normally, DCDCE have an interface to the …	**Accepted**
DE	316	8.3		ge	spelling and grammar	Data from the local network to data that is understood …	**Accepted**

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-061							
DE **-062**	317	8.3		ge	Spelling and grammar	Before delivering it to …	**Accepted**
DE **-063**	318	8.3		ge	Spelling and grammar	Delivering it …	**Accepted**
US **-064**	324	A.1		Ed	Missing “MTConnect” in Acronyms of protocols	Add MTConnect in the section	**Accepted**
DE **-065**	366				Asset administration shell (AAS) supports different deployment scenarios and serializations. Main concern is DTRE. AAS can be deployed on PME and it can be realized with OPC UA: so this is fine as well.	Add administration shell to DTRE because it defines payload for IE-A	**Accepted.** Administration shell (AAS) is added to Digital Twin entity.
KR 28 **-066**	366	A.2	Figure A.1	te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
DE **-067**	370	A.2.1		ge	Spelling and grammar	Standardized methods for data exchange, DTRE can provide web services for the …	**Accepted in principle** DTRE has been changed to Digital Twin entity (**US-005**).
DE **-068**	371	A.2.1		ge	Spelling and grammar	Through a web interface	**Accepted**
DE **-069**	374				The asset administration shell (AAS) provides serilaizations in JSON, XML and (in work) RDF. (in Work): REST-API - So AAS is an example	Mention AAS as example how to implement IE-A	**Accepted.** Text for implantation option

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					how to implement IE-A		for AAS in IE-A will be added. **SC4/WG 15 will Contact DE to ask for help.**
KR 29 **-070**	395	A.2.3		te	Use a consistent term with other parts.	Change manufacturing elements with OME.	**Accepted**
KR 30 **-071**	397	A.2.3		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
KR **-072**	404	A.2.3		te	The description is not an example of identification (7.4). It is example to digital model (7.5).	Change “Regarding Identification” to “Regarding digital model”	**Accepted**
KR 31 **-073**	404-405	A.2.3		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
KR **-074**	404	A.2.3		te	There are many standards that can be used as a reference for identification. Add description for identification.	Add description as follows. there are many standards such as ISO 22745, IEC 61360, IEC 61987, ITU-T X.660 | ISO/IEC 9834-1, ITU-T X.667 | ISO/IEC 9834-8, IETF STD 66 that can be used as a reference for identification scheme of OME. ISO 22745 (i.e., OTD) defines database of concepts with associated terms, definitions and images used for description of individuals, organizations, locations, goods, services, processes, rules and regulations. IEC 61360 (i.e., CDD) defines data model to be used for providing classifications and metadata	**Accepted**

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						definitions for describing products. The CDD for process automation equipment are defined in IEC 61987. ITU-T X.660 | ISO/IEC 9834-1 (i.e., OID) defines identification mechanism for naming any type of object, concept or 'thing' with globally unique name. ITU-T X.667 | ISO/IEC 9834-8 (i.e., UUID) defines identification mechanism using 128-bit number generated by algorithm with values that are based on a machine's network address to uniquely identify object or entity on the Internet. IETF STD 66 (i.e., URI) is defines identification mechanism with string of characters used to unambiguously indentify a logical or physical resources on the network, of which the best known type is web address (e.g. http://); Also, add reference to ISO 22745, IEC 62832, IEC 61360, IEC 61987, ITU-T X.660 | ISO/IEC 9834-1, ITU-T X.667 | ISO/IEC 9834-8, and IETF STD 66 Also, add abbreviation in A.1 as follows. CDD, OID, OTD, UUID, URI,	
US **-075**	407	A.2.3		Te	"To support presentation and visualization, CAD/CAM information". The paragraph only descripted "CAD/CAM information", didn't mention presentation and visualization such as JT ,3DPDF,3D rendering…	Add related standard of presentation and visualization,	**Accepted in principle** Text for implantation option for presentation (IE-B) and visualization (IE-A) will be added. **Project leaders and the SC 4/WG 15 meeting will further study on how to**

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							handle the description of JT, 3DPDF, 3D rendering.
KR 32 **-076**	408	A.2.3		te	Use a consistent term with other parts.	Change "manufacturing element(s)" with "observable manufacturing element".	**Accepted**
KR 33 **-077**	420	A.2.3		te	Regarding applying manufacturing information, ISO 16100 series and ISO 18828 series can also be reference. Add description on how those standards can be referenced.	Add description as follows. The ISO 16100 series can also be considered, since it defines manufacturing information model that characterizes software-interfacing requirements enabling the interoperability among manufacturing software tools (modules or systems). The ISO 18828 series defines seamless production planning. It can be used as a reference for exchanging information regarding changes of production planning. Also, add reference to ISO16100 series, ISO 18828 series	**Accepted**
US **-078**	421	A.2.3		Te	ISO 23952 (i.e., QIF) should not be an example of IE-C	Data ISO 23952 (i.e., QIF) should be an example of IE-A or IE-B	**Accepted.** QIF will be added to IE-B, and removed from IE-C.
US **-079**	425	A.2.3		Ge	"To provide graphical information, it is possible to use API such as WebGL, OpenGL. WebGL is a JavaScript API for rendering 2D/3D graphics. OpenGL is an API for rendering 2D/3D graphics" does not belong in this paragraph.	Remove the text.	**Accepted in principle.** The text "To provide graphical information, it is possible to use API such as WebGL, OpenGL. WebGL is a JavaScript API for rendering 2D/3D graphics.

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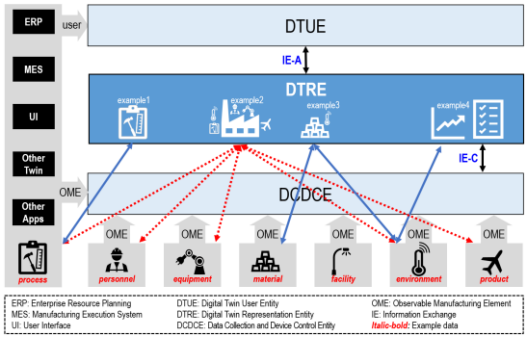
							OpenGL is an API for rendering 2D/3D graphics" belongs to IE-A, so it will be moved to IE-A.
KR 34 **-080**	441-445	A.2.4		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
US **-081**	444	A.2.4		Te	Ethernet/IP is widely used open Industrial Ethernet protocol.	Change to, "...protocol (e.g., CFX, EtherCAT, Ethernet/IP, Profinet, Modbus, RAPIENet);"	**Accepted**
KR 35 **-082**	454	A.3	Figure A.2	te	Use a consistent term (PME->OME)with other parts. For enhancement, add role of applications (ERP, MES, UI. Etc.) in the arrow. Add legend to ERP, MES, UI). Sensors/actuators in DCDCE are also a part of OME, so, figure is incorrect. Use OMEs of different types for better understanding. Relationship between digital twin in DTRE and OME are not clear, and is difficult to map different types of digital twin with the description. It is better to add identifiers for digital twin.	Change Figure A.2 as follows  	**Accepted in principle** DTRE has been changed to Digital Twin entity (**US-005**).
KR 36 **-083**	458-468	A.3		te	Change description to align with figure A.2	Change to read: - Digital Twin can be a twinning of application using source data from various manufacturing application (i.e., process) such as UI, MES, ERP as shown in example1 of Figure A.2. Application (e.g., UI, MES, ERP) can be the user of DTUE and the OME (provider of source data). For	**Accepted in principle** DTRE has been changed to Digital Twin entity (**US-005**).

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						application acting as a user of DTUE, application can utilize results from the DTRE for planning and analysis. Application acting as an OME provides data regarding manufacturing process such as product planning, manufacturing execution, quality test results; - Digital Twin can be twinning of manufacturing operations as shown in example2 of Figure A.2. It combines data from various OMEs such as process, personnel, equipment, environment, product, etc. DTRE needs to carefully maintain consistency on data received from multiple OMEs by observing and coordinating data with regards to time, location, action, condition, state, etc.; - Digital Twin can be twinning of single device of OME as shown in example3 of Figure A.3. It can also use data from the environment (e.g., sensors) for more accurate presentation of the Digital Twin; - Digital Twin can be twinning of trends or check-list as shown in example4 of Figure A.3. It can use data from environment (e.g., sensors).	
KR 37 **-084**	470-472	A.4		te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
DE **-085**	441, 396				Administration shell is no protocol, it offers a technology neutral metamodel + API plus different serializations in xml, JSON, rdf (in work), AutomationML and OPC UA and (in work) The first API that will be realized is the REST-API.	The Asset Administration is designed for implementing IE-A: applications should access information from twins and not directly from the asset it is representing. In Plattform I4.0 different deployment scenarios are distinguished. One scenario is that the twin is deployed directly on the physical device. As is described in this case IE-D is not needed. In this	**Accepted.** Will remove AAS in Figure A.3 and Figure A.4.

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						case the asset administration shell can be realized as an OPC UA server using the OPC UA Companions Specification for Asset Administration Shell (in work). However, other serializations of the asset administration shell like the one with JSON and REST would be used for IE-A and not for IE-C!! The asset administration shell is not distinguishing between IE-D and IE-C. In general there it is no standardized or preferred way described for asset administration shell how to access the data from the asset.	
KR 38 **-086**	474-475	A.4	Figure A.3	te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
KR 39 **-087**	478	A.4	Figure A.4	te	Use a consistent term with other parts.	Change PME with OME.	**Accepted**
DE **-088**	480	Bibliography			Since asset administration shell is mentioned corresponding references should be added	Add references to asset administration shell documents, e.g. link of online-library or single documents https://www.plattform-i40.de/PI40/Navigation/EN/InPractice/Online-Library/online-library.html	**Accepted**

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