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

Email of convenor: hardwick@steptools.com
Convenorship: ANSI (United States)

ISO CD 23247-1 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

Template for comments and secretariat observations

Date:	Document:	Project:

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
US 001	0	TITLE		Ge	The title is not clear nor grammatically correct.	Change title to, "Automation systems and integration – Digital twin framework for manufacturing – Part 1: Overview and general principles"	**Accepted** To be updated during DIS ballot process “Digital Twin framework for manufacturing”
DE 002		Background		Ge	Why not manufacturing with digital twins. What is “digital twin manufacturing”? There is a definition for digital twin and for digital twin manufacturing framework, but there is no term like “digital twin manufacturing”. In DT manufacturing framework it is written “DT in manufacturing”: this in fine	Reconsider formulation. ISO 23247 series defines a framework for Digital Twin in manufacturing as virtual representations of physical manufacturing elements such	**Accepted in principle** Change “a framework for Digital Twin in manufacturing” to “a Digital Twin framework for manufacturing”
FR 01 003				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.	**Accepted in principle** Assets are not specifically mentioned, however, equipment and facility are included as types of assets.
FR 02 004				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	Consider the current normative landscape.	**Noted** IEC 62264 is informatively referenced and listed in bibliography of this part. 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.

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					virtual production system. These standards are not considered in documents of the ISO 23247 series circulated as CD.		
FR 03 005				ge	There is not much additional information to ISO/IEC 30141 is this series of standards, and particularly provisions are missing. There are many redondancies between parts.	Consider publishing one technical report document.	Part 1 does not have relationship with ISO/IEC 30141.
JP01(A.O) 006		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..	Regenerate the document from scratch.	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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					There will be changes which can be captured and those which are difficult to capture. Therefore, it is understood that clear statements 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) 007		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.	**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) 008		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/	**Accepted in principle** 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

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							specific processes.
JP04(A.O) 009		A comment to the proposed document		Ge	"Overview standard" of a series of standards shall clarify (1) what are in scope of the series of standards,what are not (2) what are concepts common to all the series of standards (3) what industry problems will be solved by the application of the standards, (4) structure of the series of the standards. But, this document does not satisfy these basic requirements.	See ISO 10303-1 and other "overview" standards for learning the role of the overview standard.	**Noted** The scope and title have been improved.
JP05(A.O) 010		Introduction		Ge	The phrases "detailed modelling of physical configurations", "dynamic modelling of….." appear. These phrases should be key concepts but no detailed definitions of these phrases appear in the document. More elaborate introduction statements are required.	Rewrite from scratch.	**Accepted in principle** Introduction has been rewritten.
KR 02 021	59-60	Introduction		ed	Use a consistent term with other parts and editorial enhancement.	Change to read: ISO 23247 series defines a framework for Digital Twin manufacturing as digital representations of observable manufacturing elements including personnel, equipment, material, processes, facilities, environment and products.	**Accepted in principle** Introduction has been rewritten.
US 022	59	Introduction		Ge	Grammar error and inconsistent terms in first sentence.	Change first sentence to, "ISO 23247 series defines a framework for generating a digital twin in manufacturing as digital representations of…"	**Accepted in principle** Introduction has been rewritten.
US 023	60	Introduction		Ge	The term "assets" is ambiguous and not defined in the document.	Provide a definition for "assets" in section 3 or change the sentence to, "...physical manufacturing elements such as personnel, products, equipment material, facility, environment, and process definitions."	**Accepted in principle** Introduction has been rewritten.

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CN 024	66	Introduction		ge	Keep consistent between “Introduction” and Clause 1 “Scope”.	provides requirements and guidance for developing a Digital Twin manufacturing framework;	**Accepted in principle** Introduction has been rewritten.
CN 025	68-69	Introduction		ge	Keep consistent between part 2 description with other parts.	Provides a reference architecture goals and objectives, reference model, and reference architectural views for a Digital Twin manufacturing framework;	**Accepted in principle** Introduction has been rewritten.
JP06(A.O) 011		1. Scope		Ge	No meaningful scope statement is given.	Revise it. Meaningful in scope and out of scope statements are keen requitements.	**Accepted in principle** Scope has been rewritten.
JP10(K.D) 015	4	2. Scope		ge	The scope states the document provides an overview of Digital Twin manufacturing. Although “Digital Twin manufacturing” is not defined, , according to the explanation in Clause 4 it seems a different concept from the concept “Digital Twin” itself, which is defined as a digital model in 4.2.4. On the other hand, ISO/TC 184/SC 4 N 3224 (NWIP) states the following in its “Scope of the proposed deliverable”. This ISO xxxxx series defines a framework for Digital Twin manufacturing as virtual representations of physical manufacturing elements such as personnel, products, assets and process definitions. Digital Twin manufacturing is the detailed modeling of physical configurations, and the dynamic modeling of product, process and resource changes during manufacturing. Since this text implies that “Digital Twin manufacturing” is a digital model, the scope text of this document is inconsistent with the NWIP. This document should describe the overview of	Describe the overview of Digital Twin manufacturing as a digital model of physical manufacturing elements in the document.	**Accepted in principle** Scope has been rewritten and clarified. Clause 4 describe the overview of Digital Twin for manufacturing and Clause 5 describes Digital Twin framework for manufacturing.

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					Digital Twin manufacturing, as a digital model of physical manufacturing elements. However, this document describes almost nothing about the model and modelling, but it describes mainly functions related to Digital Twin.		
JP11(K.D) 016	4	1		ge	"describes general principles" is not specific and not appropriate for scopes. "guidance for developing a Digital Twin manufacturing framework" sounds strange. Since "Digital Twin manufacturing framework" is defined as a conceptual guidelines to support implementation of Digital Twin, "quidance" and "guideline" are duplicated each other. The phrase implies providing guidance for a guideline. However, developing the guideline is the task of this document. ISO/TC 184/SC 4 N 3224 (NWIP) states the following in its "Scope of the proposed deliverable". Part 1: Overview and general principles Provides overview of Digital Twin manufacturing and describes <u>general principles to give guidance</u> for developing a Digital Twin manufacturing framework; Since the Digital Twin manufacturing framework is a conceptual guidelines to support implementation of Digital Twin, which is a digital model, this document should provide guidelines for modelling physical manufacturing elements. However, this document describes almost nothing about the model and modelling, but it describes mainly functions related to Digital Twin.	1) Replace "describes general principles, and provides guidance for developing a Digital Twin manufacturing framework" with the following text. provide general principles of Digital Twin manufacturing framework 2) Provide guidelines for modelling physical manufacturing elements in the document.	**Accepted in principle** Scope has been rewritten and clarified. Clause 4 describe the overview of Digital Twin for manufacturing and Clause 5 describes Digital Twin framework for manufacturing.
FR 04	4	1		te	The scope states: "This document provides an overview of Digital Twin manufacturing ...".	Clarify.	**Accepted in principle** Scope has been rewritten

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017					This may be interpretated as "This document provides an overview of the manufacturing of a Digital Twin..."		and clarified. Clause 4 describe the overview of Digital Twin for manufacturing and Clause 5 describes Digital Twin framework for manufacturing.
JP12(K.D) 018	5	1		ge	The main focus of ISO TC184/SC4 “Industrial Data” is product data within Industry and modelling. ISO TC184/SC4 N1167 “SC4 Industrial Data Framework” describes the concept of “Industrial Reference Models” in Clause 4. All standards developed by ISO TC184/SC4 basically should focused on product data and modelling, instead of functions and activities. This draft is based on ISO/IEC 30141, Internet of Things (IoT) — Reference architecture, and focuses on the functional view and the system view, instead of the information view. Instead of the information view of Digital Twin.	Provide the information view of Digital Twin, especially in terms of data structure.	Scope has been rewritten and clarified. ISO 23247 Part 1 does not reference ISO/IEC 30141 and it is not the base of this standard. Information view of Digital Twin, especially in terms of data structure (information attribute) and information exchange are addressed in part 3 and part 4 of ISO 23247.
CN 019	5	1		ge	Keep consistent between “Introduction” and Clause 1 “Scope”.	and provides requirements and guidance for developing a Digital Twin manufacturing framework.	**Accepted in principle** Scope has been rewritten and clarified.
KR 01 020	4-5	1		te	Add a clause to describe the guidance for developing a Digital Twin manufacturing framework.	Propose to change “guideline” to “requirements”	**Accepted in principle** Scope has been rewritten and clarified.
JP07(A.O) 012		3. Terms and definitions		Te	Justification on why proposed redefinition of terms are necessary shall be given.	Revise it.	**Accepted**
KR 03	14-17	3.1.1		te	Preferred to reference ISO standard.	Change to read:	**Accepted**

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026						**3.1.1** **actuator** device that provides a physical output in response to an input signal in a predetermined way [SOURCE: ISO/IEC 29182‑2]	
KR 04 027	62	3.1.11		ed	Propose to change to a better definition	device that observes and measures a physical property of a natural phenomenon or man-made process and converts that measurement into a signal Note 1 to entry: Signal can be electrical, chemical, etc. [SOURCE: ISO/IEC 29182‑2]	**Accepted**
CN 028	68	3.2		ed	Besides the definition of DTM in Introduction, add a new subclause for the term “Digital Twin manufacturing” and its definition in 3.2.	3.2.x Digital Twin manufacturing the detailed modelling of physical configurations, and the dynamic modelling of product, process and resource changes during manufacturing	Digital Twin manufacturing will not be defined in the specification as a new term and the phrase has been grammatically corrected to Digital Twin for manufacturing
US 029	75	3.2.2		Te	Providing the same definition for two terms.	Pick either "digital model" or "digital representation." Or provide a separate definition for each term. For example, "Digital model: a digital representation of a physical object and serves as a basis for simulating the fabricated design and structural behavior of the part." Remove Note 1.	**Accepted** Digital representation has been removed
DE 030	78		Digital model		Compare to definition of IIC Question: Information – does it include data and behaviour? Seems so when reading the other parts of the framework Is it really always decision-related?	Consider using definition of IIC Add definition for information or add note that behaviour is included	ISO definition has been used
US 031	81	3.2.3		Te	Definition of "digital modeling" is ambiguous	Change definition to, "the procedure of creating a digital model of a physical element."	**Accepted in principle** Term has been changed to

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							Digital Twin modelling and the proposed definition has been applied with modification.
US 032	84	3.2.4		Te	Definition of "digital twin" is incomplete and ambiguous	Change definition to, "An integrated digital model that combines data from both the cyber-world and physical-world to mirror and predict activities, performance, outcomes, and/or events over the life of the digital model's corresponding physical element."	**Accepted in principle** ISO definition has been used
DE 033	85		Digital twin		Assets that a twin may represent should be more broad than just processes and physical elements (compare figure 1: seems to be the case; see also part 2 of framework: there many more manufacturing elements are described)	Extend definition to also include humans, virtual elements etc Delete data connections from definition, too technical, twins are about information not about data e.g. digital model of a manufacturing element that enables convergence between the physical and virtual states of the element at an appropriate rate of synchronisation Check also IIC definition of twin that focusses on the use cases the twin supports	**Accepted in principle** ISO definition has been used
US 034	88	3.2.5		Te	Definition not needed.	Remove the term.	**Accepted**
CN 035	90	3.2.5		ge	To use the term "Digital Twin manufacturing" instead of "Digital Twin in manufacturing".	conceptual guidelines to support implementation of Digital Twin manufacturing	**Accepted in principle** The phrase "Digital Twin manufacturing" has been changed to "Digital Twin for manufacturing"
US 036	91	3.2.6		Te	The term and definition are not clear. What is the purpose of this term? The term appears to make the language in the standard overcomplicated.	Remove the term.	**Accepted**
US 037	105	3.2.8		Te	The definition is inconsistent with the definitions for "presentation" and "representation" in ASME Y14.47-2019, "presentation: the manner in which information is displayed for use by a human," and	Change definition to align with generally accepted definition of "presentation" or adopt ASME Y14.47-2019's definition.	**Accepted**

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					"representation: the manner in which information is stored for interpretation by a machine."		
US 038	108	3.2.8		Te	Note 1 does not apply to the term.	Remove Note 1.	The Note has been modified.
CN 039	120-123	3.2.10		te	View and viewpoint are two related terms that should be defined respectively. ISO/IEC 19501:2005 is not proper source for these two terms because it does not provide their definitions. It is suggested that using ISO/IEC 19514:2017 (SysML standard) or ISO/IEC/IEEE 42010:2011 (Architecture description standard) as reference source.	3.2.10-1 architecture view work product expressing the architecture of a system from the perspective of specific system concerns 3.2.10-2 architecture viewpoint work product establishing the conventions for the construction, interpretation and use of architecture views to frame specific system concerns [SOURCE: ISO/IEC/IEEE 42010:2011] or 3.2.10-1 view the modeling element that represents the artifact that is presented to the stakeholder 3.2.10-2 viewpoint the point of view of a set of stakeholders by framing the concerns of the stakeholders along with the method for producing a view that addresses those concerns [SOURCE: ISO/IEC 19514:2017] Note: A view conforms to only one viewpoint to ensure that only one method is applied to the view. The view shall be related to the model that contains the information and the method that produces the view.	The ISO dictionary has the same entry for view and viewpoint and only makes distinction. The proposed ISO/IEC standard does not have valid terms and definitions for view and viewpoint
DE 040	124				Difficult to check whether there is abbr you are looking for	Sort abbreviation alphabetically	**Not accepted** Already in alphabetical order.
CN	133	3.3		ed	The abbreviated term “DTM” is never used in four parts of this standard.	To use “DTM” instead of “Digital Twin manufacturing” in proper cases.	**Accepted**

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041						or To delete the abbreviated term “DTM”.	
JP08(A.O) 013		4. Overview of digital twin manufacturing		Te	Consistency management between physical objects and their digital representations is a keen requirement, but no specification for consistency management, in other words detailed specifications for “dynamic modelling”, is given, which is extremely inappropriate.	Thoruough revision is required.	**Accepted in principle** Dynamic modelling has been deleted from the document.
KR 05 042	158	4.1		ed	Preferred title.	Change to read: **4.1 Concept**	**Not accepted** Changing the title may confuse 4.1 as concept of Digital Twin manufacturing. This clause describes concept of Digital Twin Note: delete “The”
DE 043	159	4.1		ge	The digital twin should remember its history to support e.g. detection of anomalies	A digital twin is a digital model of the current and historical state of a particular physical element or process with data connections that enable convergence …	**Accepted in principle** Historical aspect has been added to clause 4.2 Digital Twin for manufacturing.
US 044	159	4.1		Ge	Restated definition of "digital twin"	Replace definition of "digital twin" with the revised definition.	**Accepted**
US 045	161	4.1		Ed	Subject of the sentence unclear.	Replace "It" with the subject of the sentence.	**Accepted** Replace to ”Digital Twin”
FR 05 046	159	4.2	Entire subclause	te	The differences between "Digital Twin", "Digital Twin manufacturing" and "Digital Twin representation" are not clear in this subclause.	Clarify.	**Accepted in principle** Terms and definitions have been clarified.
US 047	169	4.2	Figure 1	Ge	Benefits are not clear here	Provide clear text in the body of the document that describes the benefits for each listed.	**Noted** Text is given in 4.4
DE 048	171				The concept really expects that there is an integrated model of the complete manufacturing domain, i.e. in a way the sum of all digital models of all twins in the system? It is not the twin that is	Please Clarify: The applications (and not only DT applications) just use the information from the models of the twins depending on the use cases they are interested in. A Digital Twin should not be	**Accepted in principle** Use cases will be given in a TR.

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					a specific kind of digital model (see term definition section)? See before: propably the term “DT manufacturing” is misleading: it is exactly one twin that is talked about in this section?	a large integrated model of the domain.	The clause has been written for clarification.
FR 06 049	171	4.2		te	A definition of "Digital Twin manufacturing" is missing.	Define "Digital Twin manufacturing".	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 050	171	4.2		Ge	Sentence incomplete	Change to, "A digital twin is used in manufacturing for maintaining a digital model…"	**Accepted in principle** Use cases will be given in a TR. The clause has been written for clarification.
KR 07 051	172	4.2		Ed	Improve sentence	From … to represent status, working conditions, product geometries, and resource states in a synchronous manner. Change to … to represent manufacturing status, manufacturing conditions, product geometries, resource state, and any other observable status and conditions in a synchronous manner.	**Accepted in principle** The clause has been written.
KR 08 052	174	4.2		Ed	Redundant. Improve sentence.	Change to Digital Twin Representation provides functionalities to maintain and synchronize the representation of a Digital Twin with its corresponding observable manufacturing elements by constantly exchanging operational and environmental data.	**Accepted in principle** The clause has been written.

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US 053	174	4.2		Te	The two sentences between Lines 174 and 177 are not technically clear and correct. The sentences do not provide value to the section.	Remove Lines 174-177.	**Accepted in principle** The clause has been written.
DE 054	178					Add reference to part 3 that explain all these use cases?	**Accepted**
US 055	178	4.2		Ge	See US-08.	Change sentence to, "A digital twin assists with detecting anomalies in the manufacturing processes…"	**Accepted**
US 056	182	4.2		Ge	"Digital twin manufacturing" is not a defined term.	Change sentence to, "The visibility into process and execution enabled by a digital twin enhances business…"	**Accepted in principle** Changed to “Digital Twin for manufacturing”
KR 06 057	186	4.2		ed	Follow a way of reference to clause in a document given in ISO/IEC Directive Part 2.	Change to read: Examples of applications, services and benefits are given in 4.3 and 4.4.	**Accepted**
KR 09 058	187	4.3		ed	Clause 4.3 describes only Digital Twin manufacturing applications. Also, clause 4.5.2.1 explains Digital entities with Digital Twin manufacturing application.	Change to read: **4.3 Applications of Digital Twin manufacturing** and change the one in Figure 1.	**Accepted**
KR 10 059	187	4.3		te	Besides given Digital Twin manufacturing application, it is worthwhile to include one of applications explained in TC 184/Ad Hoc Group: Data Architecture of the Digital Twin document.	Propose to add: **4.3.5 Engineering design** Digital Twin for engineering design is a virtual representation of the design at the point of interest in the lifecycle. In the conceptual development and proposal phase, Digital Twin consists of models that manage requirements and demonstrate the allocation and validation of requirements to functional models with behaviour.	**Accepted in principle** New clause has been added for engineering design.
KR 11 060	189	4.3.1		Ed	Reword to match clause title.	From A real time application Change to A real time control application	**Accepted**

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KR 12 061	198	4.3.4		Ed	Reword	From … to check physical elements and production processes and if necessary, schedules predictive maintenance. Change to … to check conditions of observable manufacturing elements and if necessary, schedules maintenance.	**Accepted**
US 062	200	4.4		Te	No benefits listed in each subsection.	Extend the text in Subsections 4.4.1 to 4.4.4 to describe expected benefits.	**Accepted in principle** Text shall be improved for DIS.
DE 063	216				Element is a very generic term and difficult to refer to. You would need to say “The twin represents an element of Digital Twin Manfucturing”. And not “The twin represents an entity” (IIC) or “The twin represents an asset” (Plattform I4.0) or “The twin represents a manufacturing element”	Proposal: Use “manufacturing element” as in part 3. Rename title to “Manufacturing Elements represented by a Digital Twin”	**Accepted in principle** The phrase “Digital Twin manufacturing elements” has been changed to “elements of Digital Twin for manufacturing”
DE 064	216				Since part 3 is describing manufacturing element: is this a complete list as well?	Mention that part 3 explains the manufacturing elements and may also add additional ones	Yes. This is the complete list.
US 065	216	4.5		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Elements of Digital Twins used in Manufacturing"	**Accepted in principle** The phrase “Digital Twin manufacturing elements” has been changed to “elements of Digital Twin for manufacturing”
KR 13 066	219	4.5.1		Ed	Reword	Delete “processes”	**Accepted**
KR 14	230	4.5.1.3		Ed	Reword	From … such as metal block	**Accepted**

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067						Change to … i.e., metal block, glass panel, etc.,	
KR 15 068	239	4.5.1.6		Ed	Reword (Plural to singular)	From conditions Change to condition	**Accepted**
DE 069	245	4.5.1.8		ge	The digital twin should also be able to observe engineering documents. Reasons: 1. Engineering models are essential to understand the production process. 2. Requirements mentioned in Sect. 5.4, such as fidelity can only be judged relative to the desired models (i.e. the engineering documents)	Add a new subsection: Engineering Document. An Engineering Document is any form of artefact (requirement, plan, model, specification, configuration) that helps the digital twin application and services to perform their duties.	**Accepted in principle** "Supporting document" is added Part 3 will be revised accordingly.
DE 070	246, 250, 2531				See above: product and process seems not be restricted. In Plattform Industrie 4.0 for example asset-instance-representations and asse-type-representations are distinguished. And asset is very generic. Here asset = product or process. In general: not very clear what a digital entity is. The twin itself is propably also a digital entity?	Please explain what exactly the term digital entity is used for Please check whether this list is really complete	**Accepted in principle** Clause title has been changed to "digital elements"
US 071	247	4.5.2.1		Te	Section is not clear. Also, see US-08.	Change to, "Manufacturing applications of digital twin enable the reporting and adjusting of the current state of manufacturing equipment and operations."	**Accepted in principle** Rephrased for clarification
KR 16 072	251	4.5.2.2		Ed	Reword	From … a specification of the properties of a product that are needed to characterise it such as dimensions, tolerances, surface finish, etc.	**Accepted**

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						Change to … specifications or properties of a product that are necessary to characterise it such as dimensions, tolerances, surface finish, etc.	
JP09(A.O) 014		5.		Te	What are described do not serve as a general principles. Provide detailed specifications for “dynamic modelling” for consistency management between physical objects and their digital counterparts	Thoruough revision is required.	Dynamic modelling has been deleted from this document
FR 07 073	259	5.1		te	The sentence explaining the relation between "Digital Twin manufacturing framework", "Digital Twin manufacturing system" and "Digital Twin manufacturing" is obscure.	Clarify "Digital Twin manufacturing framework", "Digital Twin manufacturing system", "Digital Twin manufacturing" and their relations.	**Accepted** The sentence has been written.
FR 08 074	257	5	Entire clause	te	The concept of Digital Twin manufacturing framework seems based on JTC 1's ISO/IEC 30141. The added value of this document to ISO/IEC 30141 is questionnable;	1- Add ISO/IEC 30141 in the normative references. 2- Provide valuable provisions focusing on industrial data, which is the scope of ISO/TC 184/SC 4.	This document does not reference ISO/IEC 30141.
FR 09 075	257	5	Entire clause	te	The concept of Digital Twin manufacturing framework seems based on JTC 1's ISO/IEC 30141. The NWIP standards gap analysis listed and summarized IEC 62264 Enterprise-control system integration being jointly developped by ISA, IEC/SC 65E and ISO/TC 184:SC 5.	Clarify the choice of ISO/IEC 30141 and the absence of reference to the hierarchies of IEC 62264.	This document does not reference ISO/IEC 30141. IEC 62264-1 is referenced and included in bibliography.
US 076	257	5		Ge	See US-01.	Change to, "General principles of the digital twin framework for manufacturing"	**Accepted**
US 077	259	5.1		Ge	See US-01.	Change to, "The digital twin framework for manufacturing provides guidance on how to construct a digital twin of a manufacturing system	**Accepted**

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						and … for the purpose of a digital twin in manufacturing, but does…"	
US 078	262	5.2		Ge	See US-01.	Change to, "Standardization scope of the digital twin framework for manufacturing"	**Accepted**
US 079	264	5.2.1	Figure 2	Ge	See US-01.	Change "Digital Twin Manufacturing Framework" to "Digital Twin Framework for Manufacturing" in both the figure and the caption	**Accepted**
US 080	266	5.2.1		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Figure 2 shows the high-level concept of the digital twin framework for manufacturing"	**Accepted**
CN 081	257	5		te	Current structure of Clause 5 is as follow: 5 General principles of Digital Twin manufacturing framework 5.1 Overview 5.2 Scope of Digital Twin manufacturing framework standardization 5.2.1 Limitations and boundaries 5.3 Hierarchical modelling of Digital Twin manufacturing 5.4 Requirements of Digital Twin manufacturing It is suggested rearrange the structure and putting requirements analysis first according to problem solving or systems engineering process.	Proposed new structure of Clause 5 as follow: 5 General principles of Digital Twin manufacturing framework 5.1 Overview 5.2 Requirements of Digital Twin manufacturing 5.3 Hierarchical modelling of Digital Twin manufacturing 5.4 Scope of Digital Twin manufacturing framework standardization 5.4.1 Limitations and boundaries	**Accepted in principle** Rearranged 5.3 ←→ 5.4
JP13 (K.D) 082	257	5	Entire Clause	ge	The Digital Twin manufacturing framework seems based on ISO/IEC 30141, however there is almost no valuable contents in addition to the original IoT-RA.	Provide valuable contents focusing on the information view.	**Accepted in principle** Information view of Digital Twin, especially in terms of data structure (information attribute) and information exchange are already given in part 3 and part 4
CN 083	259-261	5.1		ge	5.1 is a important statement on the business requirements of DTMF. It should be claimed in Introduction.	To copy the sentence "The Digital Twin manufacturing framework provides guidance on how to construct a Digital Twin manufacturing system and how applications and data sources can inter-operate for the purpose of Digital Twin manufacturing, but does not specify any implementation technologies" to the 1st paragraph of "Introduction".	**Accepted in principle** Introduction has been updated for clarification.
US	276	5.3		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin"	**Accepted in principle**

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084							The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 085	277	5.3		Ge	"Digital twin manufacturing system" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 086	277	5.3		Ed	Incorrect usage of "i.e.,"	Change "i.e.," to "e.g.,"	**Accepted**
US 087	278	5.3		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 088	278	5.3		Ed	Incorrect usage of "etc"	Remove "etc"	**Accepted**
DE 089	280ff				Please make more clear: what are the requirements w.r.t. a twin and what is required by the framework: then the twin would solve some of the requirements. But in the requirement “Management” it is already stated that the framework shall manage the twin elements…	Please distinguish requirements to the framework and to the twin itself or to the environment/infrastructure (=DT Manfuacturing System?) the twin will finally be instantiated	**Accepted in principle** “management” clasue has been written.
US 090	280	5.4		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 091	283	5.4		Ge	"Digital twin manufacturing system" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** “system” has been deleted. The phrase “Digital Twin manufacturing” has been

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							changed to “Digital Twin for manufacturing”
US 092	288	5.4.1.2		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
CN 093	296	5.4.1.5		ge	“Digital Twin framework” is a new term without definition. It is suggested using the term “Digital Twin manufacturing framework”.	A Digital Twin manufacturing framework shall be …	**Accepted in principle** The phrase “Digital Twin manufacturing framework” has been changed to “Digital Twin framework for manufacturing”
US 094	296	5.4.1.5		Te	Incorrect usage of "Digital twin framework"	Change to, "Digital twin implementation"	**Accepted in principle** “management” clasue has been written.
DE 095	305				So it is not the asset=manufacturing element the twin is representing that is simulated but the manufacturing system?	Clarify what is simulated by the twin	**Accepted in principle** The clause has been rewritten
US 096	305	5.4.1.8		Ge	See US-08.	Change "digital twin representation" to "digital twin"	**Accepted**
US 097	307	5.4.1.9		Ge	See US-08.	Change "digital twin representation" to "digital twin"	**Accepted**
US 098	316	5.4.2.3		Ge	"Digital twin manufacturing system" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** “system” has been deleted. The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
DE 099	318	5.4.2.4		ge	Scalability may be misleading: Scalability is the ability of a system, network or process to change size. But what does scalability	Granularity Digital model oft he physical element shall provide an insight at different granularities.	**Accepted**

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					signify in this context? Should the model grow as the system grows? Maybe you mean granularity. Granularity of a model describes the level of detail in which it represents its target system.		
US 100	321	5.4.3.1		Ge	"Digital twin manufacturing" is not a defined term.	Change to, "Digital twin"	**Accepted in principle** The phrase “Digital Twin manufacturing” has been changed to “Digital Twin for manufacturing”
US 101	324	5.4.3.2		Ge	See US-08.	Change "digital twin representation" to "digital twin"	**Accepted**

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