

Contents	Page
FOREWORD.....	3
INTRODUCTION.....	4
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Abbreviated terms	9
5 Specifying an architecture for digital twins	10
6 Foundational viewpoint.....	10
6.1 Stakeholders and concerns.....	10
6.1.1 General	10
6.1.2 Stakeholders	10
6.1.3 Concerns.....	10
6.2 Views and models.....	11
6.2.1 General	11
6.2.2 Conceptual models	11
6.2.3 Physical target entity	13
6.2.4 Digital target entity	13
6.2.5 Combined physical and digital target entity	14
6.2.6 Lifecycle model.....	14
7 Functional viewpoint.....	16
7.1 Stakeholders and concerns.....	16
7.1.1 General	16
7.1.2 Stakeholders	16
7.1.3 Concerns.....	16
7.2 Views and models.....	16
7.2.1 General	16
7.2.2 Design and development stage.....	17
7.2.3 Deployment stage.....	18
7.2.4 Operation stage.....	18
7.2.5 Retirement stage	19
8 Implementation viewpoint	19
8.1 Stakeholders and concerns.....	19
8.1.1 General	19
8.1.2 Stakeholders	19
8.1.3 Concerns.....	19
8.2 Views and models.....	19
8.2.1 General	19
8.2.2 Implementation of interfaces.....	20
8.2.3 Implementation of interoperability	21
8.2.4 Implementation of models.....	22
Annex A (normative) Architecture pattern viewpoint.....	24
A.1 Stakeholders and concerns.....	24

A.1.1	General	24
A.1.2	Stakeholders	24
A.1.3	Concerns	24
A.2	Views and models	24
A.2.1	General	24
A.2.2	Construction model.....	25
A.2.3	Using views and models from other reference architectures.....	26
A.3	Examples of patterns	27
A.3.1	Template	27
A.3.2	Sensing and actuating pattern	28
A.3.3	Smart manufacturing RAMI reference model pattern	30
A.3.4	Maturity pattern	31
A.3.5	Framework for manufacturing pattern	32
	Bibliography.....	34
Figure 1	– How to use this document	5
Figure 2	– Used architecture views	6
Figure 3	– Twinning model.....	12
Figure 4	– Synchronization model.....	12
Figure 5	– Digital twin for a physical target entity	13
Figure 6	– Digital twin for a digital target entity	13
Figure 7	– Digital twin for a combined physical and digital target entity	14
Figure 8	– Full lifecycle twinning	15
Figure 9	– Example of partial lifecycle twinning	16
Figure 10	– Business and usage interface model	20
Figure 11	– Inner and outer interoperability.....	21
Figure 12	– Transversal interoperability	21
Figure 13	– Model construction processes	23
Figure A.1	– Digital twin architecture construction model	25
Figure A.2	– Relationship between IoT component, IoT system and IoT environment.....	28
Figure A.3	– IoT component capability	29
Figure A.4	– RAMI architecture model.....	30
Figure A.5	– ISO/IEC 30186 [11] maturity model	31
Figure A.6	– ISO 23247-2:2021 [17] architecture	32
Figure A.7	– ISO 23247 series [19]	33
Table 1	– Capabilities in the design and development stage	17
Table 2	– Capabilities in the deployment stage	18
Table 3	– Capabilities in the operation stage	18
Table 4	– Capabilities in the retirement stage	19
Table A.1	– Example of additional views for IoT-related digital twins.....	26
Table A.2	– Architecture pattern template	27
Table A.3	– Sensing and actuating pattern legend	28
Table A.4	– Smart manufacturing RAMI reference model pattern	30
Table A.5	– Digital twin maturity pattern.....	31
Table A.6	– Framework from manufacturing pattern	32