IFC Rail Project

Storyline (SL) Implementation Report (IR)

Track Turnout Renewal (TTR)

Detailed Design Phase (DD)

SBB CFF FFS

SL-IR-TTR-DD-SBB

Contents

Room:	Railway Room	**Date:**	2021.09.07
Project/Activity:	IFC Rail Phase 2	**Test Leader:**	Ali TATAR
Document Title:	WP1: Storyline (SL) Implementation Report	**ID:**	SL-IR-TTR-DD-SBB
Version:	1.0	**Stakeholder:**	SBB

1 Storyline documentation update

The test group was defined by the test leader with the consent of each participating organisation. The meetings were held on MS Teams provided by SBB. All the documentation regarding the requirments and processes were stored on sharepoint which eventually moved to BOX provided by IFC Rail PMO.
During the first weeks the test group was supposed to deliver a time table on which milestones for the test project were available. After having the business requirements consolidated, the meeting were held occasionally when they were needed. During the software implementation a core test group was the main point of contact for the software vendors. The validation part was also conveyed in this manner, where experts were in touch with the vendors. Since there were no essential changes on the storyline, tests were conducted as planned.

1.1 Updated Storyline Synthesis

Room:	**Railway Room**	Author: Domain Expert	
Project/Activity:	**IFC Rail Phase 2**	Verification: Technical Expert	
Document Title:	**Storyline: Turnout Installation**	Approbation: Test leader	
Version:	**1.0**	PMO checker:	
Date:	**2021.09.07**	ID:	
Description (a)			
Project Phases (b)	☐ PL - Planning ☐ ID - Intermediate design	☐ Build ☐ Operation & Maintenance	

	☐ DD - Detailed design ☐ Dismiss	
Use Cases (c)	☐ ECM - Existing Condition Modelling ☐ RDM - Railway Design Modelling ☐ RDM.DD - Feasibility Study for Railway ☐ RDM.RIDM - Railway Intermediate Design Modelling ☐ RDM.RDDM - Railway Detailed Design Modelling ☐ ICM - Interference and Coordination Management ☐ 3DV - 3D Visualization ☐ QTO - Quantity Take-Off ☐ INMP - Handover from Builder to Maintainer (Information Needed for Maintenance Perspective)	
Domains	☐ Track (*)	
	☐ Signalling (*)	
	☐ Energy (*)	
	☐ Telecom (*)	
	☐ Alignment (*)	
	☐ Other (*)	
Tested Concepts (d)		
Test Leader TL (e)		
Domain Experts DE (e)		
Technical Experts TE (e)		
Software Vendors SW (e)		
Test Dataset (e)		

(a) 2 lines description (b) chose maxi 1 phase and 4 use cases (c) list only domains for the test (d) indicate Covered Unit Test Topics (e) specify names and companies

(*) *specify further sub-disciplines*

1.2 Updated Storyline Description

Description of the Business case	
Duration	
Aim	•
In Scope	
Out of Scope	•

Specific Detailed Process Map for this Storyline

[process map that defines realistic exchange scenarios between software applications ; reference to general processes defined in the IFC Rail Requirements analysis report Chapter 2 : IFC Rail Process Map also called High-level Reference Process Map (HLRP)]

There are / were no changes regarding the process map.

HLRP	ES nbr	From	To	Note [optional]
103	SLTTR-DD-ECM-ES1	Alignment Designer (or surveyor)	Alignment Designer	ECM - Existing Condition Modelling
104	SLTTR-DD-DD-ES2	Alignment Designer	Track Designer	DD – Detailed design
116	SLTTR-DD-QTO-ES3	Track Designer	Cost Eng./P.Manager	QTO - Quantity Take-Off
105	SLTTR-DD-3DV-ES4	Track Designer	Project Manager	3DV - 3D Visualization

2 Exchange Scenario (ES) and Tests

2.1 Exchange Scenario: SLTTR-DD-ECM-ES1

2.1.1 Updated Exchange Scenario

Id	**SLTTR-DD-ECM-ES1**

Exchange Scenario Description

[please describe the ES and define In/Out of Scope topics]

- Due to the limited ressources of the software vendors, the test team has decided to use the already available 3D scans and 3D modeling used by the real project. So that it was still possible to integrate the existing situation to the test project. This topic should be addressed in the definition of future MVDs.

Geometry and positioning requirements

[General description / concepts => specific on Excel sheets]

-

Spatial requirements

[General description of spatial element requirements => specific on Excel sheets]

-

Physical and functional requirements

[General description of physical elements, functional elements and important information => specific on Excel sheets]

Covered Unit Test: to be filled by Technical Expert(s)

ID	Unit Test
AWC	Alignment with Cant
LP	Linear Placement
SAS	Swept Area Solid

2.1.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
• The requirements defined by the test team are documented in the storyline provided. Due to the lack of time and capacity of the software vendors, the tests regarding existing condition modeling were postponed to a future MVD implementation. We are looking forward to handling such use cases or exchange scenarios during the MVD implementation phase. Open Issues to be addressed in the next phases: • MVD definitions for this exchange scenario • Engagement of further software vendors which are interested in actively participate. • Documentation of the work done for both sides, i.e. software implementation and validation. • To check the applicability of the standard at a real project • Keeping the standard up to date, in case of any future changes.
Test Team and Test Leader Satisfaction (Specify the Box/Github links to find the test results or documents….)
• All the open issues listed above should be addressed so that the test of this exchange scenario can be fulfilled. However, added value of the implementation of this exchange scenario is relatively low for the moment. In addition, some software vendors which have stated an active participation, could not deliver results in the given time.
Tests and Results Archives (Specify the Box/Github links to find the test results or documents….)
• Datasets regarding this exchange scenario is uploaded to the BOX platform. Due to the fact that there were no activities planned for this exchange scenario, the data from the real project (Basel II) was used to create and visualize a consolidated BIM model including ECM.

2.2 Updated Exchange Scenario: SLTTR-DD-DD-ES2

2.2.1 Updated Exchange Scenario

Id	**SLTTR-DD-DDES2**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
• Linear placement was succesfully tested in unit test, but in the storyline the layout information is provided as the basis for the modeling which is not machine readable.	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
•	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	

•
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*
Covered Unit Test: to be filled by Technical Expert(s)

ID	Unit Test
AWC	Alignment with Cant
LP	Linear Placement
SAS	Swept Area Solid

2.2.2 ES Test description and results

Test Completion
(Specify level of completion and if reserves/punchlist opened, additional TS works….)

- The requirements defined by the test team are documented in the storyline provided. Due to the lack of time and capacity of the software vendors, the tests regarding existing condition modeling were postponed to a future MVD implementation. We are looking forward to handling such use cases or exchange scenarios during the MVD implementation phase.

Open Issues to be addressed in the next phases:

- MVD definitions for this exchange scenario
- Engagement of further software vendors which are interested in actively participate.
- Documentation of the work done for both sides, i.e. software implementation and validation.
- To check the applicability of the standard at a real project
- Keeping the standard up to date, in case of any future changes.

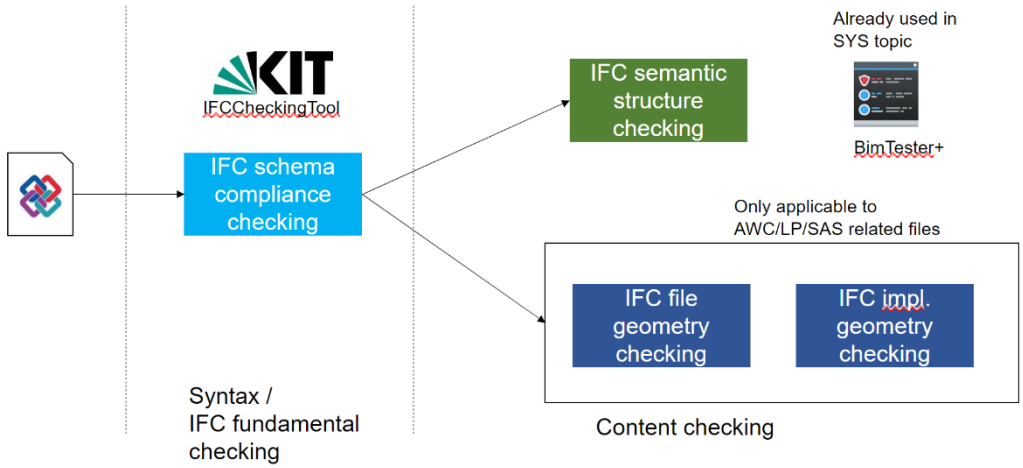


Figure 1: Schema compliance checking

- The tests which are carried out regarding this exchange scenario can be divided into three groups as shown in Figure 1.

Alignment related validation

Dataset used from Pilotproject

During the alignment validation process, it is asked to generate the alignment using .XTR file which stems from the Basel project. In this alignment dataset no cant information is given, that is why the experts provided another dataset using alignment with cant, see next section. During the tests it is clear that the semantic alignment data is consistent with geometry alignment data. The values of the alignment given were checked by alignment experts and the results can be seen in the table provided below, **Erreur ! Source du renvoi introuvable.**. All the values appear to be in compliance with the requirements and correct in the implementation of ACCA.

NAME:							SPATIAL STRUCTURE REFERENCE:				
895											
SEGMENT START POINT DISTANCE ALONG	HORIZONTAL ALIGNMENT						VERTICAL ALIGNMENT				
	COORDINATE EAST (X)	COORDINATE NORTH (Y)	TYPE segment	START DIRECTION	RADIUS	PropertySET	TYPE segment	HEIGHT	GRADIENT	RADIUS	PropertySET
2D (m)				(centesimal)	2D (m)	reference		(m)	°/°°	2D (m)	reference
0.0000	2 613 449.557830	1 265 854.674650	CA	-203.665770	185.0000		CA	275.9097	-1.769910	5 014.0000	
18.8369							CG	275.9117	1.986940	0.0000	
20.4718	2 613 429.096550	1 265 854.720740	LN	-196.621070	0.0000						
26.5253			END		0.0000		END	275.9270	1.986940		

Table 1: Alignment without Cant example from the pilotproject implemented by ACCA

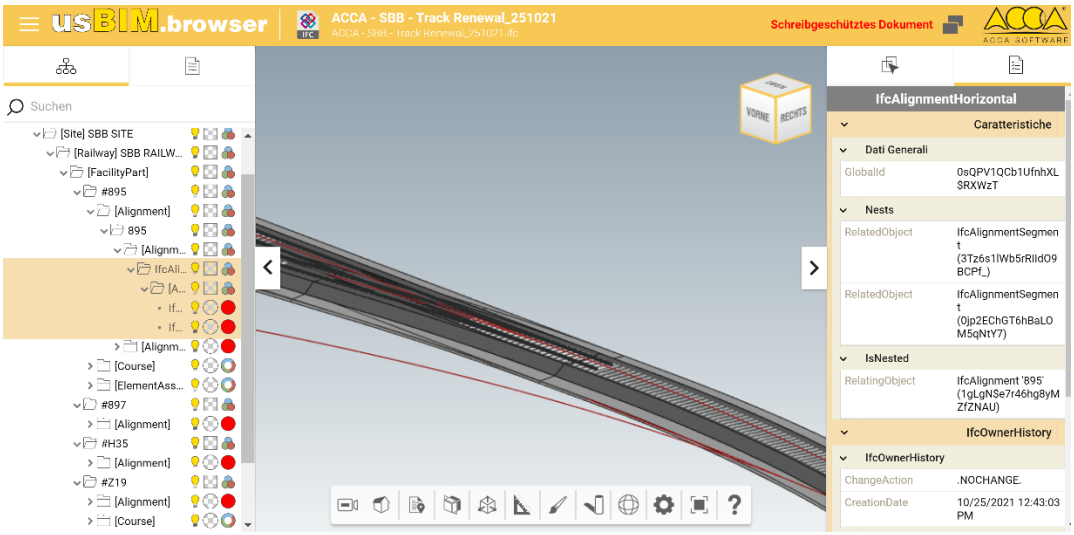


Figure 2: Alignment view of the pilot project using ACCA viewer

Dataset including alignment with cant

In order to check the alignment with cant, a second alignment set was provided to the test team and software vendors. The values for
alignment with cant seems to be in compliance with the requirements and correct in the implementation of ACCA, Table 2.

NAME:							SPATIAL STRUCTURE REFERENCE:					PROPERTY SET REFERENCE:				
9																
SEGMENT START POINT DISTANCE ALONG	HORIZONTAL ALIGNMENT						VERTICAL ALIGNMENT					CANT: 1500.0 mm				
	COORDINATE EAST (X)	COORDINATE NORTH (Y)	TYPE segment	START DIRECTION	RADIUS	PropertySET	TYPE segment	HEIGHT	GRADIENT	RADIUS	PropertySET	TYPE segment	LEFT	RIGHT	SPEED	PropertySET
2D (m)				(centesimal)	2D (m)	reference		(m)	*/**	2D (m)	reference		(mm)	(mm)	(km/h)	reference
0.0000	2 723 418.736250	1 212 559.465420	CL	-52.238440	472.0000		CG	465.9114	5.850000	0.0000		LT	-63.0	63.0		
60.6834							CA	466.2664	5.850000	-700.0000						
61.4183							CG	466.2703	4.800000	0.0000						
68.0000	2 723 467.422750	1 212 512.015520	CL	-47.652620	0.0000							LT	0.0	0.0		
133.0000	2 723 513.998910	1 212 466.696180	CA	-52.083060	-467.0000							CC	62.0	-62.0		
179.0693	2 723 543.783460	1 212 431.574380	CL	-58.363280	-467.0000							LT	62.0	-62.0		
218.0693	2 723 566.408280	1 212 399.815820	CA	-62.394780	-904.0000							CC	32.5	-32.5		
262.7086	2 723 590.344530	1 212 362.142050	CL	-65.538390	-904.0000							LT	32.5	-32.5		
301.7086	2 723 609.486070	1 212 328.170090	CA	-69.552930	-470.0000							CC	63.0	-63.0		
392.9138	2 723 643.367290	1 212 243.645610	CL	-81.906770	-470.0000							LT	63.0	-63.0		
442.3843							CA	468.0990	4.800000	-1 200.0000						
443.0442							CG	468.1019	4.250000	0.0000						
458.9138	2 723 658.885420	1 212 179.510760	CL	-86.376650	0.0000							LT	0.0	0.0		
524.9138	2 723 674.429420	1 212 115.382690	CA	-81.829370	462.0000							CC	-63.0	63.0		
540.2806							CA	468.5152	4.250000	-900.0000						
540.9106							CG	468.5177	3.550000	0.0000						
618.3384	2 723 709.588550	1 212 028.998150	CL	-68.955790	462.0000							LT	-63.0	63.0		
705.3384	2 723 755.075130	1 211 954.876570	LN	-62.961640	0.0000							CC	0.0	0.0		
875.2797							CA	469.7047	3.550000	-7 000.0000						
875.9797							CG	469.7071	3.450000	0.0000						
960.0820	2 723 895.063470	1 211 742.044290	CL	-62.961640	0.0000							LT	0.0	0.0		

Table 2: Alignment with Cant example implemented by ACCA

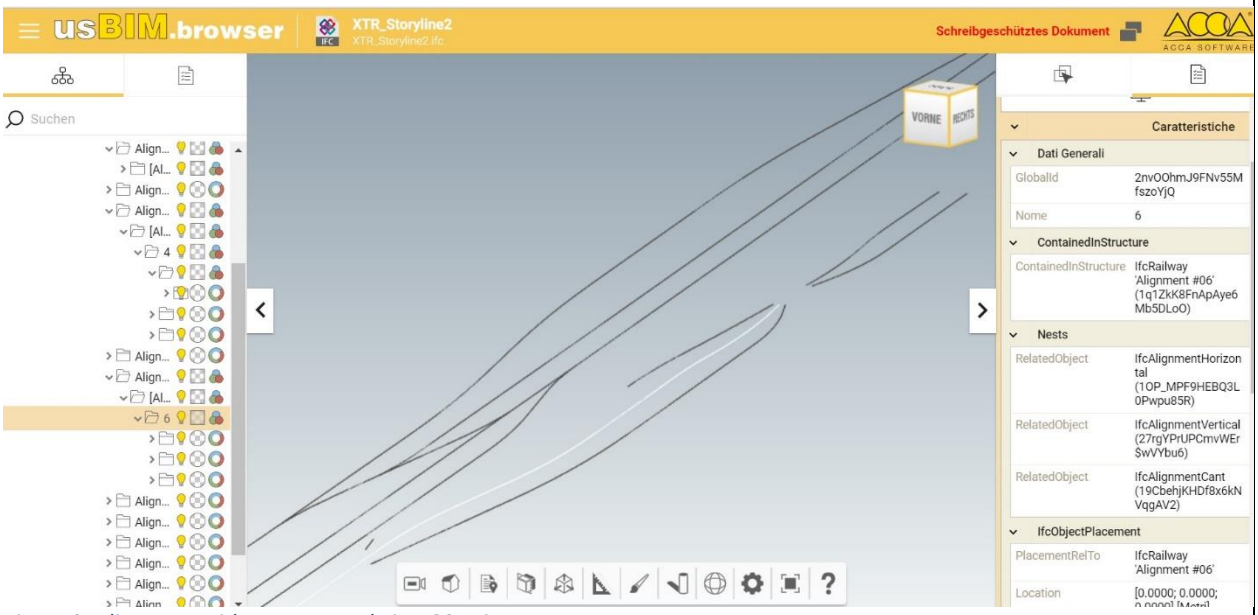


Figure 3: Alignment with cant, example in ACCA viewer

<u>Recommendation for the next phase:</u>

Some issues regarding the splitting of the alignments in the .XTR file were identified by the experts. These should be treated in a next phase. For that purpose more detailed requirements should be provided by the stakeholders such as speed, dynamic parameters (cant deficiency etc.)

Schema compliance checking: Geometry and structure related validation

For geometry validation ACCA viewer was used to check if the geometry given by the project dataset was implemented correctly. To be on the safe side, the project model which was built during the project was used for a 1 to 1 comparison. There have been no significant differences between both models. In conclusion, geometry appears to be in compliance with the requirements.

Structure related validation:

KIT Schema checker was used to validate the model structure, see Figure 4. Structure validation appears to be in compliance with the requirements. Please see the final documentation of the validation report for detailed information.

Checking Report

Filename: ACCA - SBB - Track Renewal_251021.ifc

Check Option: IFC4X3_RC4

- ☑ Show Object Statistic
- ☑ Show Full Statistic
- ☑ Show Header
- ☑ Show Messages

Results:

Total Number of Errors	0	Errors in PropertySets	0
Total Number of Warnings	1	Warnings in PropertySets	0
Total Number of Comments	0		

Message Code	Message Type	Amount
HEADER_03	WARNING	1

Figure 4: Checking report for ACCA models using KIT Checker

- **Property related validation of track elements**

The domain experts involved in validation of the properties have manually checked the properties on the model. There are no issues related to the property validation, please see storyline documentation in Appendix section for further details.

IfcClass	GUID	Name	Description	Storey	ObjectType	Type Name	Predefined Type
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3$rzxgVhr6OgCI67DaFI$H	Sleeper Z19 B#0042	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	2TUpJ0x318Kw9FirOrjE04	Sleeper Z19 B#0041	Sleeper	#Z19		Default Track Element Type	.SLEEPER.
IfcTrackElement	3k2GB$iJT1Qe4i7aXcWM4o	Sleeper Z20#0131	Sleeper	#Z20		Default Track Element Type	.SLEEPER.
IfcTrackElement	3k2GB$iJT1Qe4i7aXcWM4o	Sleeper Z20#0131	Sleeper	#Z20		Default Track Element Type	.SLEEPER.

Figure 5: List of track elements and attributes to be validated

Test Team and Test Leader Satisfaction

(Specify the Box/Github links to find the test results or documents….)

Overall tests carried out were successful. Acca was able to meet almost all the requirements for the model. Although Dassault has joined the test project relatively late, development team is still working on the dataset for delivering IFC 4.3 models as required.

- A specific definition of requirements for each element can be addressed in the next phases, as these requirements are not available currently e.g., frog, half set of blades etc.
- MVD definitions for each exchange scenario must be done in detail

• Engagement of further software vendors which are interested in actively participate, could not be achieved. • Alignment the digit resolution in centimetres may not be sufficient for all applications. • Due to the limited time and resources, the scope of some topics had to be reduced.
Tests and Results Archives (Specify the Box/Github links to find the test results or documents….)
• Please refer to this link for the results and documentation of the tests done: **https://bit.ly/3qay9kD**

2.3 Updated Exchange Scenario: SLTTR-DD-QTO -ES3

2.3.1 Updated Exchange Scenario

Id	**SLTTR-DD-QTO-ES3**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
•	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
•	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
•	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
	No topic from unit test currently covers this exchange scenario

2.3.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
• The results provided by ACCA were in compliance with the requirements.
Test Team and Test Leader Satisfaction (Specify the Box/Github links to find the test results or documents….)
• Overall tests carried out were successful. The requirements regarding the quantity take-off were relatively simple, so that these could be fulfilled without any issues by ACCA • MVD definitions for each exchange scenario has to be done in detail • Engagement of further software vendors which are interested in actively participate, could not be achieved.
Tests and Results Archives

(Specify the Box/Github links to find the test results or documents….)
• Please refer to this link for the results and documentation of the tests done: • https://bit.ly/3qay9kD

2.4 Updated Exchange Scenario: SLTTR-DD-3DV -ES4

2.4.1 Updated Exchange Scenario

Id	**SLTTR-DD-3DV-ES4**
Exchange Scenario Description *[please describe the ES and define In/Out of Scope topics]*	
•	
Geometry and positioning requirements *[General description / concepts => specific on Excel sheets]*	
•	
Spatial requirements *[General description of spatial element requirements => specific on Excel sheets]*	
•	
Physical and functional requirements *[General description of physical elements, functional elements and important information => specific on Excel sheets]*	
Covered Unit Test: to be filled by Technical Expert(s)	
ID	Unit Test
AWC	Alignment with Cant
LP/LPC	Linear Placement, Linear Placement with Cant (Sleeper). Unit test does not cover all equipment (i.e. rails, ballast, turnout).
SAS	Swept Area Solid

2.4.2 ES Test description and results

Test Completion (Specify level of completion and if reserves/punchlist opened, additional TS works….)
• The models provided by ACCA were in compliance with the 3DV requirements
Test Team and Test Leader Satisfaction (Specify the Box/Github links to find the test results or documents….)
• Overall tests carried out were successful. In addition the work done by Acca, Geodesial was also able to import the data / model provided. • MVD definitions for each exchange scenario has to be done in detail • Engagement of further software vendors which are interested in actively participate, could not be achieved.
Tests and Results Archives (Specify the Box/Github links to find the test results or documents….)
• Please refer to this link for the results and documentation of the tests done: https://bit.ly/3qay9kD

3 Supporting Files and Storyline Archives

3.1 Exchange Requirements (ER)

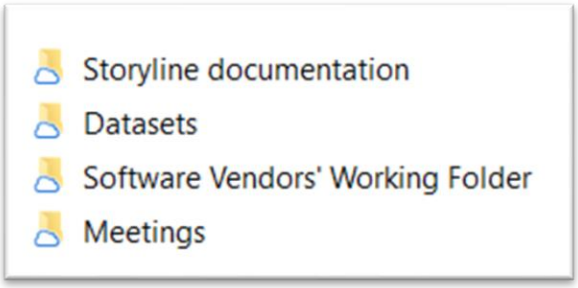
There are / were no changes regarding the exchange requirements.

3.2 SL Data archives

All files and Data are archived in:

- BOX directory: https://app.box.com/s/t538rfhiw1ddphluh925nyoq5p6iwxjo
- GITHUB: SL01_TrackRenewal

Data and documents are mainly stored on box in the following structure:



Github was only used used for storage of the produced Ifc files from software vendors.

3.3 Test Dataset(s)

All the Test Datasets utilized in this Storyline to achieve the SL Tests.

Dataset Title
• Project dataset, Alignment dataset with cant
Dataset description
• The storyline test covers the real pilot project Basel II from SBB. To get an overview of the situation which should be covered by the tests it was provided several plans in .pdf and the Ifc project file in Ifc 4. The .ifc file should only give some ideas to the software vendors on the expected visualisation but should not be used as a reference for the internal structure to be provided.
Dataset links
• https://app.box.com/s/14nduzuuzi7k83iif8yw3b1ht9d8prp3 • https://app.box.com/s/p5xoamf6jdml7i99qv45zyxmu6fcg0r5 • https://app.box.com/s/p9a6mviqjefau6h1y3sgjjh8kzaxijk7

Dataset Title
• Alignment
Dataset description
• The alignment dataset was provided in Toporail format (.XTR datafile) issued from a real life project from SBB (Basel II). Together with the datafile it was provided a documentation, which

described the internal structure of the alignment components. The alignment was chosen so that it covers track parts with several turnouts.
Dataset links
• https://app.box.com/s/xfag7qdrqb123r03wjm28dvgc5cs1sw1

Dataset Title
• Turnout
Dataset description
• The turnout dataset was compiled from different existing files and documents from the Basel II project. The files aimed to provide information on standardised dimensions, basic turnout type components and the detailed construction plan. The files were provided as.dwg files issued from CAD and .pdf files.
Dataset links
• https://app.box.com/s/ixp7m1k1ay5b92n66mxc5jjm38k1llj2

Remarks:
During the test phase the scope of the track elements to be taken into account was reduced to the turnout and its components i.e., rail, sleeper, fastener. This was because the testing of the alignment schema took much more time than expected.
One other handicap which complicated the test phase was the fact, that the provided datasets where not directly usable 1:1 by the software vendors. They had to be pre-processed in order to be used in the modelling process.

4 Appendices

4.1 Storyline Documentation

- Please use the following link for the storyline documentation
- https://app.box.com/s/i5t6w2firbagiy1zlnnucsmj26dooh5c

4.2 Turnout checking rules

The document can be found on storyline documentation

- https://app.box.com/s/i5t6w2firbagiy1zlnnucsmj26dooh5c