Virtual Reconstruction class hierarchy, aligned with portions from CIDOC CRM class hierarchies

E1 CRM Entity
E2 - Temporal Entity
E5 - - - Event
E7 - - - - Activity
E13 - - - - - Attribute Assignement
E17 - - - - - - Type Assignement
S5 - - - - - - - Inference Making
V18 - - - - - - - - Transparency Inference Making
V19 - - - - - - - - - Uncertainty Evaluation
V20 - - - - - - - - - Accuracy Evaluation
V25 - - - - - - - - - Evaluation of Dimension Provenance
E77 - Persistent Item
V1 - - Domain
E70 - - Thing
E72 - - - Legal Object
E90 - - - - Symbolic Object
E41 - - - - - Appellation
E42 - - - - - - Identifier
V7 - - - - - - - Hierarchy Identifier
V9 - - - - - - - Version Identifier
V13 - - - - - - - Order of Sequence Identifier
E71 - - - Man-Made Thing
E24 - - - - Physical Man-Made Thing
V3 - - - - - Cultural Heritage
V4 - - - - - - Find
E28 - - - - Conceptual Object
E90 - - - - - Symbolic Object
E73 - - - - - - Information Object
V17 - - - - - - - Source
E31 - - - - - - - - Document
V11 - - - - - - - Geometrical Representation
V14 - - - - - - - - Profile
V15 - - - - - - - - Path
V16 - - - - - - - Morphological Representation
D1 - - - - - - - - Digital Object
V8 - - - - - - - - - 3D Object
V6 - - - - - - - - - 3D Find
E89 - - - - - Propositional Object
V2 - - - - - - Immaterial Heritage
V5 - - - - - - Component Element
V12 - - - - - - Primitive Entity
E55 - - - - - Type
V21 - - - - - - Uncertainty Grade
V22 - - - - - - Accuracy Grade
V24 - - - - - - Type of Dimension Provenance
E39 - - Actor
E21 - - - Person
V10 - - - - Author
E54 - Dimension
V23 - - Dimension Equivalent

Virtual Reconstruction properties

ID P.	*Property Name*	*Domain*	*Range*
VP1	has domain (is domain of)	V2	V1
VP2	has domain (is domain of)	V3	V1
VP3	has type (is type of)	V2	E55
VP4	has type (is type of)	V3	E55
VP5	is identified by (identifies)	V2	E42
VP6	is identified by (identifies)	V3	E42
VP7	has evidence on (is evidence of)	V4	V3
VP8	is identified by (identifies)	V4	E42
VP9	has digital representation (digitally represents)	V4	V3
VP10	has component (is component of)	V2	V4
VP11	has component (is component of)	V3	V4
VP12	ihas component (is component of)	V5	V5
VP13	is hierarchically identified (hierarchically identifies)	V5	V7
VP14	is identified by (identifies)	V5	E42
VP15	has digital representation (is digitally represented)	V5	V8
VP16	used as derivation source	V6	V8
VP17	has version identifier (is version identifier of)	V8	V9
VP18	is authored	V9	V10
VP19	is authored	V8	V10
VP20	carried out by (performed)	V19	V10
VP21	carried out by (performed)	V20	V10
VP22	assigned (was assigned by)	V19	V21
VP23	assigned (was assigned by)	V20	V22
VP24	assigned uncertainty to	V19	V8
VP25	assigned accuracy to	V20	V8
VP26	assigned uncertainty to	V19	V17
VP27	assigned accuracy to	V20	V17
VP28	has morphological representation (morphologically represents)	V8	V16
VP29	has morphological representation (morphologically represents)	V11	V16
VP30	has geometrical representation (geometrically represents)	V8	V11
VP31	has dimension (is dimension of)	V8	E54
VP32	is identified by on (identifies)	V8	E42
VP33	has reference on (is reference of)	V11	V17
VP34	has reference on (is reference of)	V16	V17
VP35	has evidence on (is evidence of)	V11	V17
VP36	has evidence on (is evidence of)	V16	V17
VP37	has component (is component of)	V11	V14
VP38	has component (is component of)	V11	V15
VP39	has component (is component of)	V14	V12
VP40	has evidence on (is evidence of)	V16	V6
VP41	is identified by (identifies)	V12	E42
VP42	has sequence identifier (is sequence identifier of)	V12	V13
VP43	has dimension (is dimension of)	V14	E54
VP44	has dimension (is dimension of)	V14	E60
VP45	has number of primitive entities	V15	E60
VP46	has number of primitive entities	V15	E54
VP47	has type (is type of)	V17	V6
VP48	is identified by (identifies)	V17	E42
VP49	has type (is type of)	V17	E55
VP50	is interpreted from	E55	V17
VP51	is deducted from	E55	V17
VP52	is indicated on (indicates)	E55	V17
VP53	has dimension equivalent (is equivalent dimension of)	E54	V23
VP54	has unit (is unit of)	V23	E58
VP55	has value (is value of)	V23	E60
VP56	has type (is type of)	E54	V24
VP57	assigned (was assigned by)	V25	V24
VP58	has type (is type of)	V17	V16
VP59	has type (is type of)	V17	E55
VP60	has reference on (is reference of)	V2	V17
VP61	has reference on (is reference of)	V3	V17
VP62	has component (is component of)	V15	V12

Virtual Reconstruction property hierarchy, aligned with portions from CIDOC CRM property hierarchies

ID p.	*Property Name*	*Entity-Domain*	*Entity-Range*
VP1	has domain	V2 Immaterial Heritage	V1 Domain
VP2	has domain	V3 Cultural Heritage	V1 Domain
VP18	is authored	V9 Version Identifier	V10 Author
VP19	is authored	V8 3D Object	V10 Author
P1	is identified by (identifies)	E1 CRM Entity	E41 Appellation
VP5	- is identified by (identifies)	V2 Immaterial Heritage	E42 Identifier
VP6	- is identified by (identifies)	V3 Cultural Heritage	E42 Identifier
VP8	- is identified by (identifies)	V4 Find	E42 Identifier
VP13	- is hierarchically identified (hierarchically identifies)	V5 Component Element	V7 Hierarchy Identifier
VP14	- is identified by (identifies)	V5 Component Element	E42 Identifier
VP32	- is identified by on (identifies)	V8 3D Object	E42 Identifier
VP41	- is identified by (identifies)	V12 Primitive Entity	E42 Identifier
VP42	- has sequence identifier (is sequence identifier of)	V12 Primitive Entity	V13 Order of Sequence Identifier
VP48	- is identified by (identifies)	V17 Source	E42 Identifier
P2	has type (is type of)	E1 CRM Entity	E55 Type
VP3	- has type (is type of)	V2 Immaterial Heritage	E55 Type
VP4	- has type (is type of)	V3 Cultural Heritage	E55 Type
VP47	- has type (is type of)	V17 Source	V6 3D Find
VP49	- has type (is type of)	V17 Source	E55 Type
VP56	- has type (is type of)	E54 Dimension	V24 Type of Dimension Provenance
VP58	- has type (is type of)	V17 Source	V16 Morphological Representation
VP59	- has type (is type of)	V17 Source	E55 Type
P12	occurred in the presence of (was present at)	E5 Event	E77 Persistent Item
P11	- had participant (participated in)	E5 Event	E39 Actor
P14	- - carried out by (performed)	E7 Activity	E39 Actor
VP20	- - - carried out by (performed)	V19 Uncertainty Evaluation	V10 Author
VP21	- - - carried out by (performed)	V20 Accuracy Evaluation	V10 Author
P43	has dimension (is dimension of)	E70 Thing	E54 Dimension
VP31	- has dimension (is dimension of)	V8 3D Object	E54 Dimension
VP43	- has dimension (is dimension of)	V14 Profile	E54 Dimension
VP44	- has dimension (is dimension of)	V15 Path	E54 Dimension
VP53	- has dimension equivalent (is equivalent dimension of)	E54 Dimension	V23 Dimension Equivalent
P57	has number of parts	E19 Physical Object	E60 Number
VP45	- has number of primitive entities	V14 Profile	E60 Number
VP46	- has number of primitive entities	V15 Path	E60 Number
P67	refers to (is reffered to by)	E89 Propositional Object	E1 CRM Entity
P70	- documents (is documented in)	E31 Document	E1 CRM Entity
VP7	- - has evidence on (is evidence of)	V4 Find	V3 Cultural Heritage
VP33	- - has reference on (is reference of)	V11 Geometrical Representation	V17 Source
VP34	- - has reference on (is reference of)	V16 Morphological Representation	V17 Source
VP35	- - has evidence on (is evidence of)	V11 Geometrical Representation	V17 Source
VP36	- - has evidence on (is evidence of)	V16 Morphological Representation	V17 Source
VP40	- - has evidence on (is evidence of)	V16 Morphological Representation	V6 3D Find
VP50	- - - is interpreted from	E54 Dimension	V17 Source
VP51	- - - is deducted from	E54 Dimension	V17 Source
VP52	- - - is indicated on (indicates)	E54 Dimension	V17 Source
VP60	- - has reference on (is reference of)	V2 Immaterial Heritage	V17 Source
VP61	- - has reference on (is reference of)	V3 Cultural Heritage	V17 Source
P90	has value	E54 Dimension	E60 Number
VP55	- has value (is value of)	V23 Dimension Equivalent	E60 Number
P91	has unit	E54 Dimension	E58 Measurement Unit
VP54	- has unit (is unit of)	V23 Dimension Equivalent	E58 Measurement Unit
P138	represents (has representation)	E36 Visual Item	E1 CRM Identity
VP9	- has digital representation (digitally represents)	V4 Find	V3 Cultural Heritage
VP15	- has digital representation (is digitally represented)	V5 Component Element	V8 3D Object
VP28	- has morphological representation (morphologically represents)	V8 3D Object	V16 Morphological Representation
VP29	- has morphological representation (morphologically represents)	V11 Geometrical Representation	V16 Morphological Representation

VP30	- has geometrical representation (geometrically represents)	V8 3D Object	V11 Geometrical Representation
P139	has alternativa form	E41 Appellation	E41 Appellation
VP17	- has version identifier (is version identifier of)	V8 3D Object	V9 Version Identifier
P140	assigned attribute to (was attributed by)	E13 Attribute Assignement	E1 CRM Entity
VP24	- assigned uncertainty to	V19 Uncertainty Evaluation	V8 3D Object
VP25	- assigned accuracy to	V20 Accuracy Evaluation	V8 3D Object
VP26	- assigned uncertainty to	V19 Uncertainty Evaluation	V17 Source
VP27	- assigned accuracy to	V20 Accuracy Evaluation	V17 Source
P141	assigned (was assigned by)	E13 Attribute Assignement	E1 CRM Entity
VP22	assigned (was assigned by)	V19 Uncertainty Evaluation	V21 Uncertainty Grade
VP23	assigned (was assigned by)	V20 Accuracy Evaluation	V22 Accuracy Grade
VP57	assigned (was assigned by)	V25 Evaluation of Dimension Provenance	V24 Type of Dimension Provenance
P148	has component (is component of)	E89 Propositional Object	E89 Propositional Object
VP10	- has component (is component of)	V2 Immaterial Heritage	V4 Find
VP11	- has component (is component of)	V3 Cultural Heritage	V4 Find
VP12	- has component (is component of)	V5 Component Element	V5 Component Element
VP37	- has component (is component of)	V11 Geometrical Representation	V14 Profile
VP38	- has component (is component of)	V11 Geometrical Representation	V15 Path
VP39	- has component (is component of)	V14 Profile	V12 Primitive Entity
VP62	- has component (is component of)	V15 Path	V12 Primitive Entity
L21	used as derivation source (was derivation source for)	D3 Formal Derivation	D1 Digital Object
VP16	- used as derivation source	V6 3D Find	V8 3D Object

Virtual Reconstruction Class Declarations

V1 Domain

Subclass of:	E77 Persistent Item
Scope note:	This class includes all entities attributable to cultural heritage. Defines an area of interest or an area of which the object of reconstruction process is part of. Heritage includes buildings and historic places, monuments, artifacts, etc., including objects significant to the archaeology, architecture, science or technology of a specific culture.
Examples	Painting, Architecture

V2 Immaterial Heritage

Subclass of:	E89 Propositional Object
Scope note:	This class comprises immaterial heritage that are documented in some way by any kind of source and that can be virtually reproduced.
Example	The background scene (V2) in “La flagellazione di cristo” The Doric Order (V2) in “I quattro libri dell’Architettura)
Properties:	VP1 has domain: V1 Domain
	VP3 has type (is type of): E55 Type
	VP5 is identified by (identifies): E42 Identifier
	VP10 has component (is component of): V4 Find
	VP60 has reference on (is reference of): V17 Source

V3 Cultural Heritage

Subclass of:	E24 Man-Made Thing
Superclass of:	V4 Find
Scope note:	Cultural heritage includes buildings and historic places, monuments, artifacts, etc., including objects significant to the archaeology, architecture, science or technology of a specific culture that had a certain or documented physical existance.
Properties:	VP2 has domain: V1 Domain
	VP4 has type (is type of): E55 Type
	VP6 is identified by (identifies): E42 Identifier
	VP11 has component (is component of): V4 Find
	VP61 has reference on (is reference of): V17 Source

V4 Find

Subclass of:	V3 Cultural Heritage
Scope note:	This class comprises physical evidence of the Heritage object that can be virtually reconstructed by SFM process (D2) or other methods.
Example	archeological evidences fragment of a ceramic plate
Properties:	VP7 has evidence on (is evidence of): V3 Cultural Heritage
	VP8 is identified by (identifies): E42 Identifier
	VP9 has digital representation (digitally represents): V3 Cultural Heritage

V5 Component Element

Subclass of:	E89 Propositional Object
Scope note:	This class comprises instances that are considered functional units for the whole object, accordind with the declared domain. It comprise V5 component elements that are themselves instances of V5 components elements. The V5 component element could be further analyzed into sub-components creating a hierarchy of part decomposition that is declared by V7 Hierarchy Identifier.
Properties:	VP12 has component (is component of): V5 Component Element
	VP13 is hierarchically identified (hierarchically identifies): V7 Hierarchy Identifier
	VP14 is identified by (identifies): E42 Identifier
	VP15 has digital representation (is digitally represented): V8 3D Object

V6 3D Find

Subclass of:	D1 Digital Object
Scope note:	This class comprise the immaterial representation of V4 Find that are represented as a 3D model obtained by a D2 Digitization process.
Properties:	VP16 used as derivation source: V8 3D Object

V7 Hierarchy Identifier

Subclass of:	E42 Identifier
Scope note:	This class comprise the level of hierachical aggregation of the component in relation with the whole element. Depending on the domain, its classifications and its controlled vocabulary the sub-elements that compose the artifact could variate creating a hierarchy of part decomposition that is declared by V7 Hierarchy Identifier.

V8 3D Object

Subclass of:	D1 Digital Object
Scope note:	Three-dimensional (3D) models represent an artefact, using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. A 3D digital object define the volume of the object that represent. In heritage virtual reconstructions is preferred the use of solid models that are usually built with constructive solid geometry.
Properties:	VP17 has version identifier (is version identifier of): V9 Version Identifier
	VP19 is authored: V10 Author
	VP28 has morphological representation (morphologically represents): V16 Morphological Representation
	VP30 has geometrical representation (geometrically represents): V11 Geometrical Representation
	VP31 has dimension (is dimension of): E54 Dimension
	VP32 is identified by on (identifies): E42 Identifier

V9 Version Identifier

Subclass of:	E42 Identifier
Scope note:	This class comprise an identifier that declare the E42 Identifier assigned to each 3D modelled version of the same V8 3D Object based on different evidence/reference.
Properties:	VP18 is authored: V10 Author

V10 Author

Subclass of:	E21 person
Scope note:	This class comprise instances of V10 author of the version of the 3D model of a V5 Component Element.

V11 Geometrical Representation

Subclass of:	E73 Information Object
Scope note:	The class comprise the visual knowledge about the geometrical representation of a V5 Component Element.
Properties:	VP29 has morphological representation (morphologically represents): Morphological Representation
	VP33 has reference on (is reference of): V17 Source
	VP35 has evidence on (is evidence of): V17 Source
	VP37 has component (is component of): V14 Profile
	VP38 has component (is component of): V15 Path

V12 Primitive Entity

Subclass of:	E89 Propositional Object
Scope note:	The class comprise the geometrical item that can be assumed as a geometrical primitive necessary for the construction of V14 Profile and V15 Path.
Properties:	VP41 is identified by (identifies): E42 Identifier
	VP42 has sequence identifier (is sequence identifier of): V13 Order of Sequence Identifier

V13 Order of Sequence Identifier

Subclass of:	E42 Identifier
Scope note:	The class comprise an identifier that declare the E42 Identifier assigned to the V12 Primitive Entity and its position in the geometrical sequence of primitive elements that create V14 profile or V15 Path.

V14 Profile

Subclass of:	V11 Geometrical Representation
Scope note:	The class comprise the geometrical representation of the physical features of a profile in the vertical plane containing both endpoints of the profile. The profile could be intended as a vertical section of the V11 Geometrical Representation
Properties:	VP39 has component (is component of): V12 Primitive Entity
	VP43 has dimension (is dimension of): E54 Dimension
	VP45 has number of primitive entities: E60 Number

V15Path

Subclass of:	V11 Geometrical Representation
Scope note:	The class comprise the geometrical representation of the physical features of a path in the horizontal plane containing both endpoints of the path.
Properties:	VP44 has dimension (is dimension of): E54 Dimension
	VP46 has number of primitive entities: E60 Number
	VP62 has component (is component of): V12 Primitive Entity

V16 Morphological Representation

Subclass of:	E73 Information Object
Scope note:	The class comprise immaterial items related to knoledge about the morphological representation of a V5 component element.
Properties:	VP34 has reference on (is reference of): V17 Source
	VP36: has evidence on (is evidence of): V17 Source
	VP40 has evidence on (is evidence of): V6 3D Find

V17 Source

Subclass of:	E73 Information Object
Superclass of:	E31 Document
Scope note:	This class comprise instances of V17 Sources and E31 Documents used in the Virtual Reconstruction process as evidence of reference of 3D modelling.
Properties:	VP47 has type (is type of): V6 3D Find
	VP48 is identified by (identifies): E42 Identifier
	VP49 has type (is type of): E55 Type
	VP58 has type (is type of): V16 Morphological Representation
	VP59 has type (is type of): E55 Type

V18 Trasparency Inference Making

Subclass of:	S5 Inference Making
Superclass of:	V19 Uncertainty Evaluation; V20 Accuracy Evaluation; V25 Evaluation of Dimension Provenance
Scope note:	This class comprises the action of making propositions and statements about particular geometrical or morphological representations of an V4 Find, its possible virtual representations (V6 3D Find), V17 sources and 3D objects. It includes evaluations and interpretations based on sources available for 3D reconstructions with the aim to fill the gap between documentation and 3D model obtained from them..

V19 Uncertainty Evaluation

Subclass of:	V18 Trasparency Inference Making
Scope note:	This class comprises the action of make propositions on data observable from a V17 Source or E31 Document by making evaluations based on the V21 Uncertainty Grade of informations on morphological and geometrical representations of the Cultural Heritage or Immaterial Heritage that we want to digitally reproduce.
Properties:	VP20 carried out by (performed): V10 Author
	VP22 assigned (was assigned by): V21 Uncertainty Grade
	VP24 assigned uncertainty to: V8 3D Object
	VP26 assigned uncertainty to: V17 Source

V20 Accuracy Evaluation

Subclass of:	V18 Trasparency Inference Making
Scope note:	This class comprises the action of make propositions on data observable from a V17 Source or E31 Document by making evaluations based on the V22 Accuracy Grade of informations on morphological and geometrical representations of the Cultural Heritage or Immaterial Heritage that it is possible to digitally reproduce.
Properties:	VP21 carried out by (performed): V10 Author
	VP23 assigned (was assigned by): V22 Accuracy Grade
	VP25 assigned accuracy to: V8 3D Object
	VP27 assigned accuracy to: V17 Source

V21 Uncertainty Grade

Subclass of:	E55 Type
Scope note:	This class comprise instances of V21 Unvcertainty Grade that could be assigned to a V17 Source.

V22 Accuracy Grade

Subclass of:	E55 Type
Scope note:	This class comprise instances of V22 Accuracy Grade that could be assigned to a V17 Source.

V23 Dimension Equivalent

Subclass of:	E54 Dimension
Scope note:	This class comprises equivalent value that can be attribute to an E54 Dimension according with the modelling software used. The 3D modelling software usually does not use the same E54 Dimension values and units indicated on a V17 source or E31 Document available.
Properties:	VP54 has unit (is unit of): E58 Measurement Unit
	VP55 has value (is value of): E60 Number

V24 Type of dimension provenance

Subclass of:	E55 Type
Scope note:	This class comprises Type of Dimensions in relation withw their reference V17 Sources or E31 Documents. In Virtual Reconstruction Processes are defined ony three enumerated Types of Dimension Provenance: Indicated, Deducted, Interpreted.

V25 Evaluation of Dimension Provenance

Subclass of:	V18 Trasparency Inference Making
Scope note:	This class comprises the action of make propositions about Dimension Provenance: connecting the E45 Dimension and its values with a V17 Source or E31 Document used for the Virtual Recontruction.
Properties:	VP57 assigned (was assigned by): V24 Type of Dimension Provenance

E54 referred to CIDOC-CRM Class

E54 Dimension

Subclass of:	E1 CRM Entity
Scope note:	This class comprises quantifiable properties that can be measured by some calibrated means and can be approximated by values, i.e. points or regions in a mathematical or conceptual space, such as natural or real numbers, RGB values etc. An instance of E54 Dimension represents the true quantity, independent from its numerical approximation, e.g. in inches or in cm. The properties of the class E54 Dimension allow for expressing the numerical approximation of the values of an instance of E54 Dimension. If the true values belong to a non-discrete space, such as spatial distances, it is recommended to record them as approximations by intervals or regions of indeterminacy enclosing the assumed true values. For instance, a length of 5 cm may be recorded as 4.5-5.5 cm, according to the precision of the respective observation. Note, that interoperability of values described in different units depends critically on the representation as value regions. Numerical approximations in archaic instances of E58 Measurement Unit used in historical records should be preserved. Equivalents corresponding to current knowledge should be recorded as additional instances of E54 Dimension as appropriate.
Properties:	P90 has value : E60 Number,
	P91 has unit (is unit of) : E58 Measurement Unit
	VP50 is interpreted from: V17 Source
	VP51 is deducted from: V17 Source
	VP52 is indicated on (indicates): V17 Source
	VP53 has dimension equivalent (is equivalent dimension of): V23 Dimension Equivalent
	VP56 has type (is type of): V24 Type of Dimension Provenance

Mapping Classes of "Architecture" Domain into CRMvr draft proposal Classes

CRMvr Classes		*"Architecture" Domain Classes*
V1 Domain	.....	Architecture
V2 Immaterial Heritage	.....	Immaterial Architecture
V3 Cultural Heritage	.....	Built Architecture
V4 Find	.....	Find
V5 Component Element	.....	Architectural Element
V6 3D Find	.....	3D Find
V7 Hierarchy Identifier	.....	Level of Element
V8 3D Object	.....	3D model of architectural element
V9 Version Identifier	.....	Version of 3D model
V10 Author	.....	Author
V11 Geometrical Representation	.....	Geometrical Representation
V12 Primitive Entity	.....	Geometrical Atom (GA)
V13 Order of Sequence Identifier	.....	Sequence Identifier
V14 Profile	.....	Profile
V15 Path	.....	Path
V16 Morphological Representation	.....	Morphological Representation
V17 Source	.....	Reference Source
V18 Trasparency Inference Making	.....	
V19 Uncertainty Evaluation	.....	
V20 Accuracy Evaluation	.....	
V21 Uncertainty Grade	.....	Level of Uncertainty (LoU)
V22 Accuracy Grade	.....	Level of Accuracy (LoA)
V23 Dimension Equivalent	.....	Dimension Equivalent
V24 Type of Dimension Provenance	.....	Type of Dimension Provenance
V25 Evaluation of Dimension Provenance	.....	