IEEE P1484.12.4™/D1
Draft Recommended Practice for Expressing IEEE Learning Object Metadata Instances Using the Dublin Core Abstract Model

Prepared by the Learning Object Metadata Working Group of the

Learning Technology Standards Committee

Abstract: This Recommended Practice describes how to construct IEEE Learning Object Metadata instances using the Dublin Core Abstract Model.
Keywords: Dublin Core, learning object, learning object metadata (LOM), metadata.

Introduction

(This introduction is not part of IEEE P1484.12.4/D1 Draft Recommended Practice for Expressing IEEE Learning Object Metadata Instances Using the Dublin Core Abstract Model .)

There is an increasing demand for interoperable definitions of Dublin Core Metadata Initiative (DCMI) metadata terms and IEEE Learning Object Metadata (LOM) data elements which allow these to be used together in metadata instances.

This Recommended Practice addresses this requirement by describing how to use IEEE LOM metadata in Dublin Core metadata instances.

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Participants

At the time this draft Recommended Practice was completed, the Learning Object Metadata Working Group had the following membership:

<Chair Name>, *Chair*

<Vice-chair Name>, *Vice-chair*

Participant1	Participant4	Participant7
Participant2	Participant5	Participant8
Participant3	Participant6	Participant9

The following members of the balloting committee voted on this Recommended Practice. Balloters may have voted for approval, disapproval, or abstention.

(to be supplied by IEEE)

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Draft Recommended Practice for Expressing IEEE Learning Object Metadata Instances Using the Dublin Core Abstract Model

Overview

Scope

This Recommended Practice describes how to construct IEEE Standard for Learning Object Metadata (LOM) (IEEE Std 1484.12.1-2002) instances using the Dublin Core Abstract Model (DCAM). It describes how to use the definitions of metadata terms defined by the IEEE Standard for Resource Description Framework (RDF) Vocabulary for IEEE Learning Object Metadata (LOM) Data Elements (IEEE Std 1484.12.5-2009) together with DCMI metadata terms for expressing IEEE LOM conforming instances as DCAM description sets. This Recommended Practice does not address the issue of expressing DCAM description sets or DCMI metadata terms using LOM data elements.

Purpose

There is an increasing demand for interoperable definitions of Dublin Core Metadata Initiative (DCMI) metadata terms and IEEE Learning Object Metadata (LOM) data elements which allow these to be used together in metadata instances. This Recommended Practice addresses this requirement by describing how to use the definitions of metadata terms defined by the IEEE Standard for Resource Description Framework (RDF) Vocabulary for IEEE Learning Object Metadata (LOM) Data Elements (IEEE Std 1484.12.x-200x) and DCMI metadata terms together in Dublin Core metadata instances. This represents a partial and short-term solution to the overall issue of metadata interoperability in learning, education, and training contexts. The Recommended Practice also aims to inform the longer-term process of trying to align the abstract models of IEEE LOM and DCAM, as it will provide an analysis of fundamental incompatibilities between the two models.

References

IEEE LOM

W3C RDF

RFC 3986 (URI)

Dublin Core Abstract Model

Dublin Core Metadata Terms

DC-TEXT syntax

IEEE Standard for Resource Description Framework (RDF) Vocabulary for IEEE Learning Object Metadata (LOM) Data Elements (IEEE Std 1484.12.5-2009)

Definitions

LOM element occurrence – occurrence of a LOM data element within a LOM metadata instance

LOM metadata instance – a set of LOM data elements conforming to IEEE Std 1484.12.1-2002 (LOM)

Requirements and completeness

This Recommended Practice describes how to express a *strictly comforming* LOM metadata instance using a metadata instance conforming to the DCMI Abstract Model. Strict conformance is defined in IEEE 1484.12.1-2002 (LOM) as metadata instances that "consist solely of LOM data elements".

Therefore, this Recommended Practice does not specify how to map extensions to the LOM data model. LOM instances that are not strictly conforming can be partially mapped by first reducing them to a strictly conforming instance through removal of non-LOM elements.

All data values of LOM elements can be mapped, with two exceptions:

– LOM element 7.1 Relation.Kind, where the mapping has requirements that are not always fulfilled for vocabularies with a Source other than "LOMv1.0".

– LOM category 5 Educational, where only a single instance of the category is supported by the mapping.

In some cases, the ordering of data elements is lost in the translation. See section ZZZ.

Structure of the generated metadata instance

For each LOM element, Section XXXX contains a description of how an occurrence of the element should be expressed in a DCAM conforming metadata instance. The DC-TEXT format is used as a representation of the resulting metadata instance.

The generated metadata instance contains a DCAM *description set* describing two principal resources: the described learning object, denoted *LO* in Section XXXX, and the metadata record, denoted *MD*. In addition, other resources are introduced as required to represent the values of LOM data elements. For example, each occurrence of LOM category 8 Annotation is represented as a description of a distinct resource, described by a distinct set of statements.

NOTE – the DCMI produces specifications for expressing DCAM-compatible metadata using XML, RDF, and HTML/ XHTML.

Procedure for expressing a LOM metadata instance

A LOM metadata instance should be expressed using a DC-TEXT instance as follows:

1. First, the namespace declarations, as described in Section XXXX are added.

2. Then, for each occurrence of a LOM element:

   2.a The LOM element occurrence is expressed using the table in Section XXXX. The result is appended to the DC-TEXT instance

   2.b Step 2 is repeated for each occurrence of a sub-element. In this step, contextual information about how the enclosing elements were mapped may be needed.

The resulting document is a valid DC-TEXT instance.

Note − there are many ways to restructure the DC-TEXT instance in order to simplify the structure without affecting the interpretation of the DC-TEXT instance.

Namespace abbreviations

Throughout Section XXXXX, URI abbreviations are used for *property* URIs, *syntax encoding scheme* URIs and *vocabulary encoding scheme* URIs. A URI abbreviation is of the form

prefix:localName

To expand an abbreviation of the above form to a full URI, the string "*prefix:*" is replaced with the corresponding namespace URI, according to the following table:

Prefix	Namespace URI	Description
lom	http://ltsc.ieee.org/rdf/lomv1p0/terms#	The LOM terms namespace
lomvoc	http://ltsc.ieee.org/rdf/lomv1p0/vocab#	The LOMv1.0 vocabulary namespace
dcterms	http://purl.org/dc/terms/	The DCMI terms namespace
xsd:	http://www.w3.org/2001/XMLSchema#	XML Schema datatypes namespace.

This corresponds to the following header in the target DC-TEXT document:

```
@prefix lom:     http://ltsc.ieee.org/rdf/lomv1p0/terms# .
@prefix lomvoc:  http://ltsc.ieee.org/rdf/lomv1p0/vocab# .
@prefix dcterms: http://purl.org/dc/terms/ .
@prefix xsd:     http://www.w3.org/2001/XMLSchema# .
```

Note − as the chosen prefix does not affect the interpretation of DC-TEXT instances, an application may use other prefixes for the namespaces, as long as the resulting URIs are correct.

Columns in the translation table

"LOM element" column

Each entry in this column lists a LOM element that will be mapped.

"DC-TEXT representation" column

This column describes how the LOM element should be expressed using the DC-TEXT format. An entry in this column is a DC-TEXT fragment. The fragment represents one or more DCAM *descriptions*.

For certain LOM elements, the content of this column is "N/A", meaning that the element should not be mapped to any DCAM metadata. The sub-elements should still be mapped to DCAM metadata.

The content of this column uses certain conventions, listed below.

Conventions for ValueId

The DC-TEXT component **ValueId** is used to assign an identifier to the value resource of a DCAM statement, so that the same resource can be referenced within a separate DCAM description. It has no direct interpretation in terms of the DCAM, and the identifier is local to the current DC-TEXT document.

When a **ValueId** component is generated, a identifier that is unique within the target DC-TEXT instance should be generated. The identifier is then used in the translation of the element or its sub-elements.

Conventions for ResourceId

The DC-TEXT component **ResourceId** is used to distinguish descriptions of distinct resources within the same DC-TEXT document. It has no direct interpretation in terms of the DCAM. Within this standard, **ResourceID** is one of the following:

1. *LO* - the described resource is the learning object.
2. *MD* - the described resource is the metadata instance
3. in all other cases, the resource is one introduced by the **ValueId** component, either within the mapping of the element or of an enclosing LOM element. See the section on **ValueId** above.

Conventions for complex LOM values

Some LOM element has a value of a complex type, such as **LangStrings**, **DateTimes** and **Durations**. The contents of such data values need to be referenced in the translation. The contents of complex values are referenced as follows:

– A **LangString** is referenced as a set of pairs of the form (***String, Language***), where ***String*** is a character string and ***Language*** is a language tag.

– A **DateTime** is referenced as a pair of the form (***Date, Description***), where ***Date*** is a formatted date string and ***Description*** is a LangString

– A **Duration** is referenced as a pair of the form (***Duration, Description***), where ***Duration*** is a formatted duration string and ***Description*** is a LangString

– A **Vocabulary** is referenced as a pair of the form (***VocSource, VocValue***), where ***VocSource*** and ***VocValue*** are character strings.

Conventions for LOM vocabulary values

Many LOM elements use values of type **Vocabulary**. Whenever possible, a URI identifying the vocabulary value should be used. Annex ZZZZ lists URIs for all vocabulary terms defined in the LOM standard.

If there is no known URI identifying the value (typically, when using an external vocabulary with no known URIs), an alternative representation may be used.

– Replace

```
            ValueURI ( VocURI )

with

            ValueID ( VocID )
```

where *VocID* is a locally unique identifier.

– If the **Vocabulary** value is (*VocSource, VocValue*), add the following DC-TEXT fragment:

```
            Description (
              ResourceId ( VocID )
              Statement (
                PropertyURI ( lom:source )
                LiteralValueString ( VocSource )
              )
              Statement (
                PropertyURI ( lom:value )
                LiteralValueString ( VocValue )
              )
            )
```

This convention cannot be used for LOM element 7.1 Relation.Kind.

"Multiplicity" column

When the LOM element has "Size" equal to 1, this column has the content "-".

When the LOM element has "Size" other than "1", this column describes how repeated elements are represented. "Repeated Statements" means that the Statement component in the DC-TEXT fragment should be repeated for each occurrence of the LOM element.

The translation table

LOM element	DC-TEXT representation	Multiplicity	Notes
1. General	`N/A`	-	

1.1 Identifier	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( lom:identifier )`
	`    ValueId ( ID )`
	`  )`
	`)`
		Repeated statements	The resource *ID* is further described in a separate Description

1.1.1 Catalog	`Description (`
	`  ResourceId ( ID )`
	`  Statement (`
	`    PropertyURI ( lom:catalog )`
	`    LiteralValueString ( "Value" )`
	`  )`
	`)`
		-	*ID* is the resource identified in the representation of the parent **1.1 Identifier** LOM element.
			
			Value is a CharacterString.

1.1.2 Entry	`Description (`
	`  ResourceId ( ID )`
	`  Statement (`
	`    PropertyURI ( lom:entry )`
	`    LiteralValueString ( "Value" )`
	`  )`
	`)`
		-	*ID* is the resource identified in the representation of the parent **1.1 Identifier** LOM element.
			
			Value is a CharacterString.

1.2 Title	`For each (String, Language) pair in Value,`
	
	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( dcterms:title )`
	`    LiteralValueString ( "String"`
	`      Language ( Language ) )`
	`  )`
	`)`
		-	*Value* is a LangString.

1.3 Language	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( dcterms:language )`
	`    ValueString ( "Value"`
	`      SyntaxEncodingSchemeURI ( dcterms:RFC4646 )`
	`  )`
	`)`
		Repeated statements	*Value* is a language code according to RFC 1766.

LOM element	DC-TEXT representation	Multiplicity	Notes

1.4 Description	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( dcterms:description )`
	`    ValueString ( String`$_1$
	`      Language ( Language`$_1$` ) )`
	
	`[...]`
	
	`    ValueString ( String`$_n$
	`        Language ( Language`$_n$` ) )`
	`  )`
	`)`
		Repeated statements	*Value* is a LangString.

1.5 Keyword	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( lom:keyword )`
	`    ValueString ( String`$_1$
	`      Language ( Language`$_1$` ) )`
	
	`[...]`
	
	`    ValueString ( String`$_n$
	`        Language ( Language`$_n$` ) )`
	`  )`
	`)`
		Repeated statements	*Value* is a LangString.

1.6 Coverage	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	`Description (`
	`  ResourceId ( LO )`
	`  Statement (`
	`    PropertyURI ( dcterms:coverage )`
	`    ValueString ( String`$_1$
	`      Language ( Language`$_1$` ) )`
	
	`[...]`
	
	`    ValueString ( String`$_n$
	`        Language ( Language`$_n$` ) )`
	`  )`
	`)`
		Repeated statements	*Value* is a LangString.

LOM element	DC-TEXT representation	Multiplicity	Notes

1.7 Structure	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:structure)
	    ValueURI (**VocURI**)
	  )
	)
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

1.8 Aggregation level	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:aggregationLevel)
	    ValueURI (**VocURI**)
	  )
	)
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

2 Lifecycle	N/A	-	

2.1 Version	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:version)
	    ValueString (**String$_1$**
	      Language (**Language$_1$**))
	
	[...]
	
	    ValueString (**String$_n$**
	       Language (**Language$_n$**))
	  )
	)
		-	*Value* is a LangString.

2.2 Status	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:status)
	    ValueURI (**VocURI**)
	  )
	)
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

LOM element	DC-TEXT representation	Multiplicity	Notes

2.3 Contribute	<pre>Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:contribution)
	    ValueId (*CN*)
	  )
	)</pre>
		Repeated statements	The resource *CN* is further described in a separate Description
			
			Ordering is not preserved.

2.3.1 Role	<pre>If **VocURI** is a URI identifying **Value,**
	
	Description (
	  ResourceId (*CN*)
	  Statement (
	    PropertyURI (lom:role)
	    ValueURI (**VocURI**)
	  )
	)</pre>
		-	*CN* is the resource identified in the representation of the parent **2.3 Contribute** LOM element.
			
			Value is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

2.3.2 Entity	<pre>Description (
	  ResourceId (*CN*)
	  Statement (
	    PropertyURI (lom:entity)
	    LiteralValueString (**"Value"**
	      SyntaxEncodingSchemeURI (lom:VCard)
	  )
	)</pre>
		Repeated statements	*CN* is the resource identified in the representation of the parent **2.3 Contribute** LOM element.
			
			Value is a VCARD.
			
			Ordering is not preserved.

LOM element	DC-TEXT representation	Multiplicity	Notes

2.3.3 Date	`If ` **`Value`** ` = (` **`Date, Description`** `), and the LangString ` **`Description`** ` contains the pairs (` **`String₁, Language₁`** `) to (` **`Stringₙ, Languageₙ`** `), then`
	
	`Description (`
	`  ResourceId ( ` *`CN`* ` )`
	`  Statement (`
	`    PropertyURI ( dcterms:date )`
	`    LiteralValueString ( "` **`Date`** `"`
	`      SyntaxEncodingSchemeURI ( dcterms:W3CDTF ) )`
	`  )`
	`  Statement (`
	`    PropertyURI ( dcterms:date )`
	`    LiteralValueString ( "` **`String₁`** `"`
	`      Language ( ` **`Language₁`** ` ) )`
	`  )`
	
	`[...]`
	
	`  Statement (`
	`    PropertyURI ( dcterms:date )`
	`    LiteralValueString ( "` **`Stringₙ`** `"`
	`      Language ( ` **`Languageₙ`** ` ) )`
	`  )`
	`)`
		-	*CN* is the resource identified in the representation of the parent **2.3 Contribute** LOM element.
			
			Value is a DateTime.

3 Metametadata	`N/A`	-	All elements in category **3 Metametadata** apply to the metadata resource *MD*, not to the learning object

3.1 Identifier	`As ` **`1.1 Identifier,`** ` but with`
	
	`  ResourceId ( ` *`MD`* ` )`
		Repeated statements	

3.2 Contribute	`As ` **`2.3 Contribute,`** ` but with`
	
	`  ResourceId ( ` *`MD`* ` )`
		Repeated statements	For the **3.2.1 Role** element, not all LOM vocabulary values are applicable.
			
			Ordering is not preserved.

3.3 Metadata Scheme	`If ` **`VocURI`** ` is a URI identifying ` **`Value`** `,`
	
	`Description (`
	`  ResourceId ( ` *`MD`* ` )`
	`  Statement (`
	`    PropertyURI ( lom:metadataScheme )`
	`    ValueURI ( ` **`VocURI`** ` )`
	`  )`
	`)`
		Repeated statements	***Value*** is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying ***Value***, the representation in Section ZZZ may be used.

LOM element	DC-TEXT representation	Multiplicity	Notes
3.4 Language	As **1.3 Language,** but with ResourceId (*MD*)	-	The LOM definition of this element states that the value of this element is used to specify a default value for all language elements in a metadata record. Depending on this behavior in Dublin Core metadata can lead to interoperability issues, and is not recommended. Instead, all language elements should be populated where appropriate.
4 Technical	N/A	-	

4.1 Format	`Description (`
	  `ResourceId ( LO )`
	  `Statement (`
	    `PropertyURI ( dcterms:format )`
	    `VocabularyEncodingSchemeURI ( dcterms:IMT )`
	    `ValueString ( `***Value***` )`
	  `)`
	`)`
		Repeated statements	***Value*** is a MIME type.
			
			If ***Value*** = "non-digital", no Vocabulary Encoding Scheme should be given, as this is not a valid MIME type.

4.2 Size	`Description (`
	  `ResourceId ( LO )`
	  `Statement (`
	    `ValueId ( EX )`
	    `PropertyURI ( dcterms:extent )`
	    `ValueString ( `***Value***
	      `SyntaxEncodingSchemeURI ( xsd:positiveInteger ) )`
	  `)`
	`)`
	
	`Description (`
	  `ResourceId ( EX )`
	  `Statement (`
	    `PropertyURI ( rdf:type )`
	    `ValueURI ( lom:Size ) )`
	  `)`
	`)`
		-	***Value*** is a positive integer.

4.3 Location	`Description (`
	  `ResourceId ( LO )`
	  `Statement (`
	    `PropertyURI ( lom:location )`
	    `ValueString ( `***Value***
	      `SyntaxEncodingSchemeURI ( xsd:anyURI ) )`
	  `)`
	`)`
		Repeated statements	***Value*** is a URI.
			
			Ordering is not preserved.

LOM element	DC-TEXT representation	Multiplicity	Notes
4.4 Requirement	```Description (ResourceId (LO) Statement (ValueId (RQ) PropertyURI (lom:requirement)))```	Repeated statements	The resource *RQ* is further described in a separate Description
4.4.1 OrComposite	```Description (ResourceId (RQ) Statement (ValueId (AltRQ) PropertyURI (lom:alternativeRequirement)))```	Repeated statements	*RQ* is the resource identified in the representation of the parent **4.4 Requirement** LOM element. The resource Alt*RQ* is further described in a separate Description
4.4.1.1 Type	```If VocURI is a URI identifying Value, Description (ResourceId (AltRQ) Statement (PropertyURI (rdf:type) ValueURI (VocURI)))```	-	*AltRQ* is the resource identified in the representation of the parent **4.4.1 OrComposite** LOM element. *Value* is a Vocabulary. Section AAA provides URIs for all vocabularies defined by the LOM standard. If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.
4.4.1.2 Name	```If VocURI is a URI identifying Value, Description (ResourceId (AltRQ) Statement (PropertyURI (lom:technology) ValueURI (VocURI)))```	-	*AltRQ* is the resource identified in the representation of the parent **4.4.1OrComposite** LOM element. *Value* is a Vocabulary. Section AAA provides URIs for all vocabularies defined by the LOM standard. If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.
4.4.1.3 Minimum version	```Description (ResourceId (AltRQ) Statement (PropertyURI (lom:minimumVersion) LiteralValueString (Value)))```	-	*AltRQ* is the resource identified in the representation of the parent **4.4.1OrComposite** LOM element. *Value* is a version string.

LOM element	DC-TEXT representation	Multiplicity	Notes
| **4.4.1.4 Maximum version** | ```
Description (
  ResourceId ( AltRQ )
  Statement (
    PropertyURI ( lom:maximumVersion )
    LiteralValueString ( Value )
  )
)
``` | - | *AltRQ* is the resource identified in the representation of the parent **4.4.1OrComposite** LOM element.<br><br>*Value* is a version string. |
| **4.5 Installation Remarks** | If **Value** contains the pairs (**String₁**, **Language₁**) to (**Stringₙ**, **Languageₙ**), then<br><br>```
Description (
  ResourceId ( LO )
  Statement (
    PropertyURI ( lom:installationRemarks )
    ValueString ( String₁
      Language ( Language₁ ) )

[...]

    ValueString ( Stringₙ
        Language ( Languageₙ ) )
  )
)
``` | - | *Value* is a LangString. |
| **4.6 Other Platform Requirements** | If **Value** contains the pairs (**String₁**, **Language₁**) to (**Stringₙ**, **Languageₙ**), then<br><br>```
Description (
  ResourceId ( LO )
  Statement (
    PropertyURI ( lom:otherPlatformRequirements )
    ValueString ( String₁
      Language ( Language₁ ) )

[...]

    ValueString ( Stringₙ
        Language ( Languageₙ ) )
  )
)
``` | - | *Value* is a LangString. |

LOM element	DC-TEXT representation	Multiplicity	Notes

4.7 Duration	If **Value** = (**Duration**, **Description**), and the LangString **Description** contains the pairs (**String₁**, **Language₁**) to (**Stringₙ**, **Languageₙ**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (dcterms:extent)
	    ValueString (*"Duration"*
	      SyntaxEncodingSchemeURI (xsd:duration)
	
	    ValueString (*"String₁"*
	      Language (*Language₁*))
	
	[...]
	
	    ValueString (*"Stringₙ"*
	      Language (*Languageₙ*))
	  )
	)
		-	***Value*** is a Duration.

5 Educational	N/A	-	Multiple instances of this category are not supported.

5.1 Interactivity Type	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:interactivityType)
	    ValueURI (*VocURI*)
	  )
	)
		-	***Value*** is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying ***Value***, the representation in Section ZZZ may be used.

5.2 Learning Resource Type	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (rdf:type)
	    ValueURI (*VocURI*)
	  )
	)
		Repeated statements	***Value*** is a Vocabulary.
			
			Ordering is not preserved.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying ***Value***, the representation in Section ZZZ may be used.

LOM element	DC-TEXT representation	Multiplicity	Notes

5.3 Interactivity Level	```If VocURI is a URI identifying Value,
	
	Description (
	  ResourceId (LO)
	  Statement (
	    PropertyURI (lom:interactivityLevel)
	    ValueURI (VocURI)
	  )
	)```
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

5.4 Semantic Density	```If VocURI is a URI identifying Value,
	
	Description (
	  ResourceId (LO)
	  Statement (
	    PropertyURI (lom:semanticDensity)
	    ValueURI (VocURI)
	  )
	)```
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

5.5 Intended End User Role	```If VocURI is a URI identifying Value,
	
	Description (
	  ResourceId (LO)
	  Statement (
	    PropertyURI (dcterms:audience)
	    ValueURI (VocURI)
	  )
	)```
		Repeated statements	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

5.6 Context	```If VocURI is a URI identifying Value,
	
	Description (
	  ResourceId (LO)
	  Statement (
	    PropertyURI (lom:context)
	    ValueURI (VocURI)
	  )
	)```
		Repeated statements	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

LOM element	DC-TEXT representation	Multiplicity	Notes

5.7 Typical Age Range	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:typicalAgeRange)
	    ValueString (**String$_1$**
	      Language (**Language$_1$**))
	
	[...]
	
	    ValueString (**String$_n$**
	       Language (**Language$_n$**))
	  )
	)
		Repeated statements	

5.8 Difficulty	If **VocURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:difficulty)
	    ValueURI (**VocURI**)
	  )
	)
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.

5.9 Typical Learning Time	If **Value** = (**Duration**, **Description**), and the LangString **Description** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:typicalLearningTime)
	    ValueString (**"Duration"**
	      SyntaxEncodingSchemeURI (xsd:duration)
	
	    ValueString (**String$_1$**
	      Language (**Language$_1$**))
	
	[...]
	
	    ValueString (**String$_n$**
	       Language (**Language$_n$**))
	  )
	)
		-	*Value* is a Duration.

LOM element	DC-TEXT representation	Multiplicity	Notes

5.10 Description	If **Value** contains the pairs (**String$_1$**, **Language$_1$**) to (**String$_n$**, **Language$_n$**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:educationalDescription)
	    ValueString (**String$_1$**
	      Language (**Language$_1$**))
	
	[...]
	
	    ValueString (**String$_n$**
	       Language (**Language$_n$**))
	  )
	)
		Repeated Properties	*Value* is a LangString.

5.11 Language	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:educationalLanguage)
	    ValueString ("**Value**"
	      SyntaxEncodingSchemeURI (dcterms:RFC4646)
	  )
	)
		Repeated properties	*Value* is a language code according to RFC 1766.

6 Rights	N/A	-	

6.1 Cost	With **Cost = "true"** if **Value** = (*LOMv1.0, yes*), and **Cost = "false"** if **Value** = (*LOMv1.0*, no),
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:cost)
	    LiteralValueString (**Cost**
	      SyntaxEncodingSchemeURI (xsd:boolean)
	  )
	)
		-	*Value* is either (*LOMv1.0, yes*), or (*LOMv1.0, no*),

LOM element	DC-TEXT representation	Multiplicity	Notes

6.2 Copyright and Other Restrictions	With **CoR = "true"** if **Value** = (*LOMv1.0, yes*), and **CoR = "false"** if **Value** = (*LOMv1.0*, no),
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (lom:copyrightAndOtherRestrictions)
	    LiteralValueString (**CoR**
	      SyntaxEncodingSchemeURI (xsd:boolean)
	  )
	)
		-	*Value* is either (*LOMv1.0, yes*), or (*LOMv1.0, no*),

6.3 Description	If **Value** contains the pairs (**String₁**, **Language₁**) to (**Stringₙ**, **Languageₙ**), then
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (dcterms:rights)
	    ValueString (**String₁**
	      Language (**Language₁**))
	
	[...]
	
	    ValueString (**Stringₙ**
	      Language (**Languageₙ**))
	  )
	)
		-	*Value* is a LangString.

7 Relation	See 7.1 Kind	Repeated statements in the expression of 7.1 Kind,	

7.1 Kind	If **RelURI** is a URI identifying **Value**,
	
	Description (
	  ResourceId (*LO*)
	  Statement (
	    PropertyURI (**RelURI**)
	    ValueId (*RES*)
	  )
	)
		-	*Value* is a Vocabulary.
			
			Section AAA provides URIs for all vocabularies defined by the LOM standard.
			
			If there is no known URI identifying *Value*, the element cannot be represented.
			
			RES is the related learning object, described in a separate Description.

7.2 Resource	N/A	-	

LOM element	DC-TEXT representation	Multiplicity	Notes
7.2.1 Identifier	As **1.1 Identifier,** but with ResourceId (*RES*)	-	*RES* is the resource identified in the representation of the corresponding **7.1 Kind** LOM element.
7.2.2 Description	As **1.4 Description,** but with ResourceId (*RES*)	-	*RES* is the resource identified in the representation of the corresponding **7.1 Kind** LOM element.

8 Annotation	```Description (
	  ResourceId (LO)
	  Statement (
	    PropertyURI (lom:annotation)
	    ValueId (AN)
	  )
	)```
		Repeated statements	The resource *AN* is further described in a separate Description

8.1 Entity	```Description (
	  ResourceId (AN)
	  Statement (
	    PropertyURI (lom:entity)
	    LiteralValueString ("Value"
	      SyntaxEncodingSchemeURI (lom:VCard)
	  )
	)```
		-	*AN* is the resource identified in the representation of the parent **8 Annotation** LOM element.
			
			Value is a VCARD.

8.2 Date	If ***Value*** = (***Date, Description***), and the LangString ***Description*** contains the pairs (***String₁, Language₁***) to (***Stringₙ, Languageₙ***), then
	
	``Description (
	  ResourceId (AN)
	  Statement (
	    PropertyURI (dcterms:date)
	    LiteralValueString ("Date"
	      SyntaxEncodingSchemeURI (dcterms:W3CDTF))
	  )
	  Statement (
	    PropertyURI (dcterms:date)
	    LiteralValueString ("String₁"
	      Language (Language₁))
	  )
	
	[...]
	
	  Statement (
	    PropertyURI (dcterms:date)
	    LiteralValueString ("Stringₙ"
	      Language (Languageₙ))
	  )
	)```
		-	*AN* is the resource identified in the representation of the parent **8 Annotation** LOM element.
			
			Value is a DateTime.

LOM element	DC-TEXT representation	Multiplicity	Notes
8.3 Description	As **1.4 Description,** but with ResourceId (*AN*)	-	*AN* is the resource identified in the representation of the parent **8 Annotation** LOM element.
9 Classification	```Description (ResourceId (LO) Statement (PropertyURI (lom:classification) ValueId (CLN)))```	Repeated statements	The resource *CLN* is further described in a separate Description
9.1 Purpose	```If VocURI is a URI identifying Value, Description (ResourceId (CLN) Statement (PropertyURI (lom:purpose) ValueURI (VocURI)))```	-	*CLN* is the resource identified in the representation of the parent **9 Classification** LOM element. *Value* is a Vocabulary. Section AAA provides URIs for all vocabularies defined by the LOM standard. If there is no known URI identifying *Value*, the representation in Section ZZZ may be used.
9.2 TaxonPath	```Description (ResourceId (CLN) Statement (PropertyURI (lom:taxonPath) ValueId (TXP)))```	Repeated statements	*CLN* is the resource identified in the representation of the parent **9 Classification** LOM element. The resource *TXP* is further described in a separate Description
9.2.1 Source	```If Value contains the pairs (String1, Language1) to (Stringn, Languagen), then Description (ResourceId (TXP) Statement (PropertyURI (lom:taxonSource) ValueString (String1 Language (Language1)) [...] ValueString (Stringn Language (Languagen))))```	-	*TXP* is the resource identified in the representation of the parent **9.2 TaxonPath** LOM element. *Value* is a LangString.

LOM element	DC-TEXT representation	Multiplicity	Notes

9.2.2 Taxon	If **Value** contains the taxons **Taxon₁ ... Taxonₙ,**
	
	`Description (`
	`  ResourceId ( `*`TXP`*` )`
	`  Statement (`
	`    PropertyURI ( rdf:_1 )`
	`    ValueId ( `*`TN₁`*` )`
	`  )`
	
	`[...]`
	
	`  Statement (`
	`    PropertyURI ( rdf:_n )`
	`    ValueId ( `*`TNₙ`*` )`
	`  )`
	`)`
		Repeated statements	*TXP* is the resource identified in the representation of the parent **9.2 TaxonPath** LOM element.
			
			The resources *TN₁ ... TNₙ* are further described in a separate Description

9.2.2.1 Id	`Description (`
	`  ResourceId ( `*`TN`*` )`
	`  Statement (`
	`    PropertyURI ( dcterms:identifier )`
	`    LiteralValueString ( `*`"Value"`*` )`
	`  )`
	`)`
		-	*TN* is the resource identified in the representation of the parent **9.2.2 Taxon** LOM element.

9.2.2.2 Entry	`Description (`
	`  ResourceId ( `*`TN`*` )`
	`  Statement (`
	`    PropertyURI ( rdfs:label )`
	`    LiteralValueString ( `*`"Value"`*` )`
	`  )`
	`)`
		-	*TN* is the resource identified in the representation of the parent **9.2 Taxon** LOM element.

9.3 Description	As **1.4 Description,** but with `  ResourceId ( `*`CLN`*` )`	-	*CLN* is the resource identified in the representation of the parent **9 Classification** LOM element.
9.4 Keyword	As **1.5 Keyword,** but with `  ResourceId ( `*`CLN`*` )`	Repeated Properties	*CLN* is the resource identified in the representation of the parent **9 Classification** LOM element. Ordering is not preserved.

Annex A

(normative)

URIs for LOM vocabulary terms

LOM element 1.7 Structure

Value	URI
atomic	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Structure-atomic
collection	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Structure-collection
networked	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Structure-networked
hierarchical	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Structure-hierarchical
linear	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Structure-linear

LOM element 1.8 Aggregation Level

Value	URI
1	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#AggregationLevel-1
2	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#AggregationLevel-2
3	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#AggregationLevel-3
4	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#AggregationLevel-4

LOM element 2.2 Status

Value	URI
draft	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Status-draft
final	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Status-final
revised	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Status-revised
unavailable	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Status-unavailable

LOM element 2.3.1 Role and 3.2.1 Role

NOTE – Only "creator" and "validator" may be used with LOM element 3.2.1 Role

Value	URI
author	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-author
publisher	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-publisher
unknown	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-unknown
initiator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-initiator
terminator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-terminator
validator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-validator
editor	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-editor
graphical designer	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-graphicalDesigner
technical implementer	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-technicalImplementer
content provider	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-contentProvider
technical validator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-technicalValidator
educational validator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-educationalValidator
script writer	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-scriptWriter
instructional designer	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-instructionalDesigner
subject matter expert	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Role-subjectMatterExpert

LOM element 3.3 Metadata Scheme

Value	URI
LOMv1.0	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#MetadataScheme-LOMv1.0

LOM element 4.4.1.1 Type

Value	URI
operating system	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#RequirementType-operatingSystem
browser	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#RequirementType-browser

LOM element 4.4.1.2 Name

Operating System Technology

Value	URI
pc-dos	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-pc-dos
ms-windows	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-ms-windows
macos	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-macos
unix	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-unix
multi-os	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-multi-os
none	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#OperatingSystemTechnology-none

Browser Technology

Value	URI
any	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#BrowserTechnology-any
netscape communicator	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#BrowserTechnology-netscapeCommunicator
ms-internet explorer	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#BrowserTechnology-ms-internetExplorer
opera	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#BrowserTechnology-opera
amaya	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#BrowserTechnology-amaya

LOM element 5.1 Interactivity Type

Value	URI
active	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityType-active
expositive	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityType-expositive
mixed	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityType-mixed

LOM element 5.2 Learning Resource Type

Value	URI
exercise	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-exercise
simulation	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-simulation
questionnaire	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-questionnaire
diagram	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-diagram
figure	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-figure
graph	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-graph
index	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-index
slide	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-slide
table	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-table
narrative text	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-narrativeText
exam	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-exam
experiment	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-experiment
problem statement	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-problemStatement
self assessment	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-selfAssessment
lecture	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#LearningResourceType-lecture

LOM element 5.3 Interactivity Level

Value	URI
very low	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityLevel-veryLow
low	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityLevel-low
medium	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityLevel-medium
high	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityLevel-high

| very high | http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#InteractivityLevel-veryHigh |

LOM element 5.4 Semantic Density

Value	URI
very low	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#SemanticDensity-veryLow
low	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#SemanticDensity-low
medium	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#SemanticDensity-medium
high	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#SemanticDensity-high
very high	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#SemanticDensity-veryHigh

LOM element 5.5 Intended End User Role

Value	URI
teacher	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#IntendedEndUserRole-teacher
author	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#IntendedEndUserRole-author
learner	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#IntendedEndUserRole-learner
manager	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#IntendedEndUserRole-manager

LOM element 5.6 Context

Value	URI
school	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Context-school
higher education	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Context-higherEducation
training	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Context-training
other	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Context-other

LOM element 5.8 Difficulty

Value	URI
very easy	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Difficulty-veryEasy
easy	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Difficulty-easy
medium	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Difficulty-medium
difficult	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Difficulty-difficult
very difficult	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Difficulty-veryDifficult

LOM element 7.1 Kind

Value	URI
ispartof	http://purl.org/dc/terms/isPartOf
haspart	http://purl.org/dc/terms/hasPart
isversionof	http://purl.org/dc/terms/isVersionOf
hasversion	http://purl.org/dc/terms/hasVersion
isformatof	http://purl.org/dc/terms/isFormatOf
hasformat	http://purl.org/dc/terms/hasFormat
references	http://purl.org/dc/terms/references
isreferencedby	http://purl.org/dc/terms/isReferencedBy
isbasedon	http://purl.org/dc/terms/source
isbasisfor	http://ltsc.ieee.org/rdf/lomv1p0/terms#isBasisFor
requires	http://purl.org/dc/terms/requires
isrequiredby	http://purl.org/dc/terms/isRequiredBy

LOM element 9.1 Purpose

Value	URI
discipline	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-discipline
idea	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-idea
prerequisite	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-prerequisite
educationalObjective	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-educationalObjective
accessibility restrictions	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-accessibilityRestrictions
educationalLevel	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-educationalLevel
skillLevel	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-skillLevel
securityLevel	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-securityLevel
competency	http://ltsc.ieee.org/rdf/lomv1p0/vocabulary#Purpose-competency