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## Course Open Data Standards

**A project for the London LSIP funded by the Department for Education**

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## Executive Summary

Cetis have created a logical data model that supports the London Local Skills Improvement Plan (LSIP) process by allowing the provision of relevant data about Courses and the Qualifications they lead to and linking this data to relevant Occupations and Industries.

This logical data model can be expressed in four different ways:

1. The data model as-is, in JSON without reference to any external data standard.
2. The data mapped to a UK standard for course related information (XCRI) in XML.
3. The data mapped to a generic global data standard, Schema.org, in JSON-LD.
4. The data mapped to a specialised data standard for Qualification, CTDL, in JSON-LD.

The first is the simplest but offers least potential for wider use of the data as it is not standards-based. Our preference is towards the fourth option, however this comes with some requirements for creating, maintaining and providing certain web assets, detailed in [section 10](#). If option 4 is not possible, option 1 offers a way forward and the mappings described in this report would allow translation of the data to standards compliant formats in the future.

In reading this report, unless you are requiring the depth of technical detail that is presented in tables and code examples, you may wish to focus on sections 1-4, the high-level overviews in section 5, and then skip to sections 8,9 & 10.

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## 1. What the standard needs to accomplish

From discussions with stakeholders so far, there is a need to join up data on the supply of training and education with demand in the labour market in the London area and probably nationally.

From the education and skills training side, we can adopt a standard that can capture the supply of courses and qualifications and provide an articulation to the demand side in the form of related occupational outcomes.

Data from the demand side is out of scope for this strand of work, but we are assuming that at some point we can connect this data to a source of demand data (e.g. based on existing data sources such as Working Futures, the Vacancies Survey, and related government and devolved authority datasets) and [drawing on the experience of Rocket Science](#).

As set out in 'The case for change' in the project [Terms of Reference](#) the intended use of data conforming to the standard includes, but isn't limited to, (a) dashboards and analytics to inform

decision-making, for example at a college, borough or regional level that link course 'supply' with forecast labour market 'demand' and (b) services, such as course search portals, that aim to connect people to education and training opportunities that are connected with local labour market demand.

## 2. Overview of the approach

We present options for a data standard to support future iterations of the London Local Skills Improvement Plan (LSIP) that are based on a logical data model informed by several existing standards (XCRI-CAP, Schema.Org, and CDTL), prior work by Rocket Science on requirements and taking into account the availability of data from various sources.

This report presents the following interdependent parts.

**A Logical data model.** This defines the data structure and its properties at a semantic level, based on the requirements for this project, in terms of what the data means and how it is used rather than on a technical interchange level. We can consider this to be the "native schema" for the project; it does not conform directly to any standard data model but represents the data needed for the project.

In defining the logical data model we referred to known sector standards, identifier schemes, and sources of open data in order to facilitate collection of data (see [section 3](#)). We also referred to XCRI-CAP, Schema.org and CDTL, three data standards relevant to the project (see [section 4](#)), in order to facilitate mapping the data to those standards.

**Mappings to standards.** We map the logical data model to each of XCRI-CAP, Schema.org and CDTL, three data standards relevant to the project, indicating where those standards do not have the capability to express the data we require, and indicating how these gaps may be filled.

Depending on precise functional requirements and the preferences and capabilities of data providers, which are not yet fully known, it will be possible to create profiles of the data model and express data conforming to these profiles through the mappings. By profile we mean (1) information about what information is required, recommended and optional, and rules relating to permitted values; and (2) details about which properties from which standards should be used to express the data.

We have included some aspects of the profile, for example specifying the use of DfE qualification identifiers, UKPRNs for providers, UK SOC 2020. Also as no one standard is a perfect fit for the data requirements, a profile would be based on one standard and supplemented by terms from others. There may be more than one profile, for example one based on XCRI supplemented mostly with terms from schema.org and another based on schema.org supplemented with terms from CDTL.

These profiles may be expressed in ways that allow data validation, but the format will depend on the choice of standard.

**Bindings and implementation guidance.** Using example data we show how the data can be expressed in particular syntaxes used for each of the standards to which we have mapped: XML for XCRI, JSON-LD for Schema.org and CTDL.

We provide schemas and examples for systems to produce and consume data conforming to the profile, for example using XML or JSON.

We don't want to place an undue technical burden on the FE sector and its vendor community, so we also provide a minimal data collection template for Excel and CSV as one example of a way of collecting data. This can help 'bootstrap' adoption, while waiting on vendors to implement them in systems, or for central teams to write custom reporting templates. Once data can be shared automatically in a standard format, the need to create examples by hand will diminish.

Because large amounts of data are already collected, quality assured, and published at a national level, we can use common identifiers provided in the data collection template to 'enrich' minimal data with existing datasets, rather than collect the same data multiple times (with more scope for errors).

**Code examples.** We provide, as an appendix, example code for enriching the minimal template data with public open data, and exporting to a full JSON or XML representation, that could be used by suppliers of systems used by colleges, or by organisations building services to connect skills and jobs.

We also look at methods for managing common data mappings that support the use of a standard, for example Qualification to SOC, see [section 8](#).

### 3. Overview of data sources

**Course directory from ESFA (Educations and Skills Funding Agency).** This is the course directory that contains information on courses offered by learning providers who are contracted with the Education and Skills Funding Agency. Data downloads are provided monthly of all current courses (<https://www.gov.uk/government/publications/sfa-course-directory>). This contains the course identifier, name, description, level, subject, and the learning aim reference that links it to LARS. This data powers the national careers service course finder (<https://nationalcareers.service.gov.uk/find-a-course>)

**Further education and skills open data published by OfSted.** Provides statistical data about participation, achievement and other measures (<https://explore-education-statistics.service.gov.uk/find-statistics/further-education-and-skills#explore-data-and-files>). Unfortunately this is only available at subject, local authority or provider level, and not by qualification reference.

**LAD (Local authority districts)** is a classification of UK administrative areas provided by the Office of National Statistics, consisting of a code of one letter and 8 digits, and a district name. See <https://geoportal.statistics.gov.uk/datasets/ons::local-authority-districts-december-2022-names-and-codes-in-the-united-kingdom/explore>.

**LARS (Learning aim reference service)** is a service managed by ESFA (Education and Skills Funding Agency) that holds information about qualifications/learning aims. Each qualification has a unique learning aim code (typically eight digits, sometimes with trailing letter code), and information about NVQ-equivalent level, learning hours, awarding body, and subject (using SSA1 and SSA2). LARS data can be searched online (<https://submit-learner-data.service.gov.uk/find-a-learning-aim/>); a significant amount can also be downloaded directly as open data (<https://submit-learner-data.service.gov.uk/find-a-learning-aim/DownloadData>) - although the data downloads omit foundation degrees (codes starting 002/003)

**UKRLP (UK Register of Learning Providers)** is the source of data on all registered UK learning providers. It holds the UKPRN (UK Provider Reference Number) used as a common identifier for providers, plus address and other details.

**CASCOT (Computer Assisted Structured Coding Tool)** is a computer program designed to make the coding of text information to standard classifications simpler, quicker and more reliable, which may be useful in identifying SOC codes from course or qualification descriptions. <https://warwick.ac.uk/fac/soc/ier/software/cascot/>

## 4. Overview of the standards

**XCRI (eXchanging Course Related Information)** is a relatively lightweight standard developed around 2005-2009 to facilitate the provision of data about educational courses. It has been used, for example, to provide collated prospectus information. XCRI is compatible with the European Standard **Metadata for Learning Opportunities (MLO)**. For more information see <https://xcri.prospects.ac.uk>.

**Schema.org** is "a collaborative, community activity with a mission to create, maintain, and promote schemas for structured data on the Internet."<sup>1</sup> It is widely used by several large search engines, email providers and many other smaller organizations. Its main purpose is to make it easier to find information and act on the information that is found. Its scope is very wide: anything that can be described on a webpage or email, however it is broken down into schemas for smaller entity types, such as Courses, Educational Occupational Credentials (i.e. Qualifications) and Job postings. The development of the Course schema was informed by XCRI. For more details see <https://schema.org/Course>, <https://schema.org/EducationalOccupationalCredential>.

**CTDL (Credential Transparency Description Language)** is a large, detailed and consequently relatively complex standard for describing Credentials (i.e. qualifications) and many related entities such as skills, assessments, learning opportunities (Courses and Programs), education providers, tasks, occupations, educational and occupational pathways, aggregate outcomes such as employment prospects associated with earning a qualification. It draws largely on schema.org and in turn informed the development of Schema.org's description of Qualifications. For more

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<sup>1</sup> <https://schema.org/docs/about.html>

details see <https://credreg.net/ctdl/handbook>.

Also worth noting in passing, **JDX (Job Data Exchange)** is a relatively new standard covering jobs and employment generally (not just job postings), related to CTDL and Schema.org, see <https://www.uschamberfoundation.org/workforce-development/JDX>.

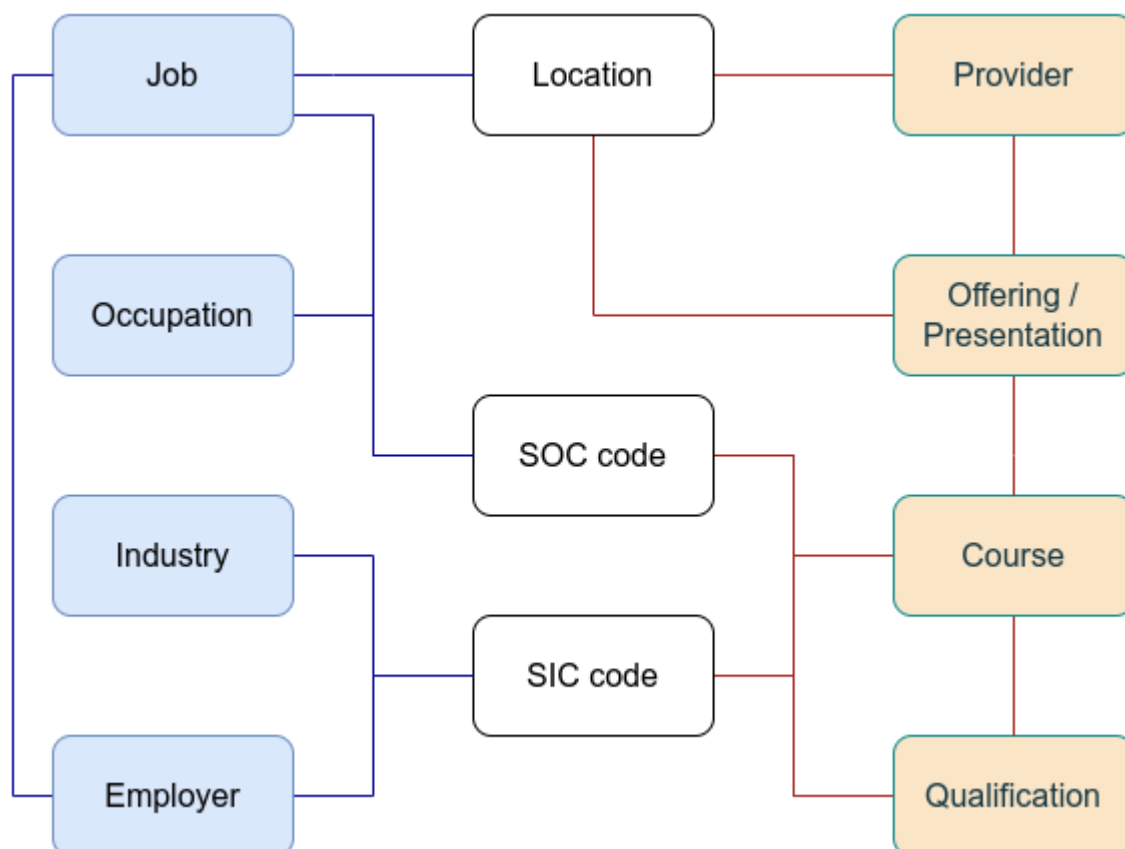
**SIC (Standard industrial classification of economic activities)** is the UK standard for coding the nature of a company's business. <https://www.gov.uk/government/publications/standard-industrial-classification-of-economic-activities-sic>

**SOC (The Standard Occupational Classification)** is a common classification of occupational information for the UK. Occupations can be classified at multiple levels; the standard hierarchy has four levels (i.e. four digits) but there are also extensions to another two digits. For example, 2134 is "Programmers and software development professionals" whereas 2134/01 is a game developer, and 2134/04 is a software developer.

<https://www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassification/soc>

## 5. Logical data model

The diagram below shows a high-level view of the entities and relationships relevant to the supply of training and education with demand in the labour market of any locality. The relationships between the entities are deliberately kept generic (not showing a direction or label) but will in most cases be obvious.



On the left hand side we show the main entities at play in employment. A **Job** is a position with an **Employer**, an **Occupation** is what a person does for their trade or profession regardless of who employs them. An **Occupation** may be associated with many classification codes, but the SOC code is the one we are interested in here.

On the right we show the main entities in the education and training arena. All terms will be defined later, but a **course** may be offered or presented repeatedly over the years and in various places as **Offerings**, by an education **Provider**; successful completion of a Course will lead to a **Qualification**.

In the middle we reflect that **Location** is a common and important factor linking Providers, Course Offerings, Employers and Jobs. We also reflect that **SIC** and **SOC** codes can be used to link the topic of Qualifications (especially vocational qualifications) to relevant industries and occupations respectively (and by implication Jobs and Employers).

The work reported here focuses on the education side, looking at how education providers can publish the data they already have and how that data can be linked to employment.

## 5.1 Comments

- We use Course as it is commonly understood in the sector to include all types of learning opportunity or educational programme, including relevant work based learning, apprenticeships etc.
- Both Courses and Qualifications are linked to SIC and SOC codes for them. Going forward we would hope that the codes would be provided on Qualifications, but when those are not available or are inaccurate the code on the course can act as a fall-back or override.
- We are currently exploring how best to find SOC and SIC codes to assign to the Qualifications. Ideally the creator of the Qualification would do this.

## 5.2 Detailed class-property model

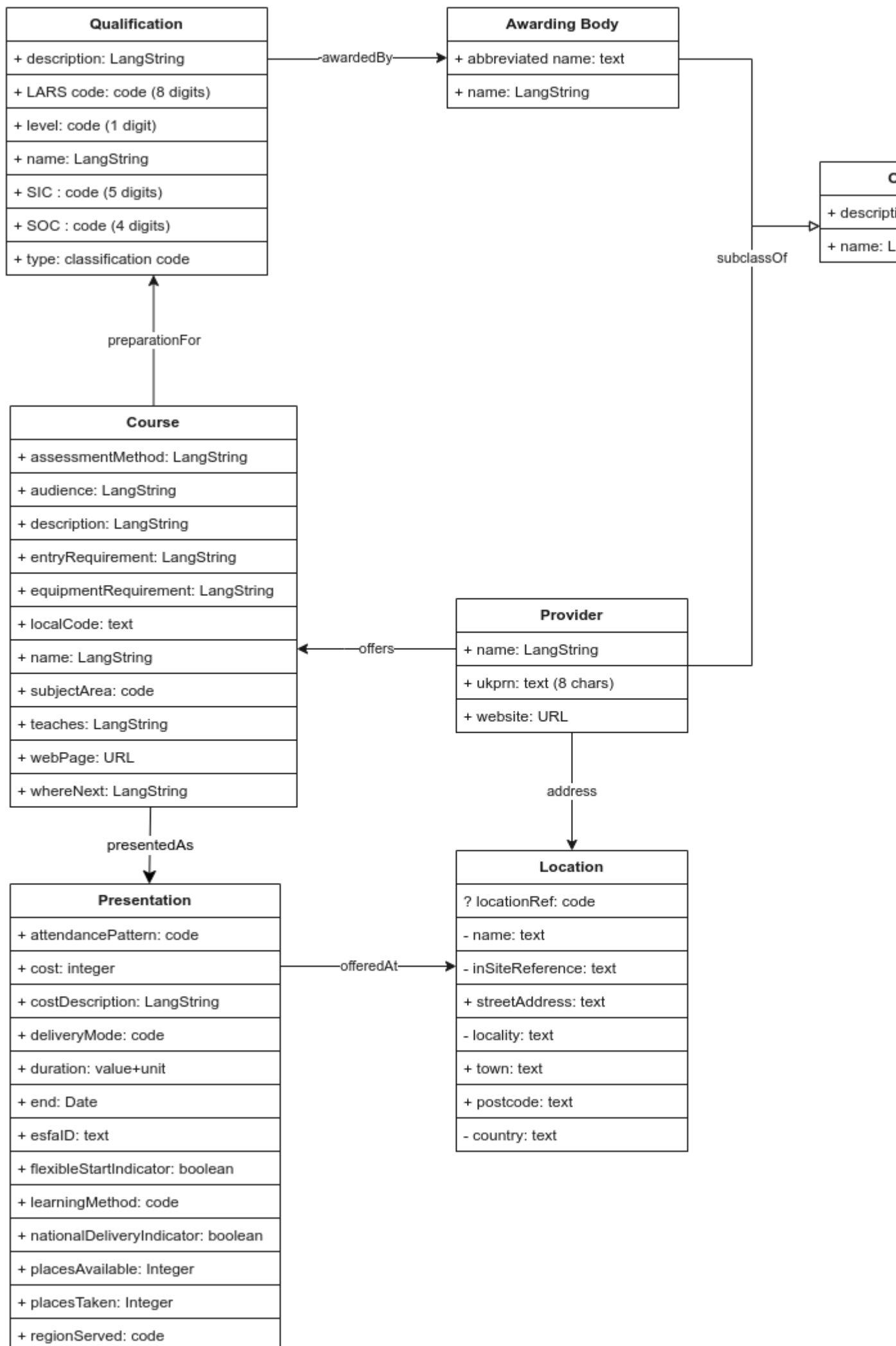
The diagram below shows the education part of the logical data model adding more detail about the properties that are used to describe the characteristics and relationships of the relevant entities<sup>2</sup>.

Several properties, notably identifier and classifier codes would be represented in data as compound objects comprising values for the code, a label, and the coding scheme; for simplicity these are not broken out in the diagram, but the datatype is shown in the tables below.

Much of the data would not need to be provided by colleges if they are able to provide the identifiers that would allow it to be obtained from relevant data sources. For example Provider information (including address) could be obtained by looking up the PRN in the UK Register of Learning Providers. See [section 7.4](#) for more details.

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<sup>2</sup> link to source: [https://app.diagrams.net/#G1y8-4-HcCUDcgAEQYm\\_bCUBiqTWm1IJWt](https://app.diagrams.net/#G1y8-4-HcCUDcgAEQYm_bCUBiqTWm1IJWt)





### 5.3 Class and Property Definitions

The definitions of the classes and properties are listed below. The definition of each class is given under the heading followed by a table listing the properties. For each property the name, definition and value data type are provided. A comment is provided where it helps to illustrate the definition. In order to keep the table width manageable, no human-readable labels are listed. Typically labels would be based on the property name in sentence case and with spaces inserted where the name concatenates several words, e.g. the property learningAimsCode would have the label "Learning aims code".

Currently no indication is provided about which properties are mandatory or what are acceptable string lengths as this would depend on details of who can provide what data and how, precisely, the data will be used; such details are not yet available. However the minimal data template in [section 7.4](#) shows how little data it may be necessary to collect from providers, assuming this can be used to obtain the rest.

Two value datatypes used in the tables need further explanation: LangString and codes values (class):

**LangString** is a language indicator using an [ISO 639-1 code](#) and a string to convey the content of the value; this allows for multilingual data. Example {"en": "This is an example."}

**Coded values** are used for Classification and Identification codes and comprise the coded value, the label for that value and the coding scheme used. Example {"code": "6133"; "label": "Dental nurses"; "scheme": "UKSOC2020"}. **Note:** there is sometimes no need to provide all three pieces of information, and potentially other data could be provided, e.g. a URL reference for the value or the scheme.

The [full schema spreadsheet](#) includes further details such as comments and potential sources for the data, the most important parts are tabulated below.

#### Qualification

**Definition:** A formal proof of successfully completed learning according to an agreed standard. [\[UNESCO\]](#)

Property	Definition	Comment	Value datatype
name	Full official name of the qualification using standard abbreviations if used in official documentation [XCRI]		LangString
description	General summary of the nature of the qualification [XCRI]		LangString
awardedBy	The awarding body that offers this qualification.		Awarding Body
learningAimsCode	The learning aims (LARS/QAN) code of the qualification.	Allows data look-up at <a href="#">LARS</a>	8 digit + optional 1 char

level	Information about the progression through an educational or training context represented by the qualification [XCRI]	Use levels from the RQF	classification code, label & scheme
sicCode	A valid five digit SIC code for an industry that the qualification is relevant to, and the specific version of SIC used.	Use codes from UK SIC	classification code, label & scheme
socCode	A valid four digit SOC code for an occupation that the qualification is relevant to, and the specific version of SOC used.	Use codes from UK SOC 2020	classification code, label & scheme
type	The category or type of qualification being described [from <a href="https://schema.org/">Schema.org</a> ]	A reference to sector-specific controlled vocabulary should be used.	classification code

## Course

**Definition:** Structured and unstructured learning and development opportunities based in direct experience, formal and informal study, observation, and involvement in discourse and practice. [[CTDL Learning Opportunity](#)]

Property	Definition	Comment	Value datatype
name	Name of the course [XCRI]		LangString
description	General summary of the course [XCRI]		LangString
assessmentMethod	The ways a learner will be assessed. [ESFA]	For example, workplace assessment, written assignments, exams, group or individual project work or portfolio of evidence.	
audience	Information that will help the learner decide whether this course is suitable for them, the learning experience and opportunities they can expect from the course. [ESFA]		
entryRequirement	Specific skills, licences, vocational or academic requirements. [ESFA]	For example, DBS, driving licence, computer knowledge, literacy or numeracy requirements	
equipmentRequired	What the learner will need to access or bring to the course. [ESFA]	For example, personal protective clothing, tools, devices or internet access.	

localCode	Identifier of the course used by the provider [based on <a href="http://schema.org">schema.org</a> ]		text
preparationFor	Qualification for which this course is preparation.		Qualification
presentedAs	Presentation of this course.		Presentation
subjectArea	Topic of the course [XCRI]	Use a value from the sector subject area classification	classification code, label & scheme
teaches	The main topics, units or modules of the course a learner can expect, include key features. [ESFA]	For example, communication, team leadership and time management.	LangString
webPage	The webpage for this course.		URL
whereNext	The further opportunities a learner can expect after successfully completing the course. [ESFA]	For example, a higher level course, apprenticeship or entry to employment.	LangString

## Presentation

**Definition:** Describes a particular presentation of a course. A presentation is a particular instance of the course offered at a particular time and place and is the entity to which learners apply. [XCRI]

Property	Definition	Comment	Value datatype
attendancePattern	Availability required in order to take part in the course.	One of Daytime, Evening Weekend, Day/Block Release	code
cost	The cost of the course to the learner [ESFA]	Currency GBP	integer
costDescription	A description of what the cost includes and additional costs to the learner. [ESFA]	For example, assessment, exam fees or study materials.	
deliveryMode	The means by which the course is presented.	one of: Classroom, Online, Work based	code
end	The date or time at which the presentation of a course finishes. [XCRI]	Quite often courses only have start dates.	
esfaID	Course run GUID used by ESFA to identify this presentation		
duration	The number of days, weeks, months or years the course runs for. [ESFA]		value & unit
flexibleStartIndi	Indicates whether there is a flexible		Boolean

cator	start date.		
learningMethod	The methods used to deliver the course. [ESFA]	For example, classroom based exercises, a work environment or online study materials.	
nationalDelivery Indicator	You can deliver the course anywhere in England and you will be shown as a national provider for this course. [ESFA]		Boolean
offeredAt	A location where a course is presented. [XCRI]		Location
placesAvailable	A textual description of the number of places available for participants in the presentation. MAY be a simple integer. [XCRI]		Integer
placesTaken	The number of enrolments.		Integer
regionServed	All the areas where you can deliver the course [ESFA]		
start	The date at which a presentation begins. [XCRI]		
studyMode	The expected mode of attendance or study.	one of: Full time, Part time, Flexible	code

## Provider

**Definition:** Providers are organisations that offer one or more courses. [XCRI]

Property	Definition	Comment	Value datatype
UKPRN	The UK Provider Reference Number of the organization.		8 digits
name	The name of the provider		langString
address	The postal address of the provider		Location
offers	The courses offered by the provider.		course
website	The provider's website.		URL

## Location

**Definition:** Physical location or geospatial area. [from [CTDL](#)]

Property	Definition	Comment	Value datatype
name	The name of the location	For example "Main campus"	
locationRef		e.g. UPRN	classification code, label & scheme

inSiteReference	Room number, floor number, suite or other similar location reference within a building.		string
streetAddress	Building number and street name.		string
locality	Locality within the area served by the postal town.	Optional	string
postalTown	The postal town or city.		string
postCode	Full postcode		string
country		Will always be UK (or England)	string

## Awarding Body

**Definition:** An organization that awards one or more qualifications [new]

Property	Definition	Comment	Value datatype
name	Full name of the Awarding Body		LangString
abbreviatedName	Abbreviated name of the Awarding Body		text

## 5.4 Example in JSON

An example of data according to the data model described above expressed as JSON is provided in [Appendix A.1](#) below.

While this is a viable format for internal use, it is non-standard and therefore limits the options for data re-use and interoperability. It illustrates the simplest binding possible.

## 6. Mapping to standards

The sections below summarise and comment on the mappings from the [schema spreadsheet](#)<sup>3</sup>.

### 6.1 Mapping to XCRI

Most of the entity types and properties can be mapped to elements from XCRI, MLO or compatible XML namespaces, remembering the XML handles embedded data about a linked entity as a complex element type—these properties are greyed out in the mapping column. Elements where a refinement is required in order to meet the needs of LSIP are highlighted in **green**; elements which need to be created for LSIP are highlighted in **yellow**.

Class	Property	Definition	Mapping to XCRI
	<b>Qualification</b>	A formal proof of successfully completed learning according to an	mlo:qualification

<sup>3</sup> <https://docs.google.com/spreadsheets/d/1VlboR8VzWbpoL-kE1zLFbJlh6rIEM1KWMetY9Au3bWk/>

		agreed standard. [ <a href="#">UNESCO</a> ]	
	name	Full official name of the qualification using standard abbreviations if used in official documentation [XCRI]	dc:title
	description	General summary of the nature of the qualification [XCRI]	dc:description
	awardedBy	The awarding body that offers this qualification.	awardedBy
	learningAimsCode	The learning aims (LARS/QAN) code of the qualification.	dc:identifier with extended type to indicate LAR
	level	Information about the progression through an educational or training context represented by the qualification [XCRI]	mlo:level with xsi:type to indicate NVQ-equivalent
	sicCode	A valid five digit SIC code for an industry that the qualification is relevant to, and the specific version of SIC used.	careerOutcome with extended type for SIC
	socCode	A valid four digit SOC code for an occupation that the qualification is relevant to, and the specific version of SOC used.	careerOutcome with extended type for SOC
	type	The category or type of qualification being described [from <a href="#">Schema.org</a> ]	dc:type
<b>Course</b>		Structured and unstructured learning and development opportunities based in direct experience, formal and informal study, observation, and involvement in discourse and practice. [ <a href="#">CTDL Learning Opportunity</a> ]	course
	name	Name of the course [XCRI]	dc:title
	description	General summary of the course [XCRI]	dc:description
	assessmentMethod	The ways a learner will be assessed. [ESFA]	mlo:assessment
	audience	Information that will help the learner decide whether this course is suitable for them, the learning experience and opportunities they can expect from the course. [ESFA]	dcterms:audience
	entryRequirement	Specific skills, licences, vocational or academic requirements. [ESFA]	mlo:prerequisite

	equipmentRequired	What the learner will need to access or bring to the course. [ESFA]	xcriTerms:requiredResource
	localCode	Identifier of the course used by the provider [based on <a href="http://schema.org">schema.org</a> ]	dc:identifier
	preparationFor	Qualification for which this course is preparation	n/a - qualification obj
	presentedAs	Presentation of this course.	n/a - presentation obj
	subjectArea	Topic of the course [XCRI]	dc:subject with extended type to indicate SSA2
	teaches	The main topics, units or modules of the course a learner can expect, include key features. [ESFA]	xcriTerms:topic
	webPage	The webpage for this course.	mlo:url
	whereNext	The further opportunities a learner can expect after successfully completing the course. [ESFA]	xcriTerms:leadsTo
<b>Presentation</b>		A presentation describes a particular presentation of a course. A presentation is a particular instance of the course offered at a particular time and place and is the entity to which learners apply. [XCRI]	presentation
	attendancePattern	Availability required in order to take part in the course.	attendancePattern
	cost	The cost of the course to the learner [ESFA]	mlo:cost with extended model to include 'price', 'priceCurrency', and dc:description
	costDescription	A description of what the cost includes and additional costs to the learner. [ESFA]	mlo:cost with extended model to include 'price', 'priceCurrency', and dc:description
	deliveryMode	The means by which the course is presented.	attendanceMode
	end	The date or time at which the presentation of a course finishes. [XCRI]	end
	esfalD	Course run GUID used by ESFA to identify this presentation	dc:identifier with extended type to indicate ESFA
	duration	The number of days, weeks, months or years the course runs for. [ESFA]	mlo:duration

	flexibleStartIndicator	Indicates whether there is a flexible start date.	extension for LSIP
	learningMethod	The methods used to deliver the course. [ESFA]	xcriTerms:teachingStrategy
	nationalDeliveryIndicator	You can deliver the course anywhere in England and you will be shown as a national provider for this course. [ESFA]	extension for LSIP
	offeredAt	A location where a course is presented. [XCRI]	venue -> provider -> mlo:location
	placesAvailable	A textual description of the number of places available for participants in the presentation. MAY be a simple integer. [XCRI]	mlo:places
	placesTaken	The number of enrolments.	extension for LSIP
	regionServed	All the areas where you can deliver the course [ESFA]	extension for LSIP
	start	The date at which a presentation begins. [XCRI]	mlo:start
	studyMode	The expected mode of attendance or study.	studyMode
<b>Provider</b>		Providers are organisations that offer one or more courses. [XCRI]	provider
	UKPRN	The UK Provider Reference Number of the organization.	dc:identifier with extended type for UKPRN
	name	The name of the provider	dc:title
	address	The postal address of the provider	mlo:location
	offers	The learning opportunities offered by the provider.	n/a
	website	The providers website.	mlo:url
<b>Location</b>		Physical location or geospatial area. [from <a href="#">CTDL</a> ]	mlo:location
	name	The name of the location	dc:title
	locationRef		dc:identifier
	inSiteReference	Room number, floor number, suite or other similar location reference within a building.	[include in street address]
	streetAddress	Building number and street name.	mlo:street
	locality	Locality within the area served by the	mlo:address



		postal town.	
	postalTown	The postal town or city.	mlo:address
	postCode	Full postcode	mlo:postcode
	country		extension for LSIP
<b>Awarding Body</b>		An organization that awards one or more qualifications [new]	n/a
	id	A unique resolvable identifier.	identifier
	name	Full name of the Awarding Body	n/a
	abbreviatedName	Abbreviated name of the Awarding Body	n/a

## 6.2 Mapping to Schema.org

The main entity types referenced in the abstract logical data model exist in schema.org, and are tabulated below:

**Qualification** → [EducationalOccupationalCredential](#)

**Course** → [Course](#)

**Presentation** → [CourseInstance](#)

**Awarding Body** → [EducationalOrganization](#)

**Provider** → [EducationalOrganization](#)

**Location** → [Place](#) & [PostalAddress](#)

Many of the properties have equivalents in Schema.org, although sometimes the modelling in Schema.org introduces an extra layer of abstraction in order to increase flexibility. For example, in order to specify the cost of something it is necessary to introduce an abstract Offer object, which can be very useful to provide details that are relevant when the same item is offered by several entities or when different prices are available for different groups of purchaser; however, the Offer object must be used even when this is not the case. Another abstract object used more than once is the AlignmentObject, which is used to express a relationship between a resource and some formal framework; it is used here for aligning to industry and occupation codes, among other places. Where mappings rely on such abstract objects a notation is used which shows path used thus: -property->Object-objectProperty. For example under Qualification awardedBy (which indicates the awarding body) is mapped to -offers->Offer-offeredBy, which indicates that the offers property is used to indicate an Offer object, and the offeredBy property of that object is used to indicate the awarding body. Occasionally the mapping will depend on values of other properties of the abstract object, which are similarly indicated.

The full mapping is as follows. Cells in **yellow** indicate where there is no match in Schema.org,

some of them have a suggested match from CTDL; others would need to be found elsewhere or created for the project. Creating them involves maintaining RDF definitions at a suitable URI and creating and hosting a JSON-LD context file to reference them.

Class	Property	Definition	Mapping to Schema.org
<b>Qualification</b>		A formal proof of successfully completed learning according to an agreed standard. [UNESCO]	<a href="#">Educational Occupational Credential</a>
	name	Full official name of the qualification using standard abbreviations if used in official documentation [XCRI]	<a href="#">name</a>
	description	General summary of the nature of the qualification [XCRI]	<a href="#">description</a>
	awardedBy	The awarding body that offers this qualification.	<a href="#">-offers-&gt;Offer-offeredBy</a>
	learningAimsCode	The learning aims (LARS/QAN) code of the qualification.	<a href="#">identifier</a>
	level	Information about the progression through an educational or training context represented by the qualification [XCRI]	<a href="#">educationalLevel</a>
	sicCode	A valid five digit SIC code for an industry that the qualification is relevant to, and the specific version of SIC used.	<a href="#">educationalAlignment-&gt;AlignmentObject-targetName</a> with <a href="#">AlignmentObject-alignmentType</a> = Industry
	socCode	A valid four digit SOC code for an occupation that the qualification is relevant to, and the specific version of SOC used.	<a href="#">educationalAlignment-&gt;AlignmentObject-targetName</a> with <a href="#">AlignmentObject-alignmentType</a> = Occupation or <a href="#">occupationalCategory-&gt;CategoryCode</a>
	type	The category or type of qualification being described [from <a href="#">Schema.org</a> ]	<a href="#">credential category</a>
<b>Course</b>		Structured and unstructured learning and development opportunities based in direct experience, formal and informal study, observation, and involvement in discourse and practice. [CTDL Learning Opportunity]	<a href="#">Course</a>
	name	Name of the course [XCRI]	<a href="#">name</a>
	description	General summary of the course [XCRI]	<a href="#">description</a>

	assessmentMethod	The ways a learner will be assessed. [ESFA]	use ctdl:assessmentMethodDescription
	audience	Information that will help the learner decide whether this course is suitable for them, the learning experience and opportunities they can expect from the course. [ESFA]	- <a href="#">audience</a> - <a href="#">EducationalAudience</a> ->description
	entryRequirement	Specific skills, licences, vocational or academic requirements. [ESFA]	<a href="#">coursePrerequisites</a>
	equipmentRequired	What the learner will need to access or bring to the course. [ESFA]	
	localCode	Identifier of the course used by the provider [based on <a href="#">schema.org</a> ]	<a href="#">courseCode</a>
	preparationFor	Qualification for which this course is preparation	<a href="#">educationalCredentialAwarded</a>
	presentedAs	Presentation of this course.	<a href="#">hasCourseInstance</a>
	subjectArea	Topic of the course [XCRI]	<a href="#">educationalAlignment</a> -> <a href="#">AlignmentObject-targetName</a> with <a href="#">AlignmentObject-alignmentType</a> = EducationalSubject
	teaches	The main topics, units or modules of the course a learner can expect, include key features. [ESFA]	<a href="#">teaches</a>
	webPage	The webpage for this course.	<a href="#">url</a>
	whereNext	The further opportunities a learner can expect after successfully completing the course. [ESFA]	
<b>Presentation</b>		A presentation describes a particular presentation of a course. A presentation is a particular instance of the course offered at a particular time and place and is the entity to which learners apply. [XCRI]	<a href="#">Course Instance</a>
	attendancePattern	Availability required in order to take part in the course.	use ctdl:scheduleTimingType
	cost	The cost of the course to the learner [ESFA]	- <a href="#">offers</a> -> <a href="#">Offer-price</a> with <a href="#">Offer-priceCurrency</a> = "GBP"
	costDescription	A description of what the cost includes and additional costs to the learner. [ESFA]	- <a href="#">offers</a> -> <a href="#">Offer-description</a>

	deliveryMode	The means by which the course is presented.	<a href="#">courseMode</a>
	end	The date or time at which the presentation of a course finishes. [XCRI]	<a href="#">endDate</a>
	esfaID	Course run GUID used by ESFA to identify this presentation	<a href="#">identifier</a>
	duration	The number of days, weeks, months or years the course runs for. [ESFA]	<a href="#">duration</a>
	flexibleStartIndicator	Indicates whether there is a flexible start date.	use ctdl:offerFrequencyType
	learningMethod	The methods used to deliver the course. [ESFA]	use ctdl:learningMethodType/Description
	nationalDeliveryIndicator	You can deliver the course anywhere in England and you will be shown as a national provider for this course. [ESFA]	
	offeredAt	A location where a course is presented. [XCRI]	<a href="#">location</a>
	placesAvailable	A textual description of the number of places available for participants in the presentation. MAY be a simple integer. [XCRI]	<a href="#">maximumAttendeeCapacity</a>
	placesTaken	The number of enrolments.	
	regionServed	All the areas where you can deliver the course [ESFA]	-offers-> <a href="#">Offer-eligibleRegion</a>
	start	The date at which a presentation begins. [XCRI]	<a href="#">startDate</a>
	studyMode	The expected mode of attendance or study.	use ctdl:audienceType
<b>Provider</b>		Providers are organisations that offer one or more courses. [XCRI]	<a href="#">Educational Organization</a>
	UKPRN	The UK Provider Reference Number of the organization.	<a href="#">identifier</a>
	name	The name of the provider	<a href="#">legalName</a>
	address	The postal address of the provider	<a href="#">address</a>
	offers	The courses offered by the provider.	-makesOffer-> <a href="#">Offer-itemOffered</a>
	website	The provider's website.	<a href="#">url</a>
<b>Location</b>		Physical location or geospatial area. [from <a href="#">CTDL</a> ]	<a href="#">PostalAddress</a> & Location
	name	The name of the location	name

	locationRef		<a href="#">identifier</a>
	inSiteReference	Room number, floor number, suite or other similar location reference within a building.	[include in street address]
	streetAddress	Building number and street name.	<a href="#">streetAddress</a>
	locality	Locality within the area served by the postal town.	<a href="#">addressLocality</a>
	postalTown	The postal town or city.	<a href="#">addressRegion</a>
	postCode	Full post code	<a href="#">postalCode</a>
	country		<a href="#">addressCountry</a>
	<b>Awarding Body</b>	An organization that awards one or more qualifications [new]	<a href="#">Educational Organization</a>
	name	Full name of the Awarding Body	<a href="#">legalName</a>
	abbreviatedName	Abbreviated name of the Awarding Body	<a href="#">alternateName</a>

### 6.3 Mapping to CTDL

The main entity types are mapped as:

**Qualification** → [Credential](#) (and subtypes)

**Course** → [LearningOpportunity](#)

**Presentation** → [ScheduledOffering](#)

**Awarding Body** → [CredentialOrganization](#)

**Provider** → [CredentialOrganization](#)

**Location** → [Place](#)

The general considerations concerning the use of abstract intermediate objects for things like classifiers and identifiers are the same for CTDL as they are for Schema.org (see [above](#)).

Cells in yellow indicate where there is no match in CTDL, some of them have a suggested match from Schema.org; others would need to be found elsewhere or created for the project. Creating them involves maintaining RDF definitions at a suitable URI and creating and hosting a JSON-LD context file to reference them.

Class	Property	Definition	Mapping to CTDL
<b>Qualification</b>		A formal proof of successfully completed learning according to an agreed	<a href="#">Credential</a> or more specific type

		standard. <a href="#">UNESCO</a> ]	
	name	Full official name of the qualification using standard abbreviations if used in official documentation [XCRI]	<a href="#">name</a>
	description	General summary of the nature of the qualification [XCRI]	<a href="#">description</a>
	awardedBy	The awarding body that offers this qualification.	<a href="#">offeredBy</a>
	learningAimsCode	The learning aims (LARS/QAN) code of the qualification.	<a href="#">-identifier-&gt;IdentifierValue-identifierValueCode</a>
	level	Information about the progression through an educational or training context represented by the qualification [XCRI]	use <a href="#">schema.org/educationalLevel</a>
	sicCode	A valid five digit SIC code for an industry that the qualification is relevant to, and the specific version of SIC used.	<a href="#">industryType-&gt;skos:Concept-prefLabel</a>
	socCode	A valid four digit SOC code for an occupation that the qualification is relevant to, and the specific version of SOC used.	<a href="#">occupationType-&gt;skos:Concept-prefLabel</a>
	type	The category or type of qualification being described [from <a href="#">Schema.org</a> ]	use @type
<b>Course</b>		Structured and unstructured learning and development opportunities based in direct experience, formal and informal study, observation, and involvement in discourse and practice. <a href="#">CTDL</a> Learning Opportunity]	<a href="#">Learning Opportunity</a>
	name	Name of the course [XCRI]	<a href="#">name</a>
	description	General summary of the course [XCRI]	<a href="#">description</a>
	assessmentMethod	The ways a learner will be assessed. [ESFA]	<a href="#">assessmentMethodDescription</a>
	audience	Information that will help the learner decide whether this course is suitable for them, the learning experience and opportunities they can expect from the course. [ESFA]	use <a href="#">schema.org/audience</a>
	entryRequirement	Specific skills, licences, vocational or academic requirements. [ESFA]	<a href="#">entryCondition-&gt;ConditionProfile-description (&amp; other more specific properties)</a>

	equipmentRequired	What the learner will need to access or bring to the course. [ESFA]	
	localCode	Identifier of the course used by the provider [based on <a href="http://schema.org">schema.org</a> ]	<a href="#">codedNotation</a>
	preparationFor	Qualification for which this course is preparation	<a href="#">isPreparationFor</a>
	presentedAs	Presentation of this course.	<a href="#">hasOffering</a>
	subjectArea	Topic of the course [XCRI]	<a href="#">subject</a> ->skos:Concept-prefLabel
	teaches	The main topics, units or modules of the course a learner can expect, include key features. [ESFA]	<a href="#">teaches</a>
	webPage	The webpage for this course.	<a href="#">subjectWebpage</a>
	whereNext	The further opportunities a learner can expect after successfully completing the course. [ESFA]	
<b>Presentation</b>		A presentation describes a particular presentation of a course. A presentation is a particular instance of the course offered at a particular time and place and is the entity to which learners apply. [XCRI]	similar to <a href="#">Scheduled Offering</a>
	attendancePattern	Availability required in order to take part in the course.	<a href="#">scheduleTimingType</a> + <a href="#">scheduleFrequencyType</a>
	cost	The cost of the course to the learner [ESFA]	- <a href="#">estimatedCost</a> -> <a href="#">CostProfile-price</a> with CostProfile-currency="GBP"
	costDescription	A description of what the cost includes and additional costs to the learner. [ESFA]	- <a href="#">estimatedCost</a> -> <a href="#">CostProfile-description</a>
	deliveryMode	The means by which the course is presented.	<a href="#">deliveryType</a>
	end	The date or time at which the presentation of a course finishes. [XCRI]	use <a href="http://schema.org/endDate">schema.org/endDate</a>
	esfaID	Course run GUID used by ESFA to identify this presentation	?identifier
	duration	The number of days, weeks, months or years the course runs for. [ESFA]	<a href="#">estimatedDuration</a> -> <a href="#">DurationProfile-exactDuration</a> (or min/maxDuration)

	flexibleStartIndicator	Indicates whether there is a flexible start date.	<a href="https://purl.org/ctdl/vocabs/scheduleFrequency/OnDemand">offerFrequencyType-&gt;ScheduleFrequency- https://purl.org/ctdl/vocabs/scheduleFrequency/OnDemand</a>
	learningMethod	The methods used to deliver the course. [ESFA]	<a href="https://purl.org/ctdl/terms/learningMethodDescription">https://purl.org/ctdl/terms/learningMethodDescription</a> or <a href="https://purl.org/ctdl/terms/learningMethodType">https://purl.org/ctdl/terms/learningMethodType</a>
	nationalDeliveryIndicator	You can deliver the course anywhere in England and you will be shown as a national provider for this course. [ESFA]	
	offeredAt	A location where a course is presented. [XCRI]	<a href="https://purl.org/ctdl/terms/availableAt">https://purl.org/ctdl/terms/availableAt</a>
	placesAvailable	A textual description of the number of places available for participants in the presentation. MAY be a simple integer. [XCRI]	use <a href="https://schema.org/maximumAttendeeCapacity">schema.org/maximumAttendeeCapacity</a>
	placesTaken	The number of enrolments.	
	regionServed	All the areas where you can deliver the course [ESFA]	<a href="#">region</a> ->Place->addressRegion
	start	The date at which a presentation begins. [XCRI]	use <a href="https://schema.org/startDate">schema.org/startDate</a>
	studyMode	The expected mode of attendance or study.	<a href="https://purl.org/ctdl/terms/attendanceType">https://purl.org/ctdl/terms/attendanceType</a> {PartTime FullTime, need to add Flexible}
<b>Provider</b>		Providers are organisations that offer one or more courses. [XCRI]	<a href="#">Credential Organization</a>
	UKPRN	The UK Provider Reference Number of the organization.	- <a href="#">identifier</a> -> <a href="#">IdentifierValue-identifierValueCode</a>
	name	The name of the provider	<a href="#">name</a>
	address	The postal address of the provider	<a href="#">address</a>
	offers	The courses offered by the provider.	<a href="#">offers</a>
	website	The providers website.	<a href="#">subjectWebpage</a>
<b>Location</b>		Physical location or geospatial area. [from <a href="#">CTDL</a> ]	<a href="#">Place</a>
	name	The name of the location	<a href="#">name</a>
	locationRef		<a href="#">geoURI</a> or identifier
	inSiteReference	Room number, floor number, suite or other similar location reference within a	[include in street address]



		building.	
	streetAddress	Building number and street name.	<a href="#">streetAddress</a>
	locality	Locality within the area served by the postal town.	<a href="#">addressLocality</a>
	postalTown	The postal town or city.	<a href="#">addressRegion</a>
	postCode	Full post code	<a href="#">postalCode</a>
	country		<a href="#">addressCountry</a>
<b>Awarding Body</b>		An organization that awards one or more qualifications [new]	<a href="#">Credential Organization</a>
	name	Full name of the Awarding Body	<a href="#">name</a>
	abbreviatedName	Abbreviated name of the Awarding Body	<a href="#">alternateName</a>

## 7. Bindings and implementation guidance

Note, all binding examples are "non-normative" and have not been fully tested at this stage because there are as yet no formal schema definition files that would allow validation.

### 7.1 XCRI / XML

The native format for XCRI is XML, an example of data conforming to XCRI/XML is provided in [Appendix A.2](#). It is probably fair to say that XML is not as well-regarded as it once was, JSON now being favoured. In theory it would be possible to express XCRI data in JSON, but at the cost of losing interoperability with other implementations of XCRI, and with limited benefit compared to standards that use JSON by default.

If XCRI is adopted it would be necessary to create maintain and publish some controlled vocabularies (enumerations to be used as values for some elements) and of an XML Schema that would allow some validation of the data provided.

### 7.2 Schema.org / JSON-LD

The most suitable binding for schema.org metadata is JSON-LD. The other two widely used options are microdata and RDF/a, however both of these are tightly bound to data in html web pages which is not helpful for our use case. In principle any RDF serialisation could be used, but JSON-LD is the most widely understood by consumers of Schema.org. An example of data conforming to Schema.org/JSON-LD is provided in [Appendix A3](#).

Schema.org is undoubtedly popular and widely used, offering some prospect of making the data more widely usable. However the current uses of Schema.org are not always well aligned with the aims of this project and the type of resource being described. The linked data paradigm is designed to enhance reuse of data.

If Schema.org is used, some decision will be required on the use of URIs for identifiers. In order to express the data as JSON-LD, i.e. Linked Data it is best practice to identify each entity being described with a URL, which is used as the value for the JSON-LD keyword @id. Example URLs have been used here but in practice these would need to be generated based on some other local identifier. It is not strictly necessary for these identifiers to resolve, however it is best if they do. While this is an extra burden on data providers it is more efficient when the same data is used repeatedly across a dataset. This use of URLs gives "5-star linked data"<sup>4</sup> which is definitely where we want to be going, however it might be too big a first step.

A minor point to note is that Schema.org does not support LangStrings, and so the example here shows all the data as in English. For our current use this is probably reasonable.

If Schema.org is adopted it will be necessary to find or create suitable terms for those not covered by Schema.org or a compatible RDF language such as CTDL. Therefore this option would require creation, maintenance and publication of some term definitions and controlled vocabularies in RDF, and a JSON-LD context file, as well as a JSON-Schema and or other schema files to allow validation of any data provided.

### **7.3 CTDL / JSON-LD**

CTDL, like Schema.org, is an RDF vocabulary normally expressed in JSON-LD, an example is provided in [Appendix A4](#).

Although not as widely used as Schema.org CTDL is designed specifically to describe the types of resources that this project will deal with, and its use in similar projects is gaining some traction. It also uses the linked data paradigm to enhance reuse of data.

There are similar considerations concerning the use of URIs to identify terms from controlled vocabularies for CTDL as for Schema.org. CTDL in design and usage leans more strongly into the use of URIs than Schema.org does, often not providing the flexibility to use a simple string instead. One example of this is that in order to specify the precise type of Qualification (e.g. HND, T-Level etc) best practice would be to declare these are RDF types and subclasses of ctdl:Credential.

As with Schema.org, if CTDL is adopted it will be necessary to find or create suitable terms for those not covered by Schema.org or a compatible RDF language such as Schema.org. Therefore this option would require creation, maintenance and publication of some term definitions and controlled vocabularies in RDF, and a JSON-LD context file, as well as a JSON-Schema and or other schema files to allow validation of any data provided.

### **7.4 Collecting minimal data in Excel/CSV for transformation to complete JSON or XML**

Many colleges use systems for managing course information which don't natively produce JSON or XML output; in other cases it is technically possible but requires advanced configuration (e.g.

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<sup>4</sup> <https://5stardata.info/en/>

Tribal SITS requires XML templates to be mapped to native entities within the system, a complex task that requires a specialist.)

However, because most of the data needed is already collected through other means and disseminated as open data, it isn't necessary for all the data to be generated directly from the college in the first instance. This is because the information about a college or other provider is already held by UKRLP, while detailed information about the qualifications offered by colleges is provided by the LAR. Each of these systems has a unique identifier already used by colleges in making their submissions to the ILR and ESFA course directory. For relating occupations and industries to qualifications, the common mapping approach may be used as described later in this report.

A minimal CSV output from the MIS, or a completed Excel sheet, with only a few columns, can be used as a starting point for building a complete dataset. This could help 'bootstrap' the standard by enabling early adopters at colleges to produce data quickly from existing sources, ahead of the full automation of complete feeds by system vendors.

The process of transformation from CSV/Excel to a complete JSON or XML feed could be fully automated with minimal human input. Some scripts that illustrate how to extract data from current data sources are available at: <https://github.com/scottbw/lcip> based on this example template: [LSIP Minimal Data Collection Template](#)<sup>5</sup>. This minimal collection template is intended to work for the first "policy-makers" scenario for using the data standard, however, for the second "citizen-facing" scenario colleges would need to publish data conforming to our emerging data standard, the data could then be aggregated (see [below](#)). If successful, MIS software providers would hopefully recognise the demand for data export in standards compliant formats and remove the need for CSV and processing to stitch the data together. However, new features for MIS products tend to take years rather than months to develop, so this approach will allow us to realise benefits early.

## 8. Managing common mappings to SOC and SIC

Mappings, also known as crosswalks, are ways of connecting together datasets and vocabularies. In the case of linking together qualifications and jobs, this means linking a qualification reference identifier from LAR to SOC and/or SIC.

While the definition of a qualification is owned by the awarding body, there may be good reasons why they may be reluctant to provide a definitive mapping of their qualifications for common use.

Colleges may be able to map the qualifications they offer courses for to occupations, but this would likely lead to inconsistencies, as the same qualification at different colleges could be

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<https://docs.google.com/spreadsheets/d/1WN7ejkSb2LFR1mYXzMiQYwNjVjYbdOJVwgtVogR1s2g/edit#gid=1611798467>

mapped to different occupations, even where the course is substantively similar.

A number of organisations have also previously defined partial mappings; for example IFATE have created mappings from apprenticeships to SOC. A number of efforts at mapping subjects to occupations have also been made; this is problematic as subjects tend not to be defined in a sufficiently granular way to be related to specific occupations, so these tend to be very high level, e.g. SSA1 to SOC 2-digit.

The Rocket Science report has demonstrated that mapping qualifications to SOC and SIC, assisted by semi-automated tools such as Cascott, is feasible on a small to medium scale. With a sufficiently narrow scope, for example only for qualifications equivalent to levels 2-5, and only for colleges within a particular region, the number of mappings needed may be small enough to be developed by a small team, with only periodic updates.

Technically, a mapping could look very simple: a single CSV file listing qualification identifiers and associated SOCs and SICs.

Stewardship of mappings like this, that occur on the boundaries between organisations and professions, is notoriously difficult. If there is no single logical 'owner' for such a mapping (or there is such an organisation but it doesn't want to take on the responsibility) then an 'open source' model may be more appropriate, with collective voluntary stewardship.

By 'open source' approaches we mean those that build on the kinds of models used in open source software—typically a small number of maintainers working on a common set of artefacts with a lightweight approach to governance, usually effort can be voluntary as the people contributing to the artefacts are also the primary users of them too.

Some data models and de-facto standards have been managed in this way; for example, prior to more official mappings connecting levels of qualifications in the UK becoming available, an informal 'metadata in education group' managed a common mapping across UK educational levels through participation in a mailing list. A number of well-known specifications, standards and vocabularies have also started out as informal coalitions of interested parties editing a shared document - for example, what is now 'HTML5' started out as a document on Github edited by participants from various browser vendors before moving to the World Wide Web Consortium. Another example would be the HEAR (Higher Education Achievement Report) technical standards, which were developed largely from input from the main system vendors involved (Tribal, GradIntel, AdvancedSecure, Digitary) and some of the pilot institutions via a Github site, administered with a fairly light touch secretariat function.

For the mapping from qualifications to SOC this may be a reasonable starting point: building on the work of the Rocket Science report, and other previous mappings developed by individual projects, create a single shared document in a platform-agnostic format as a starting point and invite participation from the individuals and organisations that have an interest in making use of it.

Note that most *de jure* standards are developed in essentially the same way, using volunteer

effort, but with a layer of governance provided by the standards body or consortium.

## 9. Example models for using data standards

### The “collection agency” model

In this model, a single entity acts as the data collector. The standard forms the basis by which the agency collects data from participants. An example of this kind of model would be HESA collecting HE data, ESFA collecting FE course data, or Prospects collecting Postgraduate course data.

In these models, a standard acts as a ‘contract’ between the agency performing the collection and organisations providing data.

It is also possible in this model for the parties involved to add conditions to the use of the data, and to use a non-open way of transporting the data between the source and the collector.

### The “aggregation” model

In this model, each organisation that holds data provides that data to anyone who wishes to make use of it. Organisations that want to use the data need to ‘aggregate’ the data from each provider. The standard provides the common basis for aggregating data.

Typically the data is shared by hosting the data on the source’s website for public access.

A key challenge in this model is discovery—how does the aggregator know where to find all the datasets they need?

A key strength of this model is that it is decentralised and relatively robust.

A weakness of this model is that it relies on the sources of data to be happy about providing their data as fully open data, regardless of how it may be used.

### The web crawl / schema.org approach

Google uses data encoded in schema.org to enrich its search results in what is essentially a variation on the aggregation model tailored that uses web-crawling (following links from one page to another) to discover the data. Organizations embed metadata about something, often as “islands” of JSON-LD, in the webpage for the thing that is being described. Google gathers this metadata while crawling the web and building its search index.

Strengths of this approach are that many web content management systems already handle embedding schema.org data in webpages as part of their SEO functionality, and that the data being provided will be available to Google and other search engines—though there is no guarantee that it will be used.

The weaknesses are that this may mean exposing more data more publicly than is strictly

necessary and the capability built for SEO may not be sufficient for all the data that needs to be published.

Often the data obtained in this way is closed, or at least access to it is limited by the search engine that does the crawling. A notable exception is the [Common Crawl](https://commoncrawl.org)<sup>6</sup> repository, from which the [Web Data Commons](http://webdatacommons.org)<sup>7</sup> project extracts and provides access to structured Schema.org data. Unfortunately the data provided by these two projects is only released annually some months after it was gathered. They do however illustrate some possibility for doing something more limited within the scope of this project.

## 10. Recommendations and future work required

There are four options described in this report, each of which is viable, each with its own strengths and each requiring some degree of further work. During the time of the project it was not possible to acquire the information from potential implementers and users of the standard to allow a final decision.

The options are:

1. **The logical data model "as-is" expressed in JSON.** This is the simplest option, requiring only the creation and publication of a JSON-Schema file to allow validation of any data provided. However, the data will not conform to any external standard which may limit options for data reuse and interoperability.
2. **The data mapped to a UK standard for course related information (XCRI) in XML.** This would have the advantage of using an external standard, albeit a rather old one in a format that is less regarded now that JSON is. This would require the creation and publication of some controlled vocabularies (enumerations to be used as values for some elements) and of an XML Schema that would allow some validation of the data provided.
3. **The data mapped to a generic global data standard, Schema.org, in JSON-LD.** Schema.org is undoubtedly popular and widely used, offering some prospect of making the data more widely usable. However the current uses of Schema.org are not always well aligned with the aims of this project and the type of resource being described. The linked data paradigm is designed to enhance reuse of data. This option would require creation, maintenance and publication of some term definitions and controlled vocabularies in RDF, and a JSON-LD context file, as well as a JSON-Schema and or SHACL files to allow validation of any data provided.
4. **The data mapped to a specialised data standard for Qualification, CTDL, in JSON-LD.** Although not as widely used as Schema.org CTDL is designed specifically to describe the types of resources that this project will deal with, and its use in similar projects is gaining some traction. It also uses the linked data paradigm to enhance reuse of data. This option would require creation, maintenance and publication of some term

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<sup>6</sup> <https://commoncrawl.org>

<sup>7</sup> <http://webdatacommons.org>

definitions and controlled vocabularies in RDF, and a JSON-LD context file, as well as a JSON-Schema and or SHACL files to allow validation of any data provided.

The artefacts that would be required for any of these options, one created, could be maintained and published using an "open source" model, along with other project requirements such as SOC/SIC mappings.

Of the options we recommend aiming for option 4, CTDL in JSON-LD which expresses all the data required in a suitable standard format; however we recognise that it is among the more complex options and that option 1 is viable for local use and the mappings presented in this report offer the potential of translating data provided in this bespoke format to any of the standards in the future.

The options for gathering the data are probably progressive: initially a simple CSV supplied by colleges and other learning providers would allow data from collection agencies to be collated into the format required. Hopefully this would spur software vendors to implement export of all the data directly in the required format, which could be gathered by aggregation. If the scope of the project expands, and if search engine adoption provides enough incentive, then the web-crawl model may become the preferred approach.

## Appendix: Code examples

The data examples and some scripts that illustrate how to extract data from current data sources are available at: <https://github.com/scottbw/lsip>

Note, all binding examples are "non-normative" and have not been fully tested at this stage because there are as yet no formal schema definition files that would allow validation.

All examples are based on the same data.

### A.1 Logical data model "as is" in JSON

An example of data according to the data model described above expressed as JSON is provided below. It shows a college offering one course (relevant to dentistry) as two Presentations, one in 2022, one in 2023.

While this is a viable format for internal use, it is non-standard. It illustrates the simplest binding possible.

NB: in the absence of a formally encoded schema this data has not been validated and should be considered as informative only.

[\[skip this code\]](#)

```
{
  "name": {"en": "Example College"},
  "ukprn": "123435678",
  "address": {
```

```

    "inSiteReference": "Room 101",
    "streetAddress": "1 Example Street",
    "postalTown": "London",
    "postCode": "W1A 1EG"
  },
  "website": "https://example.edu/",
  "offers": [
    {
      "name": {"en": "Example course"},
      "description": {"en": "An example course."},
      "assessmentMethod": {"en": "Example assessment methods."},
      "entryRequirement": {"en": "Example entry requirements."},
      "equipmentRequired": {"en": "Example equipment required."},
      "localCode": "Dent001",
      "subjectArea": {
        "code": "1.1",
        "scheme": "SSA",
        "name": {"en": "Medicine and dentistry"}
      },
      "teaches": [
        {"en": "An example learning objective"},
        {"en": "Another example learning objective"}
      ],
      "webPage": "https://example.edu/courses/Dent001",
      "whereNext": {"en": "Example further opportunities."},
      "preparationFor": {
        "type": "NVQ",
        "name": {"en": "Example Qualification"},
        "description": {"en": "An example qualification."},
        "learningAimsCode": "12345678",
        "level": {
          "code": "5",
          "scheme": "RQF"
        },
        "sicCode": {
          "code": "86230",
          "scheme": "UKSIC2007",
          "name": {"en": "Dental practice activities"}
        },
        "socCode": {
          "code": "6133",
          "scheme": "UKSOC2020",
          "name": {"en": "Dental nurses"}
        },
        "awardedBy": {
          "name": "Example Awarding Body",
          "abbreviatedName": "EG"
        }
      },
      "presentedAs": [

```



```

{
  "attendancePattern": "Daytime",
  "cost": 500,
  "costDescription": {"en": "Example cost description"},
  "deliveryModel": {"name": {"en": "Classroom"}},
  "esfaID": "23af-23230ge-etc",
  "start": "2022-01-01",
  "end": "2022-12-30",
  "duration": "PT1Y",
  "flexibleStartIndicator": false,
  "learningMethod": {"en": "Example learning methods"},
  "nationalDeliveryIndicator": false,
  "placesAvailable": 25,
  "placesTaken": 25,
  "regionServed": "London",
  "studyMode": {"label": {"en": "Full time"}},
  "offeredAt": {
    "name": "Rm101 Example Campus",
    "locationRef": {"code": "Eg101"},
    "inSiteReference": "Room 101",
    "streetAddress": "1 Example Street",
    "postalTown": "London",
    "postCode": "W1A 1EG"
  }
}, {
  "attendancePattern": "Daytime",
  "cost": 450,
  "costDescription": {"en": "Example cost description"},
  "deliveryModel": {"name": {"en": "Classroom"}},
  "esfa": "23af-23230ge-etc",
  "start": "2021-01-01",
  "end": "2021-12-30",
  "duration": "PT1Y",
  "flexibleStartIndicator": false,
  "learningMethod": {"en": "Example learning methods"},
  "nationalDeliveryIndicator": false,
  "placesAvailable": 20,
  "placesTaken": 20,
  "regionServed": "London",
  "studyMode": {"name": {"en": "Full time"}},
  "offeredAt": {
    "name": "Rm101 Example Campus",
    "locationRef": {"code": "Eg101"},
    "inSiteReference": "Room 101",
    "streetAddress": "1 Example Street",
    "postalTown": "London",
    "postCode": "W1A 1EG"
  }
}
]

```

```

    }
  ]
}

```

## A.2 XCRI / XML

For some values codes have been used with the assumption that these would correspond to values in controlled vocabularies. For example <attendanceMode>1</attendanceMode> is used to indicate that attendance mode is "Daytime".

```

<catalog xmlns="http://xcri.org/profiles/1.2/catalog"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
  xmlns:dcterms="http://purl.org/dc/terms/"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xcriTerms="http://xcri.org/profiles/1.2/catalog/terms"
  xmlns:lsip="https://www.businessldn.co.uk/schemas/lsip"
  xmlns:mlo="http://purl.org/net/mlo"
  generated="2023-04-17T17:45:00Z"
  xsi:schemaLocation="http://xcri.org/profiles/1.2/catalog
  ../schemas/lsip_xcri_profile.xsd http://xcri.org/profiles/1.2/catalog/terms
  ../schemas/xcri_cap_terms_1_2.xsd http://purl.org/net/mlo
  ../schemas/lsip_mlo_profile.xsd http://purl.org/dc/elements/1.1/ ../schemas/dc.xsd
  https://www.businessldn.co.uk/schemas/lsip ../schemas/lsip_extensions.xsd
  http://purl.org/dc/terms/ ../schemas/dcterms.xsd"
>
  <provider>
    <dc:identifier xsi:type="lsip:UKPRN">123435678</dc:identifier>
    <dc:title>Example College</dc:title>
    <course>
      <dc:subject>
        <dc:identifier xsi:type="lsip:SSA2">1.1</dc:identifier>
        <dc:description>Medicine and dentistry</dc:description>
      </dc:subject>
      <dc:title>Example course</dc:title>
      <mlo:prerequisite>Example entry requirements</mlo:prerequisite>
      <mlo:qualification>
        <dc:identifier xsi:type="lsip:LAR">12345678</dc:identifier>
        <dc:title>Example Qualification</dc:title>
        <mlo:level xsi:type="lsip:RQF">5</mlo:level>
        <xcriTerms:careerOutcome>
          <dc:identifier xsi:type="lsip:SOC2020">6133</dc:identifier>
          <dc:description>Dental nurses</dc:description>
        </xcriTerms:careerOutcome>
      </mlo:qualification>
      <presentation>
        <mlo:start>2022-01-01</mlo:start>
        <studyMode>1.0</studyMode>
        <attendanceMode>1</attendanceMode>
        <attendancePattern>1.0</attendancePattern>
        <mlo:places>25</mlo:places>
      </presentation>
    </course>
  </provider>

```

```

<mlo:cost>
  <lsip:price>500.0</lsip:price>
  <lsip:priceCurrency>GBP</lsip:priceCurrency>
  <dc:description>Tuition fee</dc:description>
</mlo:cost>
<venue>
  <provider>
    <dc:identifier xsi:type="lsip:UKPRN">123435678</dc:identifier>
    <dc:title>Example College</dc:title>
    <mlo:location>
      <mlo:street>1 Example Street</mlo:street>
      <mlo:town>London</mlo:town>
      <mlo:postcode>W1A 1EG</mlo:postcode>
    </mlo:location>
  </provider>
</venue>
<lsip:flexibleStartDate>False</lsip:flexibleStartDate>
<lsip:placesTaken>25</lsip:placesTaken>
</presentation>
<presentation>
  <mlo:start>2021-01-01</mlo:start>
  <studyMode>1.0</studyMode>
  <attendanceMode>1</attendanceMode>
  <attendancePattern>1.0</attendancePattern>
  <mlo:places>20</mlo:places>
  <mlo:cost>
    <lsip:price>450.0</lsip:price>
    <lsip:priceCurrency>GBP</lsip:priceCurrency>
    <dc:description>Tuition fee</dc:description>
  </mlo:cost>
  <venue>
    <provider>
      <dc:identifier xsi:type="lsip:UKPRN">123435678</dc:identifier>
      <dc:title>Example College</dc:title>
      <mlo:location>
        <mlo:street>1 Example Street</mlo:street>
        <mlo:town>London</mlo:town>
        <mlo:postcode>W1A 1EG</mlo:postcode>
      </mlo:location>
    </provider>
  </venue>
  <lsip:flexibleStartDate>False</lsip:flexibleStartDate>
  <lsip:placesTaken>20</lsip:placesTaken>
</presentation>
</course>
</provider>
</catalog>

```

### A.3 Schema.org / JSON-LD

Example URLs have been used here but in practice these would need to be generated based on

some other local identifier. It is not strictly necessary for these identifiers to resolve, however it is best if they do. While this is an extra burden on data providers it is more efficient when the same data is used repeatedly across a dataset.

Even more use of URIs can be made than is shown in this example as they can be used wherever a term is used that is drawn from some controlled vocabulary. Thus where the data below we have used

```
"educationalLevel": {
  "@type": "DefinedTerm",
  "inDefinedTermSet": {
    "name": "RQF"
  },
  "termCode": "5"
}
```

to uniquely identify when an alternative would be to use a URI:

```
"educationalLevel": "https://example.org/lsip/RQF/5"
```

where the URL resolves to a full definition of the educational level being referenced. This use of URLs give "5-star linked data"<sup>8</sup> which is definitely where we want to be going, however it might be too big a first step.

Another point to note is that Schema.org does not support LangStrings, and so the example here shows all the data as in English. For our current use this is probably reasonable.

**NOTE:** it will be necessary to find or create suitable terms for those marked as "ext:" (external/extension to Schema.org. This involves maintaining RDF definitions at a suitable URI and a JSON-LD context file referencing them.

```
{
  "@context": [
    "https://schema.org/",
    {
      "ext": "https://example.org/extension/"
    }
  ],
  "inLanguage": "en",
  "@graph": [
    {
      "@id": "http://example.edu/Provider/001",
      "@type": "EducationalOrganization",
      "name": "Example College",
      "identifier": {
        "@type": "PropertyValue",
        "propertyID": "UKPRN",
        "value": "123435678"
      },
      "address": {
        "streetAddress": "1 Example Street",
        "addressLocality": "London",

```

---

<sup>8</sup> <https://5stardata.info/en/>

```

        "postalCode": "W1A 1EG"
    },
    "url": "https://example.edu/",
    "makesOffer": [
        {
            "@type": "Offer",
            "itemOffered": "https://example.edu/Opportunity/001"
        }
    ]
}, {
    "@id": "https://example.edu/Opportunity/001",
    "@type": "Course",
    "name": "Example course",
    "description": "An example course.",
    "ext:assessmentMethod": "Example assessment methods.",
    "audience": {
        "@type": "EducationalAudience",
        "description": "Example audience information."
    },
    "coursePrerequisites": "Example entry requirements.",
    "ext:equipmentRequired": "Example equipment required.",
    "courseCode": "Dent001",
    "educationalCredentialAwarded": "http://example.edu/Quals/Q001",
    "hasCourseInstance": [
        "http://example.edu/Presentation/001-2022",
        "http://example.edu/Presentation/001-2021"
    ],
    "educationalAlignment": {
        "@type": "AlignmentObject",
        "alignmentType": "educationalSubject",
        "targetName": "1.1",
        "targetDescription": "Medicine and dentistry",
        "educationalFramework": "SSA"
    },
    "teaches": [
        "An example learning objective",
        "Another example learning objective"
    ],
    "url": "https://example.edu/courses/Dent001",
    "ext:whereNext": "Example further opportunities."
}, {
    "@id": "http://example.edu/Quals/Q001",
    "@type": "EducationalOccupationalCredential",
    "credentialCategory": {
        "@type": "DefinedTerm",
        "inDefinedTermSet": {
            "name": "UK Credential Categories"
        },
        "termCode": "NVQ"
    },
    "name": "Example Qualification",
    "description": "An example qualification.",
    "offers": {

```

```

        "@type": "Offer",
        "offeredBy": "https://example.edu/AwardingBody/AB001"
    },
    "identifier": {
        "@type": "PropertyValue",
        "propertyID": "LearningAimsCode",
        "value": "123435678"
    },
    "educationalLevel": {
        "@type": "DefinedTerm",
        "inDefinedTermSet": {
            "name": "RQF"
        },
        "termCode": "5"
    },
    "educationalAlignment": [
        {
            "@type": "AlignmentObject",
            "alignmentType": "industry",
            "targetName": "86230",
            "targetDescription": "Dental practice activities",
            "educationalFramework": "UKSIC2007"
        },
        {
            "@type": "AlignmentObject",
            "alignmentType": "occupation",
            "targetName": "6133",
            "targetDescription": "Dental nurses",
            "educationalFramework": "UKSOC2020"
        }
    ]
}, {
    "@id": "http://example.edu/Presentation/001-2022",
    "ext:attendancePattern": "Daily",
    "offers": {
        "price": 500,
        "priceCurrency": "GBP",
        "offeredBy": "http://example.edu/Provider/001"
    },
    "courseMode": "Classroom",
    "identifier": {
        "@type": "PropertyValue",
        "propertyID": "ESFAID",
        "value": "23af-23230ge-etc"
    },
    "start": "2022-01-01",
    "end": "2022-12-30",
    "duration": "PT1Y",
    "ext:flexibleStartIndicator": false,
    "ext:learningMethod": "Example learning methods",
    "ext:nationalDeliveryIndicator": false,
    "maximumAttendeeCapacity": 25,
    "ext:placesTaken": 25,

```

```

        "location": "https://example.org/Places/101"
    },{
        "@id": "http://example.edu/Presentation/001-2021",
        "ext:attendancePattern": "Daily",
        "offers": {
            "price": 450,
            "priceCurrency": "GBP",
            "offeredBy": "http://example.edu/Provider/001"
        },
        "courseMode": "Classroom",
        "identifier": {
            "@type": "PropertyValue",
            "propertyID": "ESFAID",
            "value": "42ga-572909a-etc"
        },
        "start": "2021-01-01",
        "end": "2021-12-30",
        "duration": "PT1Y",
        "ext:flexibleStartIndicator": false,
        "ext:learningMethod": "Example learning methods",
        "ext:nationalDeliveryIndicator": false,
        "maximumAttendeeCapacity": 20,
        "ext:placesTaken": 20,
        "location": "https://example.org/Places/101"
    },{
        "@id": "https://example.org/Places/101",
        "@type": "Place",
        "name": "Rm101 Example Campus",
        "locationRef": "Eg101",
        "address": {
            "streetAddress": "Room 101, 1 Example Street",
            "addressLocality": "London",
            "postalCode": "W1A 1EG"
        }
    }
]
}

```

#### A.4 CTDL / JSON-LD

To illustrate the choices that will have to be made in implementation details, there is often a choice between including data about classifiers or identifiers (and similar objects) or referring to that data by a URI. The latter should allow consuming applications to obtain the data when needed, though this requires that someone maintain a webserver to deliver that information. In the example, the difference would be that encoding a SOC code would look like

```
"ceterms:industryType": "https://example.org/lsip/UKSOC2020/6133"
```

instead of

```
"ceterms:industryType":{
    {
```

```

        "@type": "ceterms:CredentialAlignmentObject",
        "ceterms:alignmentType": "occupation",
        "ceterms:codedNotation": "6133",
        "ceterms:targetNodeName": {
            "en": "Dental nurses"
        },
        "ceterms:framework": "https://example.org/lcip/UKSOC2020",
        "ceterms:frameworkName": {
            "en": "UK SOC 2020"
        }
    }
}

```

NOTE: we will need to find or create suitable terms for those marked as "ext:" (external/local extensions)

```

{
  "@context": [
    "https://schema.org/docs/jsonldcontext.json",
    "http://credreg.net/ctdl/schema/context/json",
    {
      "ext": "https://example.org/extension/"
    }
  ],
  "@graph": [
    {
      "@id": "http://example.edu/Provider/001",
      "@type": "ceterms:CredentialOrganization",
      "ceterms:name": {"en": "Example College"},
      "ceterms:identifier": {
        "@type": "ceterms:IdentifierValue",
        "ceterms:identifierTypeName": "UKPRN",
        "ceterms:identifierValueCode": "123435678"
      },
      "ceterms:address": {
        "@type": "ceterms:Place",
        "ceterms:streetAddress": {"en": "1 Example Street"},
        "ceterms:addressLocality": {"en": "London"},
        "ceterms:postalCode": "W1A 1EG"
      },
      "ceterms:subjectWebpage": "https://example.edu/",
      "ceterms:offers": [
        "https://example.edu/Opportunity/001"
      ]
    },
    {
      "@id": "https://example.edu/Opportunity/001",
      "@type": "ceterms:LearningOpportunityProfile",
      "ceterms:name": {"en": "Example course"},
      "ceterms:description": {"en": "An example course."},
      "ceterms:assessmentMethodDescription": {
        "en": "Example assessment methods."
      }
    }
  ]
}

```



```

    },
    "schema:audience": {
      "@type": "schema:EducationalAudience",
      "schema:description": "Example audience information."
    },
  },
  "ceterms:entryCondition": {
    "@type": "ceterms:ConditionProfile",
    "ceterms:description": {"en": "An example course"}
  },
  },
  "ext:equipementRequired": {"en": "Example equipment required."},
  "ceterms:codedNotation": "Dent001",
  "ceterms:isPreparationFor": "http://example.edu/Quals/Q001",
  "ceterms:hasOffering": [
    "http://example.edu/Presentation/001-2022",
    "http://example.edu/Presentation/001-2021"
  ],
  },
  "ceterms:subject": {
    "@type": "skos:Concept",
    "skos:notation": "1.1",
    "skos:prefLabel": "Medicine and dentistry",
    "skos:inScheme": "http://example.org/lqip/SSA"
  },
  },
  "ceterms:teaches": [{
    "ceasn:competencyText":
      {"en": "An example learning objective"}
  }, {
    "ceasn:competencyText":
      {"en": "Another example learning objective"}
  }
  ],
  "ceterms:subjectWebpage": "https://example.edu/courses/Dent001",
  "ext:whereNext": {"en": "Example further opportunities."}
}, {
  "@id": "http://example.edu/Quals/Q001",
  "@type": [
    "ceterms:EducationalOccupationalCredential",
    "https://example.org/lqip-types/NVQ"
  ],
  },
  "ceterms:name": {"en": "Example Qualification"},
  "ceterms:description": {"en": "An example qualification."},
  "ceterms:offeredBy": "https://example.edu/AwardingBody/AB001",
  "ceterms:identifier": {
    "@type": "ceterms:IdentifierValue",
    "ceterms:identifierTypeName": {"en": "LearningAimsCode"},
    "ceterms:identifierValueCode": "123435678"
  },
  },
  "schema:educationalLevel": {
    "@type": "schema:DefinedTerm",
    "schema:inDefinedTermSet": {
      "schema:name": "RQF"
    }
  }
}

```

```

    },
    "schema:termCode": "5"
  },
  "ceterms:industryType": {
    "@type": "ceterms:CredentialAlignmentObject",
    "ceterms:alignmentType": "industry",
    "ceterms:codedNotation": "86230",
    "ceterms:targetNodeName": {
      "en": "Dental practice activities"
    },
    "ceterms:framework": "https://example.org/lsip/UKSIC2007",
    "ceterms:frameworkName": {
      "en": "UK SIC 2007"
    }
  },
  "ceterms:occupationType": {
    "@type": "ceterms:CredentialAlignmentObject",
    "ceterms:alignmentType": "occupation",
    "ceterms:codedNotation": "6133",
    "ceterms:targetNodeName": {
      "en": "Dental nurses"
    },
    "ceterms:framework": "https://example.org/lsip/UKSOC2020",
    "ceterms:frameworkName": {
      "en": "UK SOC 2020"
    }
  },
}, {
  "@id": "http://example.edu/Presentation/001-2022",
  "@type": "ceterms:ScheduledOffering",
  "ceterms:scheduleTimingType": {
    "ceterms:targetNode": "scheduleTiming:Weekdays"},
  "ceterms:scheduleFrequencyType": {
    "ceterms:targetNode": "scheduleFrequency:MultiplePerWeek"},
  "ceterms:estimatedCost": {
    "@type": "ceterms:CostProfile",
    "ceterms:price": 500,
    "ceterms:currency": "GBP"
  },
  "ceterms:deliveryTypeDescription": "Classroom",
  "ceterms:identifier": {
    "@type": "ceterms:IdentifierValue",
    "ceterms:identifierTypeName": "ESFAID",
    "ceterms:identifierValueCode": "23af-23230ge-etc"
  },
  "schema:start": "2022-01-01",
  "schema:end": "2022-12-30",
  "ceterms:estimatedDuration": {
    "@type": "ceterms:DurationProfile",
    "ceterms:exactDuration": "PT1Y"
  }
}

```

```

    },
    "ceterms:offerFrequencyType":
      {"ceterms:targetNode": "scheduleFrequency:Annually"},
    "ceterms:learningMethodDescription": "Example learning methods",
    "ext:nationalDeliveryIndicator": false,
    "schema:maximumAttendeeCapacity": 25,
    "ext:placesTaken": 25,
    "ceterms:availableAt": "https://example.org/Places/101"
  },{
    "@id": "http://example.edu/Presentation/001-2021",
    "@type": "ceterms:ScheduledOffering",
    "ceterms:scheduleTimingType":
      {"ceterms:targetNode": "scheduleTiming:Weekdays"},
    "ceterms:scheduleFrequencyType":
      {"ceterms:targetNode": "scheduleFrequency:MultiplePerWeek"},
    "ceterms:estimatedCost": {
      "@type": "ceterms:CostProfile",
      "ceterms:price": 450,
      "ceterms:currency": "GBP"
    },
    "ceterms:deliveryTypeDescription": "Classroom",
    "ceterms:identifier": {
      "@type": "ceterms:IdentifierValue",
      "ceterms:identifierTypeName": "ESFAID",
      "ceterms:identifierValueCode": "42ga-572909a-etc"
    },
    "schema:start": "2021-01-01",
    "schema:end": "2021-12-30",
    "ceterms:estimatedDuration": {
      "@type": "ceterms:DurationProfile",
      "ceterms:exactDuration": "PT1Y"
    },
    "ceterms:offerFrequencyType":
      {"ceterms:targetNode": "scheduleFrequency:Annually"},
    "ceterms:learningMethodDescription": "Example learning methods",
    "ext:nationalDeliveryIndicator": false,
    "schema:maximumAttendeeCapacity": 20,
    "ext:placesTaken": 20,
    "ceterms:availableAt": "https://example.org/Places/101"
  },{
    "@id": "https://example.org/Places/101",
    "@type": "ceterms:Place",
    "ceterms:name": "Rm101 Example Campus",
    "ceterms:identifier": {
      "@type": "ceterms:IdentifierValue",
      "ceterms:identifierValueCode": "Eg101"
    },
    "ceterms:streetAddress": {"en": "Room 101, 1 Example Street"},
    "ceterms:addressLocality": {"en": "London"},
    "ceterms:postalCode": "W1A 1EG"
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} ] }