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Global Micro-Credential Schema Mapping: A Vital Step Towards Interoperability and Mobility

August 20th, 2024

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Abstract

The CTDL Advisory Group embarked on a project to map micro-credential schemas using the Data Ecosystem Schema Mapper (DESM) tool. This global initiative aimed to develop an understanding of how different micro-credential data standards or other regional and local documents can be aligned to improve interoperability. Micro-credential schemas define key information such as name, description, credits earned, cost, competencies, digital issuance, and more. These elements are essential for individuals and organizations to assess the value of micro-credentials and take actions such as hiring, credit transfer towards other credentials, and other important use cases. By identifying baseline micro-credential element definitions and crosswalking them, the project sought to facilitate better data integration and recognition of micro-credentials across various regions and organizations. This report outlines the project's benefits, methodology, and key reflections, offering insights into the importance of schema harmonization in the evolving landscape of micro-credentials.

An essential next step is expanding the number of schemas and countries involved, and broadening the terms covered. Collaboration with UNESCO and other international bodies is key to scaling and enriching this mapping

initiative. This will enhance the global applicability and utility of micro-credentials, enabling more organizations and individuals to benefit from these innovative credentials.

Why a Micro-Credential Schema Mapping is Important at a Global Level

Micro-credentials are innovative, stackable credentials that incrementally document what a person knows and can do. They are typically designed to offer flexibility for busy schedules, affordability, adaptability to job market changes, and recognition of informal learning. Despite ongoing debates on their classification, micro-credentials are at the forefront of digital credentialing, often awarded as digital badges or other types of digital credentials. However, the varied definitions of micro-credentials across different regions and contexts make it challenging to understand their meaning and value consistently. This inconsistency can lead to missed opportunities for individuals and organizations. To address this issue, Credential Engine's Credential Transparency Description Language (CTDL) Advisory Group initiated a schema mapping project that aligns different micro-credential definitions from around the world to facilitate understanding and comparison. The Global Micro-Credential Schema Mapping project involves taking different schemas and frameworks for defining micro-credentials and lining them up against each other for comparison. This mapping does not involve any personally identifiable information about individuals or the credentials issued to them; it focuses on the metadata structures defining micro-credentials. The project includes schema terms defining the micro-credential owner or offeror, issuer, assertion, and claim. The benefits of such mappings include:

- **Global Transferability:** Schema mapping aids in providing context for transferring credentials across systems and geographic areas, ensuring they are recognized and valued globally.
- **Clarity in Complex Landscapes:** It offers clear definitions and structures, helping to navigate the complex landscape of different credentialing systems.
- **Rapid Response to Changes:** Mapping enables quick adaptations to changes in the job market and educational requirements, allowing credentialing systems to remain relevant.
- **Guidance for Policymakers:** It provides insights and frameworks that can assist policymakers in developing and refining micro-credential governance and recommendations, ensuring they meet the needs of various stakeholders.
- **Collaboration and Credit Recognition:** Facilitates collaboration between

institutions and improves the recognition of credits in numerous contexts, including international admissions and among different types of educational structures, promoting mobility and lifelong learning.

- **Facilitation of Comparisons and Compatibility:** Detailed mapping quantifies compatibility, supports micro-credential transferability between regions, grounds conversations with standardized definitions, and aids collaboration among diverse credentialing systems.
- **Enhancing Global Portability:** Schema mapping supports interoperability, aids in understanding regional nuances, enhances the recognition and application of micro-credentials across diverse regions and organizations, promotes mobility, and breaks down silos.

Understanding regional definitions and regulations, establishing a shared language, and building trust are crucial in navigating the varied contexts of micro-credentials.

Introduction to the Data Ecosystem Schema Mapping Tool

The Data Ecosystem Schema Mapper (DESM) is a specialized web application designed for creating, editing, maintaining, viewing, and exporting crosswalks between different data models (schemas). DESM was used to complete the schema definition crosswalks for the micro-credential schema mapping project.

This tool was developed through the collaborative efforts of the Open Competency and Data Standards Networks, affiliated with the T3 Innovation Network and sponsored by the U.S. Chamber of Commerce Foundation. As a relatively new tool, it's noteworthy that expertise in its use is still being developed. Also, DESM upgrades will support future expansions of the initial mapping project, allowing for further development and refinement.

How DESM Works

The table below outlines the key steps and crosswalking relationships created in DESM. Using this tool involves uploading schemas for mapping and aligning their definitions based on categories of information and the degree of similarity or difference between these definitions.

<table>
<tr><th>Aspect</th><th>Description</th></tr>
<tr><td>Categorizing Information</td><td>
Entity Types: Most data models categorize the information they cover into several related types of entities or classes. For example, in the micro-credential domain, entities might include Issuers (who provide the credentials), Holders (who receive the credentials), and the Credentials themselves. Each schema will likely do this in a different way. Each type of entity will have its own characteristics and relationships to other entities. Different data models will normally differ in how they handle these entities. There are also differences in how the data are expressed. For instance:

Relational Databases: Organize data into tables with rows and columns.
XML or JSON Hierarchies: Structure data in a tree format, where each piece of information is nested within another.
Linked Data (RDF): Connects data about different entities into a linked web of data using a variety of defined relationships.

Common Model: To map across different schemas, it is necessary to create a common model for the domain and then map classes and properties from each schema to that data model. We refer to the categories in the common model as abstract classes.
</td></tr>
<tr><td>Pairwise Mappings</td><td>
Schema Upload: Schemas, including their terms, definitions, and relationships to different types of entities, are uploaded to the tool.
Synthetic Spine: For each abstract class a "synthetic spine" is created that encompasses all relevant terms from the schemas being mapped. It allows for semantic alignment, meaning if the terms from two schemas align closely with the synthetic spine, their relationship can be inferred without direct mapping. The synthetic spine that is created can be more or less comprehensive to allow the degree of semantic precision required for a given mapping.
Alignment Process: Users create pairwise alignments between terms. These alignments are expressed through mappings from terms in the schema to the synthetic spine, or if no term exists in the synthetic spine a new one is added that is identical to the term being mapped.
</td></tr>
</table>

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DESM Terminology

To aid understanding, here is a summary of key terminology used in DESM:

- **Abstract Model:** A comprehensive model that covers the entire range of information included in all the schemas being mapped.
- **Abstract Class:** A category within the abstract model that represents a type of entity, like "Issuer" or "Credential."
- **Class:** Part of a data model that specifies what kind of entity is being described, like a specific type of credential or issuer.
- **Data Model:** A representation showing types of entities, their key characteristics, and possible relationships within a domain.
- **Domain Mapping:** The process of selecting relevant terms for an abstract class from the various categories in the schemas being mapped.
- **Property:** An element or attribute used to describe a characteristic of an entity, such as the name of a credential or the date it was issued.
- **Property Mapping:** Expressing the relationship between the definition of a property in a schema and a definition of a property in the synthetic spine.
- **Schema:** A technical definition outlining the categories and properties in a data model.
- **Synthetic Spine:** A set of properties synthesized from the mapped schemas for an abstract class, enabling alignment and comparison.

Micro-Credential Mapping Scope, and Process

This mapping project represents the first step toward creating a comprehensive global micro-credential schema mapping. It is not a complete mapping of all schemas within the entire domain but serves as an initial exploration. The project's scope was determined by selecting schemas that are widely significant and leveraging input from Credential Engine's CTDL Advisory Group and available expertise.

Given that we needed to test and validate the scoping for this mapping, the initial project was defined with a small group of volunteers. These volunteers had an interest in the development of DESM, experience with schema mappings, and expertise about particular schemas. The inclusion or exclusion of any schema in this initial mapping should not be seen as a judgment of its importance.

Mapping Scope

This section outlines the schemas included in the initial mapping project. Each schema was chosen based on its significance and the expertise available. The table below shows the names of the six schemas that were mapped, their publishers, brief descriptions, and the individuals responsible for the mappings comprising the mapping team. For complete information about each schema, please refer to the publishers' full documentation.

A Schema Name	B Schema Publisher	C Description / link	D Mapper (Affiliation)
Credential Description Transparency Language (CTDL)	Credential Engine	An RDF linked data vocabulary for describing all types of Credentials and many related entities important to education and employment. https://credreg.net/ctdl/terms	Nate Argo (Credential Engine)
European Learning Model (ELM)*	European Commission	The ELM provides the first unitary and comprehensive data model across the European Education Area.* https://europa.eu/europass/elm-browser/	Ildiko Mazar (ELM / NTT DATA)
MyCreds Canada	Instructure	MyCreds is Canada's official credential wallet for post-secondary learners and graduates. https://mycreds.ca/	Takis Diakoumis (Instructure)
My eQuals Badges	Instructure	My eQuals is the official tertiary credentials digital platform for the higher education sector, students, and verifiers for Australian and New Zealand. https://www.myequals.edu.au/	Takis Diakoumis (Instructure)
Open Badges 2.0 (OB2)	1EdTech	This specification describes a method for packaging information about accomplishments, embedding it into portable image files as digital badges, and establishing resources for its validation. https://www.imsglobal.org/sites/default/files/Badges/OBv2p0Final/	Nate Otto (Skybridge Skills)

A Schema Name	B Schema Publisher	C Description / link	D Mapper (Affiliation)
Open Badges 3.0 (OB3)	1EdTech	This specification is a new version of the 1EdTech Open Badges Specification that aligns with the conventions of the Verifiable Credentials Data Model v2.0 for the use cases of Defined Achievement Claim and a Skill Claim. https://www.imsglobal.org/spec/ob/v3p0/	Nate Otto (Skybridge Skills)
Verifiable Credentials (VC)	W3C	The vocabulary used by the Verifiable Credentials data model, which provides a mechanism to express any type of credential on the Web in a way that is cryptographically secure, privacy respecting, and machine-verifiable. https://www.w3.org/2018/credentials/ https://www.w3.org/TR/vc-data-model-2.0/	Phil Barker (Credential Engine / Cetis LLP)

* A sample credential and property mapping to ELM[1] that is compliant with the European Council Recommendation for a European approach to micro-credentials for lifelong learning and employability[2] was prepared by Ildiko Mazar and endorsed by the European Commission DG EMPL.

While these schemas can be used for more than just micro-credentials, not all of them cover everything necessary to provide information about a micro-credential as awarded to an individual. The mapping team's efforts focused on properties that help meet the requirements of national and international policies for micro-credentials, such as the European Approach to Micro-credentials. We also aimed to showcase the range of possibilities offered by various data standards to inform future developments.

[1] https://europass.europa.eu/system/files/2024-05/MC-Mapping.pdf
[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022H0627%2802%29

Mapping Project Process

The project followed a structured process, led by CTDL team member Phil Barker, and was set up to ensure clarity and effectiveness in the schema mapping:

1. **Initial Meeting**: All participants met to agree on the scope and the abstract domain model. This meeting set the foundation for the mapping work.
2. **Turn-Based Mapping**: Each participant mapped their assigned schema one at a time. This approach prevented confusion that could arise if multiple participants were mapping simultaneously and making changes to the synthetic spine. It also allowed for better management of support efforts during the mapping process and enabled reflection on progress.
3. **Review and Revisions**: A second meeting was held with all participants to review the completed mappings. Any necessary revisions were agreed upon during this meeting.

The project was initially planned to be a short-term effort, lasting three months with each individual contributing up to eight hours of work. However, the project took about twice as long due to scheduling issues and the addition of two extra schemas, W3C Verifiable Credentials and Open Badges.

Throughout the project, one-to-one assistance was provided by the project lead. This support helped introduce each mapper to the DESM tool and address any conceptual issues, such as how to map to the abstract domain model.

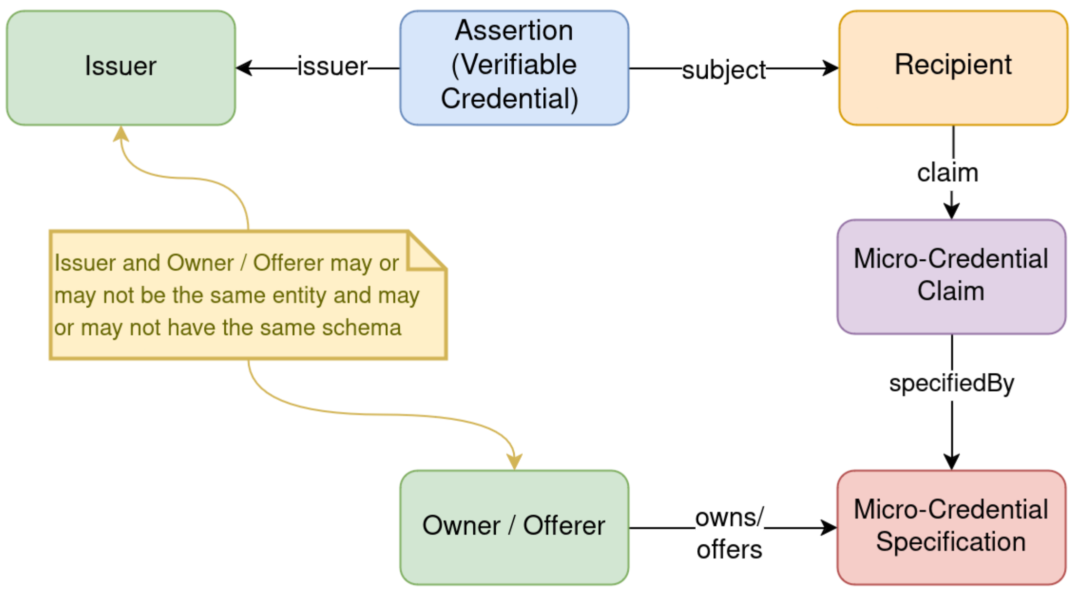
In some cases, schemas were available in formats that could be directly uploaded in their native formats and used with the DESM tool (i.e., CTDL, W3C Verifiable Credentials). Minor amendments were needed for some schemas to fix syntax or adjust property class relationships (i.e., Open Badges 3.0, ELM). For other schemas (i.e., MyCreds, My eQuals, Open Badges 2.0), it was necessary to construct a CSV file based on tables in the published standard or the system used to manage the schema. These modifications required a certain level of technical know-how but were not overly complex.

After completing all mappings, a final "all hands" meeting was held to discuss the mappings, make any adjustments to the mappings, address any remaining issues, and reflect on the mapping team's experiences.

Defining the Abstract Domain Model

The project scoping included defining the abstract domain model within the broad scope of micro-credentials that are issued as Verifiable Credentials or Open Badges. The abstract domain model we agreed on for these micro-credentials is shown in figure 1 below and the following Abstract Class Definitions.

(figure 1)



Abstract Class Definitions

- **Assertion**: The core component of a verifiable credential, which provides statements about the issuance of the micro-credential to an individual.
- **Issuer**: The organization or person responsible for issuing the micro-credential to the recipient.
- **Micro-credential Claim**: The specific details or parameters of the recipient's achievement that the micro-credential represents.
- **Micro-credential Specification**: The detailed description of the micro-credential that can be awarded to a person.
- **Owner/Offerer**: The organization or person that owns the rights to or provides the micro-credential.
- **Recipient**: The individual who receives the micro-credential (Note: The recipient was out of scope for this initial mapping).

These choices are intended to reflect the approaches of the various schemas being mapped rather than recommending a "best" data model. For example, two of the schemas, ELM and OB3, are based directly on W3C Verifiable Credentials, while others, MyCreds Canada, MyEquals and OB2, have a shared lineage. Therefore, it makes sense to use a model similar to the W3C VC data model for the relationship of an issuer asserting a claim about a subject/recipient. However, this relationship does not appear in CTDL, which deals with credentials as entities offered by credentialing organizations, a relationship that is also present in ELM.

This distinction leads to a separation of micro-credentials into:

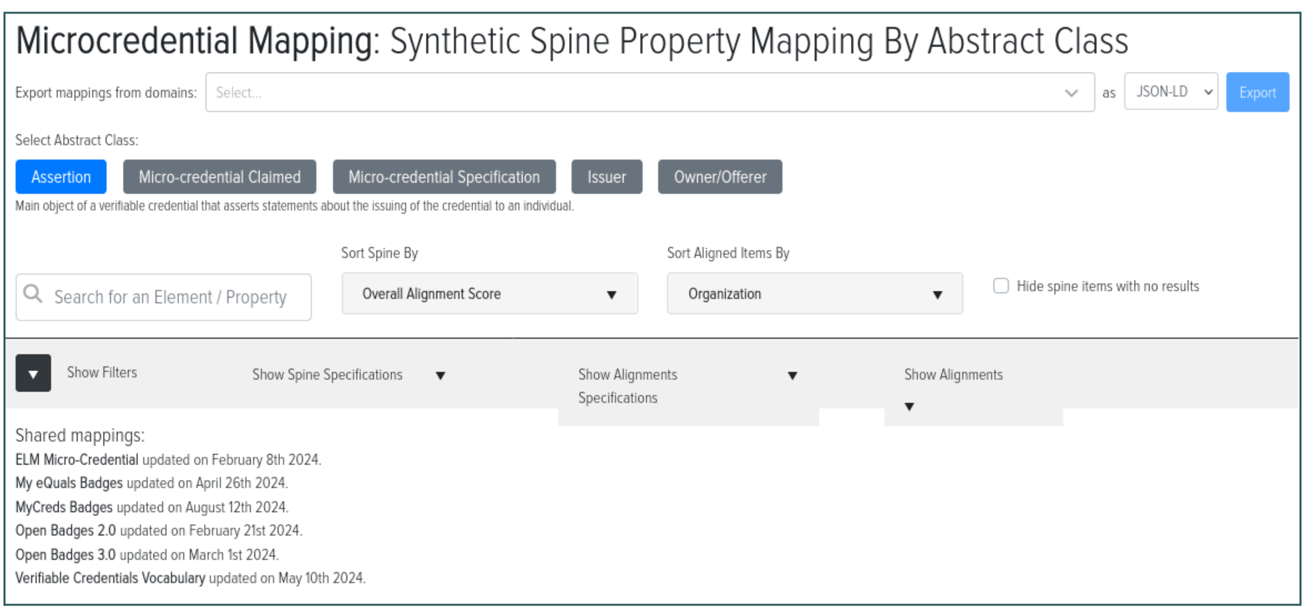
- A claim made about a recipient (the assertion in the model).
- A description of what is designed, offered, and may be earned (the micro-credential specification in the model).

Linking the different domain models from schemas designed for related but different purposes is one of the most challenging aspects of schema mapping and results in some complexities in the process.

Property Mappings

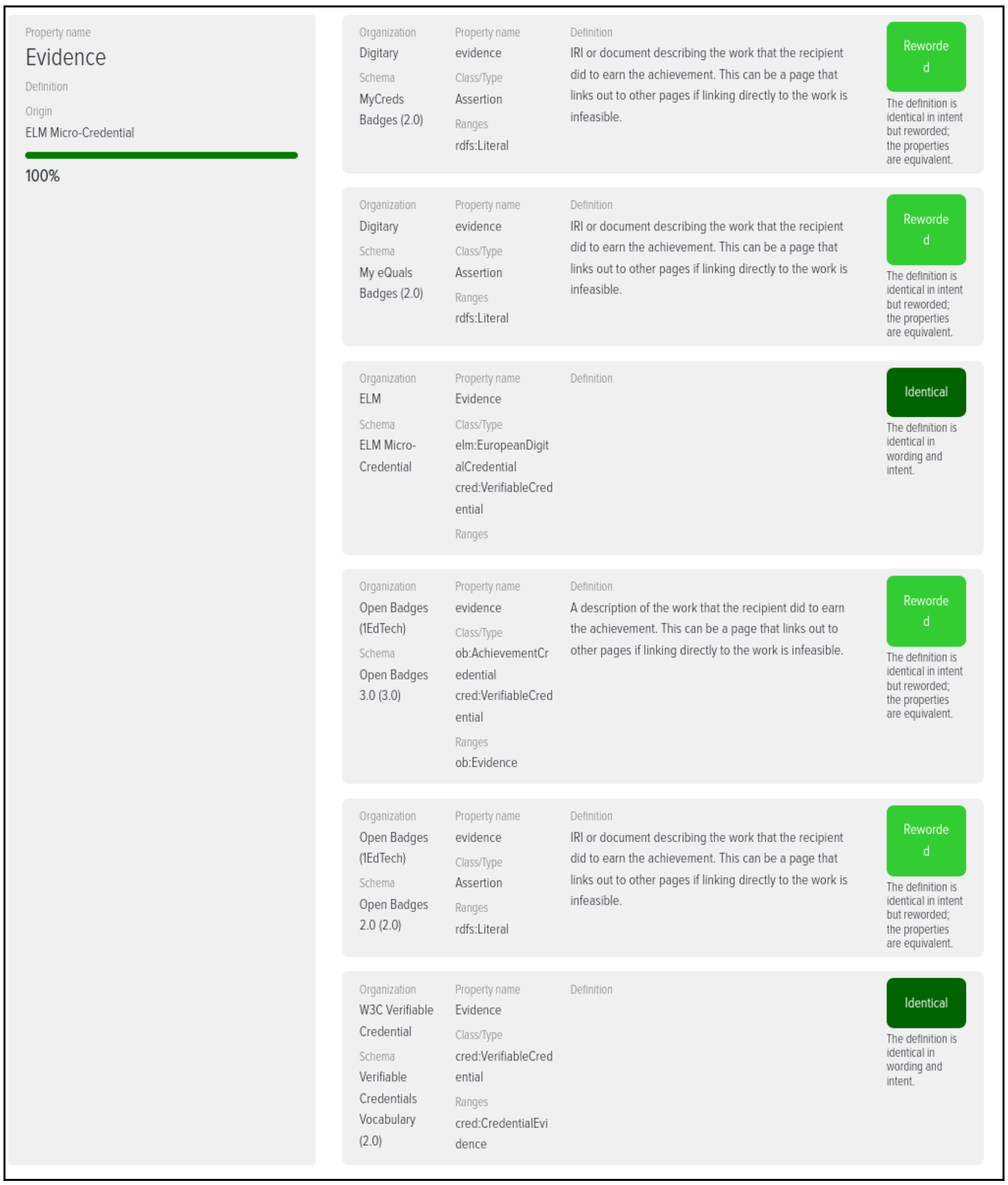
The results of the micro-credential mapping project are available as public information on [Credential Engine's DESM](). The menu across the top of the page allows you to choose the abstract domain for which mappings to a synthetic spine are available. Immediately below this menu, there are various options for filtering and sorting the mapped properties. Directly above the menu, you will find the export options (*see figure 2 below*).

(figure 2)



Each DESM mapping page shows spine terms (on the left) mapped to properties (on the right), including information about the spine terms, the property, and the semantic alignment between the two (see figure 3 below). For example, “Evidence” with an origin of ELM Micro-Credential is in the spine, and the list of properties aligned to it are shown to its right. The available information includes property names and definitions, the organization that manages the term, the schema each term is included in, and other relevant information directly from the schema, as well as the definition of each pairwise crosswalk. Note that in the example shown, definitions for some terms are not available from the source term definition files used for the schemas, including the spine term.

(figure 3)



The semantic alignment between the spine and each property is shown. The degree of alignment varies from "identical" to "no match". The full set of alignment definitions used for this project are:

- **Identical:** The definition is identical in wording and intent.
- **Reworded:** The definition is identical in intent but reworded; the properties are equivalent.
- **Inverse:** The spine term and the term being mapped are exact inverses of each other.
- **Similar:** The definition is similar in intent but with significant wording differences.
- **Transformed:** A simple data transformation will yield a value for the spine term; for example, concatenating values from several properties being mapped. The transform should be described in a comment on the alignment.
- **Has sub-property:** The term in the spine has a broader definition, covering all the cases where the term being mapped would be used and more.
- **Sub-property Of:** The term in the spine has a narrower definition, covering a subset of the cases where the term being mapped would be used.
- **Concept:** The definition is related only at a conceptual level; no simple transformation can render the data from one to the other.
- **No Match:** There is no match for the spine term in the schema being mapped.

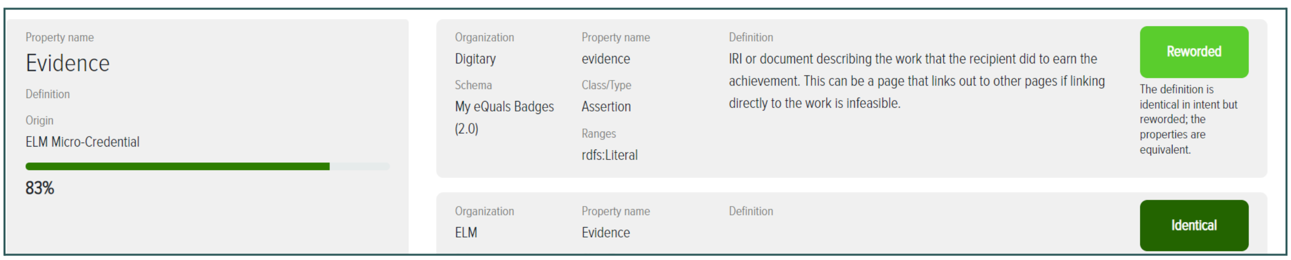
Note that "Has sub-property" and "Sub-property Of" are inverses of each other. "Has sub-property" indicates that the spine term has a broader definition and the term being mapped a narrower definition, while "Sub-property Of" indicates that the spine term has a narrower definition and the term being mapped a broader definition.

The degree of semantic alignment determines whether data expressed in one schema can be translated to another. For example, if terms from two schemas are both mapped to the spine as "identical" or "reworded", it should be possible to translate the data values between those terms. Similarly, it should be possible to translate data values from a term identical or reworded to the spine term to one that is broader (i.e., mapped using "Sub-property Of"). In other cases, the chance of translating data decreases as the degree of semantic alignment decreases.

In some cases, the translation of data between schemas might be improved or made possible through the use of a transform. For example, a value "full name" in one schema might be semantically close to the concatenation of the values for "given name" and "family name" in another. Other examples might arise from differences in the domain models for the two schemas; for example, handling "nicknames" and "legal names" might be modeled differently in different schemas. The development of a means to handle these transforms is being investigated in the DESM development project. In this project, we used a mapping predicate of "transformed" to indicate where such functionality would be useful.

For the spine, the "degree of alignment" is shown as a green bar and percentage, indicating how widely represented that property is in the schemas being mapped. In the example shown in figure 4 below, 83% indicates that functionally equivalent terms are available in 5 of the 6 schemas mapped (CTDL is the exception because it does not cover personal data about an individual and the credentials they have earned). This information is relevant to several use cases around the development of local schemas and the support of specifications or standards, such as gap analysis when reviewing schemas and prioritization of features when developing software to process data, based on the assumption that the most widely represented terms are the most important.

(figure 4)



Reflections on the Mappings

In this section, key insights and lessons learned from the micro-credential mapping are summarized. Some reflections focus on the mapping process itself, while others pertain to the nature of the schemas being mapped. Although we haven't labeled them as recommendations, we hope these reflections will aid future mappings and the development of schemas for micro-credentials.

Reflection: Harmonization Aids Interoperability Within a Data Ecosystem
When two schemas are based on a common model and vocabulary, the semantic alignment between them is high, and the prospects for translating data between them are very good. For example, ELM directly imports W3C VC terms and is based on the same model for expressing assertions regarding credential subjects, thus ensuring a good data translation. However, successful translation isn't guaranteed if local content requirements (e.g., language) differ, which is beyond the scope of this mapping. This use of common terms between different standards exemplifies schema harmonization, which involves using a common modeling paradigm (like RDF) and considering other data models and vocabularies in the same domain.

Reflection: Complementary Schemas Are Also Beneficial

The full results show that different schemas take different views on what constitutes a micro-credential: something awarded to a person (e.g., Issuer,Assertion, Recipient entities) or something offered by an organization (e.g., Offerer/Owner and Micro-Credential Specification entities). Initially, this difference led to confusion, but it became clear that schemas like CTDL and Verifiable Credentials address different aspects of the same domain. Each schema supplies a means of describing what the other omits. Thus, it is possible to combine W3C VC and CTDL to cover the same extent as ELM, another example of schema harmonization.

Reflection: Different Models Are Challenging to Encompass

As the term-definition and modeling choices between schemas diverge, the prospects of translating data between them decrease. For example, ELM and OB3 have slightly differing views on what the credential subject is, leading to difficulties in partitioning properties between Recipient and Microcredential Claim in the abstract model. Additional functionality being developed for DESM and increased expertise in future iterations may help express these mappings better. However, divergence in modeling introduces complexities.

Reflection: A Comprehensive Spine Is Required to Show All Relationships

The representation of semantic alignments between schemas in DESM depends on choices made by mappers based on the project scope. Starting with CTDL and ELM terms meant that these were added to the spines for relevant abstract classes first. Stronger matches between terms in OB2, MyCreds, and MyEquals are only shown if mappers chose to add these terms to the spine. A weak semantic match between both and another term in the spine does not infer a stronger match between them.

Reflection: Understanding Differences and Identifying Gaps

Balancing an all-encompassing spine with the difficulty of mapping to a large vocabulary is crucial. It is possible that a schema can have a more indepth set of defined schema terms and other schemas being mapped do not. This distinction is important to document with the mapping. This may signify gaps that other schemas can fill and utilize existing definitions to fill those gaps.

Reflection: Mappers Gained Valuable Insights

Members of the mapping team found the experience useful in learning more about schemas beyond their expertise. Facilitating mapping projects requires knowledge of multiple schemas or a level of expertise to be able to complete an analysis of the schemas to be mapped to properly scope a project. DESM facilitates team mapping, and participating in the mapping process helps individuals gain a broader understanding of the approaches taken by others in the same domain. This essential understanding gained from the mapping process may prove as important as the published crosswalks.

Implications for Future Work

A recurring theme identified by the CTDL Advisory Group is the potential benefits of micro-credential schema mapping, emphasizing the need for technical and educational frameworks that define micro-credentials to be transportable and interoperable globally. However, this process is often dependent on local factors. Understanding and working with this variability is essential, whether dealing with foundational standards or the ultimate aim of individuals gaining recognition for their skills. Mapping micro-credential schemas addresses some of these challenges but will not provide a full solution; in some cases, it may only reveal that the issues are larger than initially foreseen.

Many policies for micro-credentials exist only as documents, not as technical implementations. These policies describe the information that should be provided as part of (or referenced by) a micro-credential when it is issued, but do not specify how to encode that information. The output of this project can be seen as a collection of possible ways to define and encode that information. While not complete, the micro-credential schema mapping already indicates what is possible without inventing anything new. Expanding the project will demonstrate that even more is achievable. Approaching the technical implementation of policy frameworks with the mindset of doing so within existing technical frameworks is probably the single most important step that can be taken toward the interoperability of issued micro-credentials. An expanded micro-credential mapping covering more aspects of micro-credentials in more formats will assist with this. The ability to extend a schema for local use with terms borrowed from other existing schemas will likely be crucial in facilitating reuse (see the reflections above on harmonization and complementary schemas).

When micro-credentials are used globally, challenges arise in data translation and recognition. Data translation is facilitated by using similar terms in a similar data model, and DESM can indicate when this is the case. DESM can, to some extent, also record data transformations that are necessary when semantic alignment is not present. However, DESM does this in an abstract way and does not have access to the data itself. Therefore, information about data translation would need to be interpreted by one of the readily available tools that can process the data directly. While support for the recognition of micro-credentials is beyond the scope of DESM, the data translation facilitated by DESM would assist in evaluating whether a micro-credential contains the necessary information and what that information means.

To advance this initiative, we call for the expansion of the number of schemas and countries involved, and for broadening the terms covered. By collaborating with UNESCO and other international bodies, we can scale and enrich this mapping effort. Such an expansion is vital for enhancing the global applicability and utility of micro-credentials, thereby enabling more organizations and individuals to benefit from these innovative credentials.

Conclusion

The CTDL Advisory Group's project to map global micro-credential schemas using the Data Ecosystem Schema Mapper (DESM) represents a significant initial step toward achieving greater interoperability and understanding of micro-credentials across different regions and contexts. By aligning various schemas, this project has established a foundational framework for improved data integration and recognition of micro-credentials worldwide. This initial exploration has underscored both the potential benefits and the challenges associated with schema harmonization. The project demonstrated that using common models and vocabularies can facilitate data translation and interoperability. However, it also highlighted the complexities that arise from differing term definitions and modeling choices. The reflections from the mapping process emphasize the importance of broad expertise, close collaboration, and ongoing efforts to address gaps and differences between schemas.

The implications for future work are clear. Expanding the scope of micro-credential mappings to encompass more aspects and formats will further enhance interoperability. Addressing local variability and ensuring that technical implementations align with policy frameworks are critical steps toward global recognition of micro-credentials. While DESM provides a robust foundation for mapping, further development and the use of complementary tools will be essential in overcoming data translation and recognition challenges.

In conclusion, the project's success is a testament to the collaborative efforts of the mapping team and the support from the broader community. As we continue to refine and expand these mappings, we move closer to a world where micro-credentials are seamlessly integrated and recognized, unlocking greater opportunities for individuals and organizations alike.

Acknowledgements

Credential Engine would like to acknowledge the CTDL Advisory Group and its chairperson, Simone Ravaioli (Instructure) for developing the framework for the micro-credential schema mapping project and the hard work and time devoted to this project by the people who performed the mappings reported here. We especially want to recognize their good humor and understanding regarding some of the difficulties encountered. Thank you to Phil Barker (Cetis LLP), Nate Argo (Credential Engine), Ildiko Mazar (ELM / NTT DATA), Takis Diakoumis (Instructure), and Nate Otto (Skybridge Skills).

We also acknowledge the U.S. Chamber of Commerce Foundation's T3 Innovation Network program for the development of DESM and the funders of that development.

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- Thea Sommerseth Myhren, CEO and Co-Founder, Diwala

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Resources

1. Benefits That Arise from Global Micro-Credential Schema Mappings (Upd...
2. Credential Engine's DESM: Micro-Credential Schema Mapping
3. Navigating the Micro-Credential Landscape: A Global Mapping Initiative
4. Data Ecosystem Schema Mapping Tool (DESM) - Resources - T3 Network Hub
5. Guidelines for Planning a Successful Data Ecosystem Schema (DESM) Mapping Project - Resources - T3 Network Hub

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About Credential Engine

Credential Engine is a non-profit whose mission is to map the credential landscape with clear and consistent information, fueling the creation of resources that empower people to find the pathways that are best for them. Credential Engine provides a suite of web-based services that creates for the first time a centralized Credential Registry to house up-to-date information about all credentials, the Credential Transparency Description Language (CTDL) a common description language to enable credential comparability, and a platform to support customized applications to search and retrieve information about credentials.

PLEASE CITE AS: Credential Engine. (2024). Global Micro-Credential Schema Mapping: A Vital Step Towards Interoperability and Mobility, Washington, DC: Credential Engine