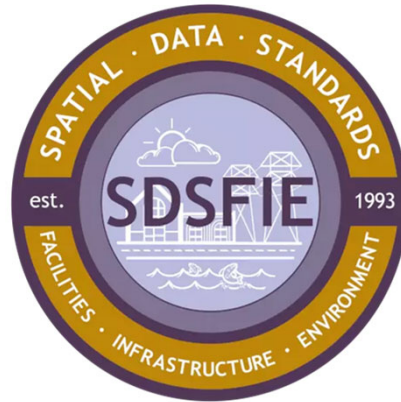




ASSISTANT SECRETARY OF DEFENSE FOR ENERGY, INSTALLATIONS, AND ENVIRONMENT

SDSFIE Training – Webinar Series:

Understanding the Vector (V) Standard



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Welcome. This is the “Understanding the Vector (V) Standard” webinar, a resource for SDSFIE Training.



Audience and Prerequisites

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Intended Audience: all users

Prerequisites: none for this training content

Optional Background Videos:

- “*SDSFIE Program Overview*”, or its shortened version: “*What is SDSFIE?*”
- “*SDSFIE Use and Governance*”

All videos available at <https://www.sdsfieonline.org/Support/Training>

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This training resource is designed for a general audience.

Viewers need not have any prior familiarity with SDSFIE or its components. The 3 background training resources listed here are optional, but they may add to your overall understanding of SDSFIE.

Note that “What is SDSFIE” is an abbreviated version of the more detailed “SDSFIE Program Overview” presentation.



Training Goal and Objectives

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Goal: All participants understand the purpose, structure, and parts of the SDSFIE family of standards (or “standards framework”)

Objectives – The audience understands:

- What SDSFIE is, what DoD Components are involved, and who governs the standards
- What SDSFIE-Vector (V) is, what its purpose is, and how it is implemented
- SDSFIE-V Data Model Terminology and Process
- SDSFIE-V Logical Data Model Hierarchy
- SDSFIE-V Implementation Guidance
- SDSFIE-V Mandate and Recent Versions
- SDSFIE-V Model Elements: Terminology and Properties
- SDSFIE-V Adaptation Process
- SDSFIE Portal

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The overall goal for our training resources is that all SDSFIE users understand the purpose, structure, and parts of the SDSFIE family of standards or “standards framework”.

The specific objectives for *this* presentation are that the audience gains an understanding of the following:

- What SDSFIE is and what DoD Components are involved
- What SDSFIE-Vector, or “V”, is, what its purpose is, and how it is implemented
- SDSFIE-V Data Model Terminology and Process
- the Logical Data Model Hierarchy
- Implementation Guidance
- the Vector standard Mandate and Recent Versions
- Model Elements and Terminology
- Element Properties
- the Adaptation Process, and
- the SDSFIE Portal, your point of entry for accessing standards, tools, policies and guidance



SDSFIE Defined

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*Spatial **D**ata **S**tandards for **F**acilities, **I**nfrastructure, and **E**nvironment*

SDSFIE Definition = *a framework for a family of standards governed by the **IGG**, supported with online tools, technical support, and training, to meet the DODI goal of making Installation and Civil Works geospatial data and services visible, accessible, understandable, linked, trusted, interoperable, and secure across the DoD*

SDSFIE is a family of 6 standards:

- Vector
- Quality
- Metadata
- Raster
- Portrayal*
- Endorsed*

IGI&S
Governance
Group (**IGG**)
Components:



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SDSFIE is an acronym for: Spatial Data Standards for Facilities, Infrastructure, and Environment. The “F-I-E” thus represents the different types of data in the installation, range, and training space that our standards encompass.

The Definition of SDSFIE provides both its Structure,

a framework for a family of standards governed by the Installation Geospatial Information and Services Governance Group, or “IGG”, supported with online tools, technical support, and training,

and its Purpose,

meeting the DODI goal of making Installation and Civil Works geospatial data and services visible, accessible, understandable, linked, trusted, interoperable, and secure, or “VAULTIS”, across the DoD.

In the last decade, SDSFIE has evolved in a number of ways. This includes expanding from the single Vector standard to a family of 6 standards, with the additions of the Quality, Metadata, and Raster standards, and the emerging Portrayal and Endorsed standards.

The IGG is composed of DoD Components that include the Army, Navy, Air Force, Marine Corps, the Army Corps of Engineers, and the Washington Headquarters Service. The IGG is chaired by the Geospatial Information Officer, or “GIO”, for the Assistant Secretary of Defense for Energy, Installations, and Environment, and is supported by the Defense Installation Spatial Data Infrastructure or “DISDI” Program.



SDSFIE-Vector (V) Defined

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SDSFIE-V:

- A content standard for vector geospatial data used in DoD installation and civil works GIS
 - consensus on set of well-defined real-world entities and characteristics of each
 - provides agreed-upon *structure* for the “containers” that hold the data records
- Provides “master dictionary” supporting interoperability across DoD worldwide
- Standardizes common core geospatial data sets used across DoD Installation Geospatial Information and Services (IGI&S) and civil works missions
- Complies with DoD IT Standards policy and governance mandates
 - logical data model (LDM)
 - can be implemented in any GIS software (vendor neutral)
- Is fundamentally structured in alignment with the DoD Real Property Information Model (RPIM) and accountability requirements
- SDSFIE-V “Gold”
 - based on consensus input from all IGG Components and SMEs
 - enterprise-level core data model
- DoD Components build “adaptation” of the Gold model

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SDSFIE-V is a content standard for vector geospatial data. SDSFIE-V provides a shared, standardized schema for the types of geospatial entities and their characteristics, or attributes, which are used in Installation Geospatial Information and Services, or “IGI&S” and Civil Works missions throughout the DoD.

To be clear, a content standard does not, in and of itself, contain any data records. Rather, as a consensus data content standard it provides an agreed upon structure for the database containers that hold actual data records. This is not unlike a set of spreadsheets, each with well-defined and agreed-upon column headings, but without any values populating the rows.

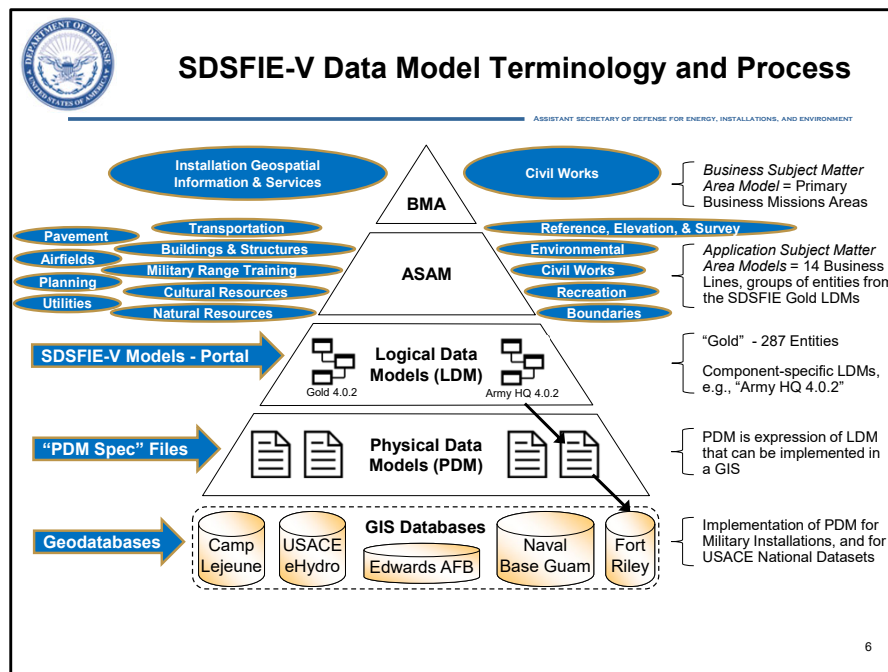
The Purpose of SDSFIE-V is:

- To provide a “master dictionary” of data elements which support interoperability and common understanding of installation geospatial data for DoD worldwide
- To standardize the common core geospatial data sets used across DoD for installation management, energy and environment missions, test & training range operations, and Civil Works
- To comply with DoD IT Standards policy and governance mandates, including developing, registering, and publishing the standard in the form of a logical data model, which means it is vendor neutral and thus can be implemented in any commercial or open-source GIS software today

SDSFIE-V is fundamentally structured in alignment with the DoD Real Property Information Model, or “RPIM”, and real property accountability requirements. This promotes a core goal of IGI&S which is to provide a geospatial feature type in which key attribute data can be stored for each DoD real property asset. This is important for purposes such as real property accounting and reconciliation, and for maintenance cost forecasting.

SDSFIE-V Gold is an enterprise-level, versioned data model that contains the core entities, attributes and picklists defined by subject matter experts representing all IGG Components and their requirements.

Lastly, each DoD Component has the ability to build their own version, or “adaptation”, of the Gold model. These adaptations are tailored to Component-specific business requirements and systems.



This is a data modeling diagram, which is helpful in understanding the SDSFIE-Vector modeling process.

The pyramidal shape represents an increasing level of detail moving from the top two tiers, where a more general conceptual model based on mission requirements and rules is defined, to a highly detailed and structured set of data tables, relationships, and rules that are implemented in a GIS at the bottom.

At the top of this pyramid are the Business Mission Areas. Here we determine the scope of what data is applicable to SDSFIE, and thus what the SDSFIE-V model and resulting GIS database will contain.

Next, the Application Subject Matter Area Model or "ASAM" level, organizes and groups the data defined above into the 14 distinct subject matter areas shown here.

At the Logical Data Model or "LDM" level, the specific structure of the IGI&S and Civil Works requirements for data layers, or in "modeling speak" entities, relationships between entities, attributes about each entity, and picklists for certain attributes are defined. These model elements are established using documented modeling rules and best practices. These will be defined in greater detail in a later slide.

Component-specific LDMs are developed from a version of the consensus core "Gold" SDSFIE-V model, and then are reviewed and approved, at which point they can be expressed as, or transformed to, a physical data model, or "PDM".

The SDSFIE Portal system provides for PDM download in either in Excel workbook format, perhaps to serve as a local data dictionary, or in "PDM Spec" format.

The PDM Spec file is used to transfer the logical schema of an SDSFIE-V data model to the GIS.

An Esri geodatabase created in this manner is compliant to the approved LDM from which it is produced and is ready to accept data in the standardized format.

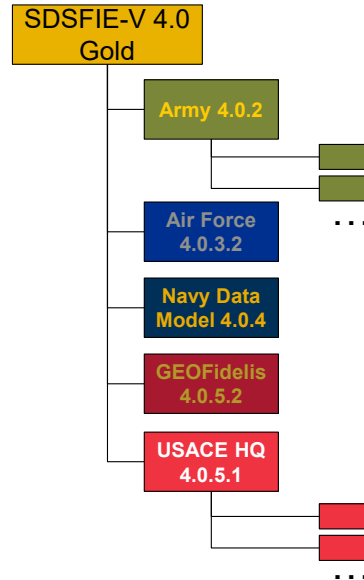
It is important to point out that this discussion is about modeling and the structure of the data container, with no data involved. The population with records of points, lines, polygons and associated tabular attribute data come into play when data is subsequently loaded into a compliant Esri geodatabase using workflows such as the SDSFIE Portal's Data Migrator.



SDSFIE-V Logical Data Models

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- In SDSFIE-V, a “Model” consists of an organized set of elements
- In each Version of SDSFIE-V (e.g., 3.1, 4.0 or 5.0), there is a Gold model that is the root of all other models
- Each Service adapts the Gold model to create their own Headquarters Adaptation model
- Services may allow lower echelons to develop their own Sub-Adaptation
- All adaptations must adhere to SDSFIE-V Implementation Guidance (SVIG)



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In SDSFIE-V, models consist of a defined set of elements.

One important part of DoD’s VAULTIS goal is interoperability. In the case of installation and civil works datasets, interoperability would mean that the data from different installations can be easily aggregated at the Component-level, and those aggregate data stores from different Components can be seamlessly rolled up at the DoD-level.

To achieve this interoperability but provide flexibility for Components, there is a model hierarchy within any version of the model. The “Gold” version is at the top of this structure, with Component-specific models derived or “adapted” from the Gold parent. Components can then further tailor the model for specific elements of their organizations through the “adaptation” process, which will be explained in more detail later in this presentation.

Both the Gold LDMs and their adaptations must adhere to the rules specified in the SDSFIE-V Implementation Guidance or “SVIG” to ensure interoperability.



The SVIG Rules

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SVIG = SDSFIE Vector Implementation Guidance

Specifies rules and best practices for:

- All SDSFIE Vector LDMs
 - Gold
 - Component HQ Adaptations
 - Component Sub-Adaptations
- Adaptation Submission Requirements
- Global Element Properties
 - Model Name and Alias
 - Definition, Description, Note
- Element-specific Properties



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The SDSFIE Vector Implementation Guidance or “SVIG” document is our “rule book” for creating and versioning our Vector Gold model and subsequent Component adaptations, as well as the submittal requirements and review process. The SVIG specifies the model elements and their relationships, properties common to all types of elements, and rules about properties unique to each type of element. Additionally, the SVIG provides best practices for element naming, and guidance for adding location, measurement, and unit of measure attributes.

This is a detailed document, and we won’t do a deep dive today. However, it is important to have this document on hand when building or reviewing an adaptation.

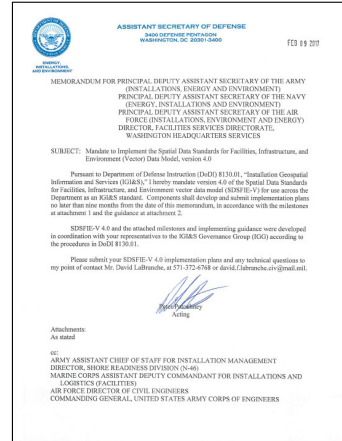
Each version of the SVIG corresponds to a major release of the Gold model. A new version of the SVIG , Version 5, is currently under review and is expected to be approved and published in conjunction with SDSFIE-V Gold version 5.



SDSFIE-V Mandate and Versioning

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- SDSFIE-V 4.0 was DoD mandated on 9 February 2016
 - Implementation by the DoD Components was required to be complete 1 January 2021
 - Actual completion not achieved until December 2021
- SDSFIE-V 4.0 released April 2016
- Updates to SDSFIE-V 4.0:
 - SDSFIE-V 4.0.1 (March 2018)
 - SDSFIE-V 4.0.2 (September 2018)
 - SDSFIE-V 4.0.3 (September 2020)
 - SDSFIE-V 4.0.4 (November 2020)
 - SDSFIE-V 4.0.5 (July 2021)

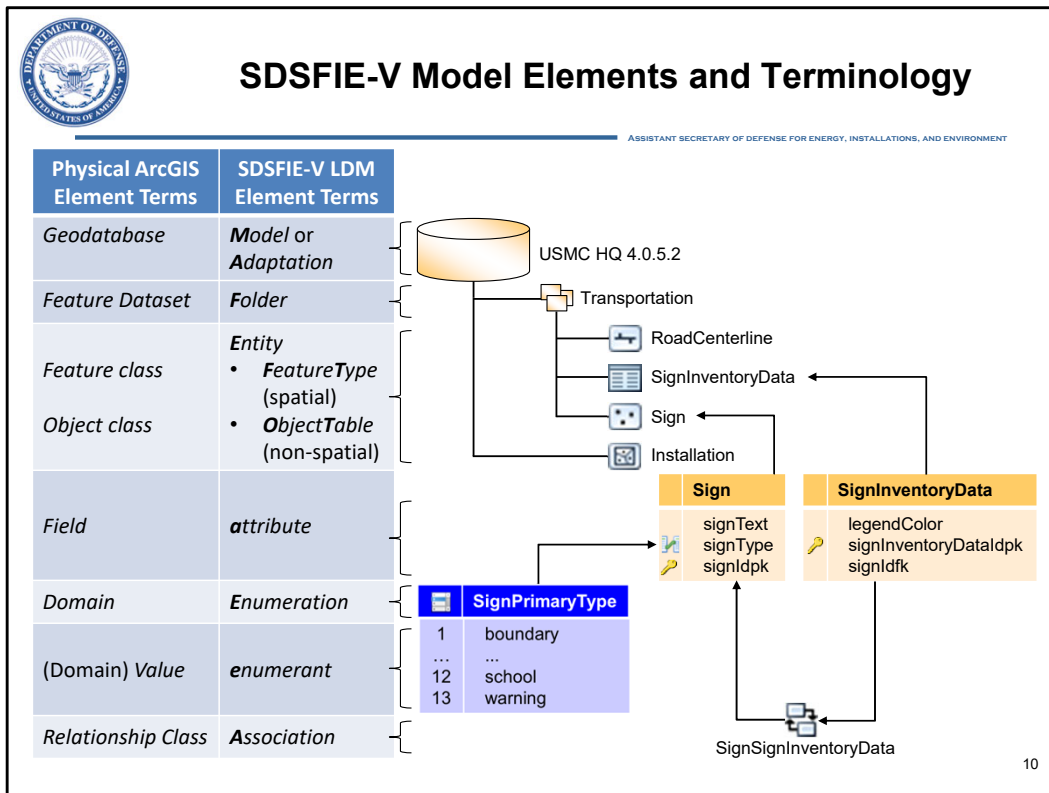


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For the SDSFIE-V Gold 4.0 release, the DoD published a memo on February 9th, 2016, shown here at lower right, that mandated the use of this version. It stated that SDSFIE-V implementation was required to be completed within 5 years, by the beginning of 2021. That ambitious goal was nearly met with all Components creating an adaptation of Gold by July 2021 and migrating their data to a geodatabase compliant to the standard by December 2021.

Throughout that period of initial 4.0 Vector implementation, there were a total of 5 releases of the consensus Gold standard. These versions were produced just ahead of each Component finalizing their adaptation of Gold, so as to encompass as many IGG-approved Gold changes as possible.

We expect the next significant release of Gold to be version 5.0.



Each SDSFIE-V logical data model element is defined in the SVIG. These elements, presented in the table's right-hand column, have a direct correspondence to the first class element objects in the ESRI geodatabase model. The definitions of the SDSFIE-V LDM elements and the correspondence to the objects in the Esri physical model are as follows:

- A *model* is simply a specific collection of SDSFIE-V elements. In Esri ArcGIS, models are implemented as geodatabases.
- A *folder* is a set of feature types that are grouped together for database organizational purposes. In ArcGIS, this corresponds to a feature dataset.
- In SDSFIE-V there are two types of *entities*: First, *feature type* represents a set of thematically equivalent features which can be expressed as records, or rows in a feature attribute table, that are linked to a geometric feature that is a point, line, or polygon. Second, *object tables* define a non-spatial data table that can be linked to one or more feature type records. In an Esri geodatabase, these elements are called feature classes and object classes
- An *attribute* of a feature type is a characteristic of the features, and can be expressed as a column in a feature attribute table. In Esri, an attribute is called a field.
- An *enumeration* constrains an attribute to a permissible set or numerical range of values. In an Esri geodatabase, the synonymous term is domain.
- An *enumerant* is a value within an enumeration. The enumerants for an enumeration comprise the permissible set of values for that enumeration. In Esri these are called domain values.
- An *association* is used to establish a relationship between two entities using a foreign key in one attribute table that points at the primary key of another entity. In an Esri geodatabase, this is called a relationship class.



SDSFIE-V Elements, and Element Properties

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Physical Element Terms, in ArcGIS Geodatabase	SDSFIE-V LDM Element Terms	SDSFIE-V Properties for All Element Types
<i>Feature Dataset</i>	<i>Folder</i>	- Alias - common name
<i>Feature class</i>	<i>Entity</i> <i>FeatureType</i> (spatial) <i>ObjectTable</i> (non-spatial)	- Model Name * - PascalCase or - camelCase
<i>Object class</i>		- Definition - Succinct characterization
<i>Field</i>	<i>attribute</i>	- Description - Elaborate on Def. - Examples; AKAs
<i>Domain</i>	<i>Enumeration</i>	- Note - Usage details - Deconfliction
<i>(Domain) Value</i>	<i>enumerant</i>	
<i>Relationship</i>	<i>Association</i>	- Justification - Rationale - References

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This table builds on columns 1 and 2 on the left that were presented in the last slide by adding a list of 6 “standard” properties that are applied to *all* types of elements – as shown in column 3.

Among the standard properties,

- The Alias is the common name, in English, of the element.
- The Model Name is typically the same as the Alias if a single word, or if multiple words a concatenation with no spaces.
- A Definition is a characterization of the element, typically in two sentences and a paragraph at the most.
- A Description is optional and may be used to elaborate on the Definition, to provide examples, and to list one or more alternative names for the element.
- A Note, also optional, may be used to provide usage or implementation details, deconfliction information regarding similar terms or concepts, and/or relationships to other model elements.
- Finally, the Justification property is where the rationale for existence of the element is stored, along with any references or citations, for example any used in establishing the Definition.

Regarding Model Names, they are either “pascal case” or “camel case”, depending on the element type.

Pascal case, where the first letter of *all* words are capitalized, is used for Folders, Entities, Enumerations, and Associations. Camel case, like Pascal case except without capitalizing the first letter of the *first* word, is used for attributes and enumerants.

Of the standard properties, and according to the SVIG, it is the Model Name and the Definition that make an element unique. Additionally, the text strings contained in these standard element property values are what is searched by the query algorithms in the Model Viewer application.



SDSFIE-V Elements, and Element Properties

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Physical Element Terms, in ArcGIS Geodatabase	SDSFIE-V LDM Element Terms	SDSFIE-V Element-Specific Properties	SDSFIE-V Properties for <i>All</i> Element Types
<i>Feature Dataset</i>	<i>Folder</i>	N/A	- Alias - common name
<i>Feature class</i>	<i>Entity</i>	- Default Geometry - one: point, line, or area - Permissible Geometry - one or more of above - Parent Entity [if subclass]	- Model Name - PascalCase or camelCase
<i>Object class</i>	<i>FeatureType</i> (spatial) <i>ObjectTable</i> (non-spatial)		- Definition - Succinct characterization
<i>Field</i>	<i>attribute</i>	- Entity Model Name - Data Type - E.g., String, Real, DateTime - Length (in most cases) - Constraining Enumeration	- Description - Elaborate on Def. - Examples; AKAs
<i>Domain</i>	<i>Enumeration</i>	Length	- Note - Usage details - Deconfliction
<i>(Domain) Value</i>	<i>enumerant</i>	Enumeration Model Name	
<i>Relationship</i>	<i>Association</i>	- Parent Entity and Attribute - Child Entity and Attribute	- Justification - Rationale - References

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The final addition to the table is an inserted column that contains element properties that are specific to *particular* types of elements. These *element-specific* properties augment the *standard* properties that we just covered.

For example, the Default and Permissible vector Geometry types must be defined for the SDSFIE-V *entity* element type. For feature types which have a spatial geometry, the “point”, “line”, and “polygon” values are used, with a value of “none” used for the non-spatial object tables.

For attributes, several element-specific properties are required.

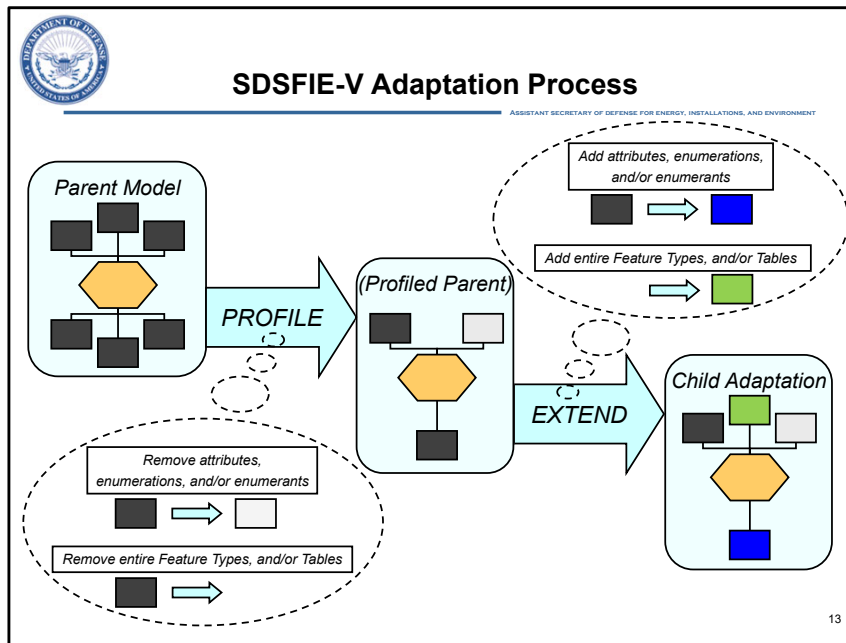
First, and because of the hierarchical nature of this data model where entities contain attributes and attributes are assigned to entities, the “Entity Model Name” is a property that must be populated to understand where the attribute belongs.

Second, because an attribute in the logical data model ultimately defines a field in a physical data table, the “Data Type” property (for example text, integer, decimal, or date/time) and “Length” property are required.

Third, the Constraining Enumeration property is required to be able to utilize a picklist for selecting from a valid set of values to populate an attribute.

For enumerants, an Enumeration Model Name property is required, again due to the hierarchical nature of this data model.

The SVIG contains the full list of element properties for a particular model version.



As stated, the SDSFIE consensus process leads our community to adopting an agreed-upon Gold model that is mandated for Component use through an adaptation process.

This diagram will depict that process in a conceptual manner. The adaptation process consists of profiling, extending, and changing the elements of a “parent” model to create an adapted “child” model. The Parent Model depicted here has 6 entities, each represented by a dark rectangle. As we just learned about SDSFIE-V’s hierarchical element structure, each of those 6 entities contain attributes, and some of those attributes may be constrained by an enumeration which in turn contains a picklist of enumerant values.

For Components, the “Parent Model” for a new headquarters adaptation will typically be the most recent version of SDSFIE-V Gold. In cases of doing a simpler “adaptation upgrade”, the Component’s previous headquarters model serves as the parent for the adaptation.

The first step in the process it to selectively Profile elements from the parent model.

The bubbles depicts the selective profiling of elements including entire feature types and object tables, as well as non-mandatory attributes, enumerations, and/or enumerants, from the parent model.

The result of profiling actions

that include removing 3 entire entities and removing lower-level elements from within one of the retained entities is an intermediate “Profiled Parent” model.

The next step in this process is to Extend the profiled parent by adding elements that do not exist in the parent model.

The next set of bubbles depict the selective extending of elements to the parent model. These “extended elements” can be entire feature types or object tables, as well as additional attributes, enumerations, or enumerants.

The result of extending actions

that include adding 1 entirely new entity and adding lower-level elements to one of the retained entities is the “Child Adaptation”.

As mentioned, the SDSFIE-V Implementation Guidance or “SVIG” specifies the rules for adaptation actions. While not depicted in this diagram, Components may customize their model through a number of allowable change actions. Components may change an Alias name, add a Note or Description if one does not exist, or augment an existing Note or Description in any type of element. As mentioned, rules specific to particular elements must also be considered when developing an adaptation. For example, attributes can be decreased in length, and constraining enumerations can be added to attributes that are unconstrained in Gold.

All of the three main steps of the Adaptation Process – profile, extend, and change – allow a Component the flexibility to shape the Gold model to meet its unique mission requirements, while maintaining the consistency that ensures interoperability with the data from other Components.



SDSFIE Portal

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- Pages on background, Governance, each standard in the family, models and tools for implementation
- Component-specific pages
- Automated Process Portal (A/P/P) for facilitating the Change Management Process (CMP)
- Tools focused on implementation of Vector model
 - Model Viewer
 - Model Builder
 - Model Comparator
 - Model Validator
 - Data Migrator
 - ArcGIS Tools
- Support: webinars, videos, and user manuals



For now: www.sdsfieonline.org, (URL may change to www.sdsfie.mil)

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The SDSFIE Portal contains a set of resources that include:

- web pages that provide background, governance, standard-specific information, and Component-specific content
- Access to the Automated Process Portal (A/P/P) which is the online system that facilitates the Change Management process, or “CMP”
- Access to support resources such as recorded webinars, training videos, and user manuals
- Access to the suite of SDSFIE tools, most of which focus on implementation of data models that are compliant to the Vector standard, and in some cases the Metadata standard. These web browser-based applications include the following:

Model Viewer enables users to browse and search single or multiple models for key terms and/or phrases, and to optionally generate logical and physical representations of a model.

Model Builder enables users to create a new model as an adaptation of an existing parent model.

Model Comparator enables users to compare two logical models: a parent, and an adaptation of that parent, and fully describes their similarities and differences at an elemental level.

Model Validator verifies a model as an adaptation of a parent model using a rule set defined in the SDSFIE Vector Implementation Guidance, and provides a spreadsheet output listing all non-compliance findings.

Data Migrator is an ArcGIS-based toolset supporting the migration of data from one adaptation of SDSFIE-V to another version of the same adaptation.

ArcGIS Tools is a set of 3 downloadable tools that run in the Esri ArcGIS environment: the “Geodatabase Creator”, the “Logical Data Model Creator”, and the “Geodatabase Comparator”



Recommendations for Next Trainings

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The next training resources in this series are:

- “*SDSFIE Program Overview*”, or its shortened version: “*What is SDSFIE?*”
- “*SDSFIE Use and Governance*”
- “*Understanding LDMs and PDMs*”
- “*SDSFIE-V Model Elements*”
- “*The SDSFIE-V Gold Model, Versioning, and Adaptations*”

All videos available at <https://www.sdsfieonline.org/Support/Training>

Note that “*What is SDSFIE-V?*” is a condensed version of *this* video.

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This concludes the “Understanding the Vector Standard” training. If you want to learn about the SDSFIE Program, SDSFIE Governance and Use, more about the SDSFIE Vector model, or other detailed SDSFIE topics, visit our Training Resources page at the URL listed here.

Note that the “*What is SDSFIE-V?*” video, not listed here, is a condensed version of *this* video.

Thank you for your interest in the SDSFIE Program.