DDI Cross-Domain Integration (DDI-CDI): An Introudction

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Outline

- Why DDI-CDI?
  - Relevance for official statistics
- Key features
  - General considerations
  - Foundational metadata
  - Data description
  - Process description
- Examples of use
- Current status/looking forward

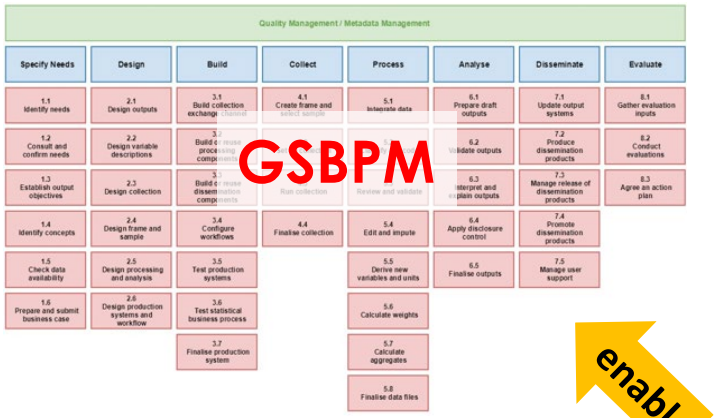
Why DDI-CDI?

- Increased focus in the scientific community on cross-domain research
  - CODATA's "Decadal Programme: Making Data Work for Cross-Domain Grand Challenges" (climate change, infectious disease, sustainable cities, disaster risk, etc.)
  - The FAIR principles (*F*indability, *A*ccessibility, *I*nteroperability, *R*eusability)
  - Organizations/initiatives: Research Data Alliance (RDA), GO FAIR, European Open Science Cloud (EOSC), etc.
- Relevance for official statistics:
  - Research to support timely policy
  - Integration of research with official data, both as source and as consumer
- DDI perspective: new and "unfamiliar" data being integrated within social, behavioural, and economic sciences
  - Unfamiliar structures and semantics
  - New technology platforms used in other domains
  - Need to describe and integrate based on standard metadata

Requirements for DDI-CDI

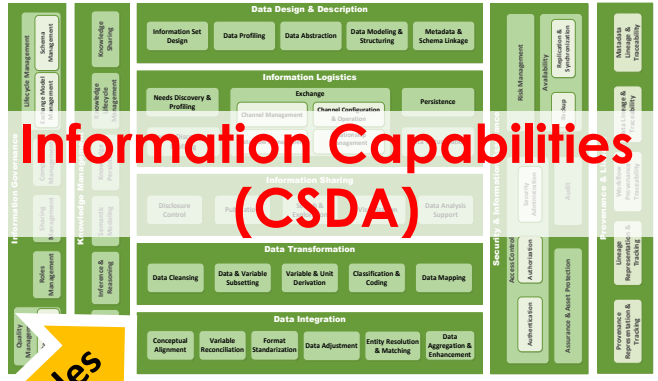
- A model which builds on and aligns with existing standards
- Domain-agnostic
- Enables integration of data across domain and institutional boundaries
  - Not focused on data management/archiving
  - Not focused on data collection/production
- Technology-agnostic/model-driven
  - UML model in “canonical” XMI
  - Implementable in different syntaxes and technology stacks
  - RDF, XML, JSON, Python, SQL, etc.
- Emphasis on data structure and data provenance/processing
- Emphasis on scalability through automation

DDI-CDI and other standards



enables

implements



enables

other implementation Standards…

integrates

DDI-CDI

integrates

integrates

integrates

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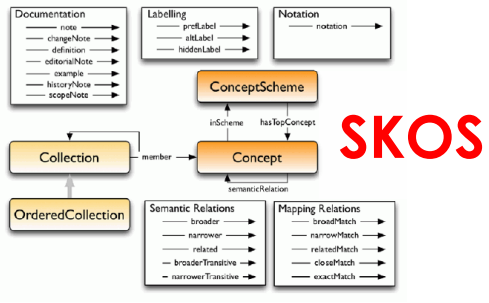
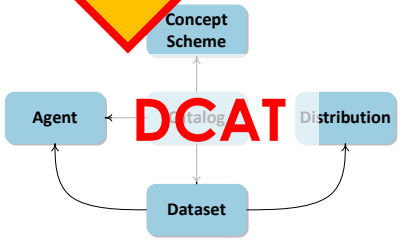
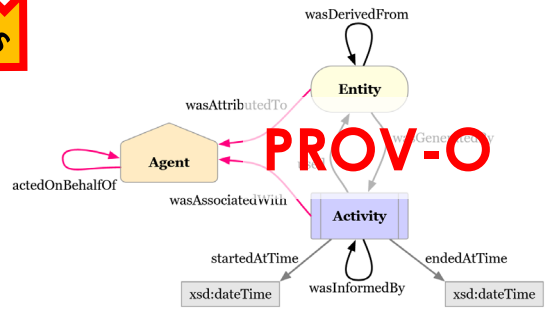






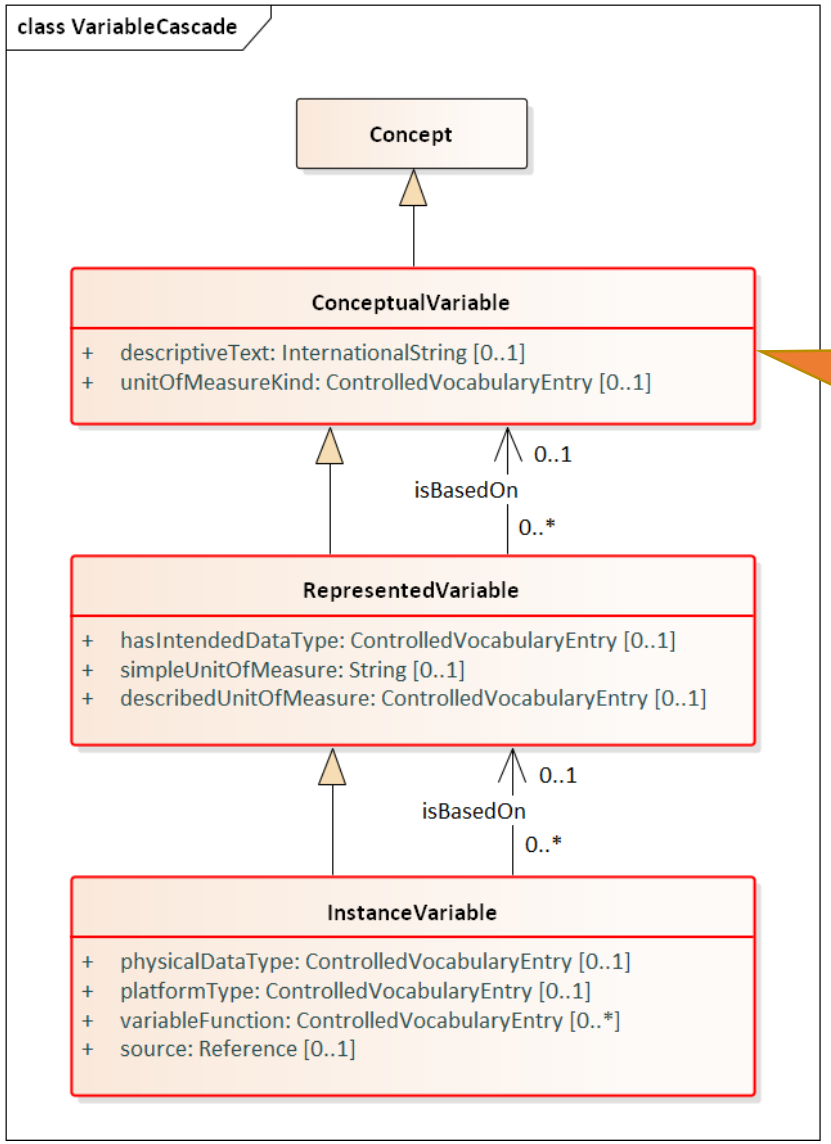
Key Features

- Foundational metadata (concepts, classifications, variables)
- Structural metadata (wide data, long/streaming data, key-value “big” data, multi-dimensional data)
- Process metadata
  - Framework for understanding how data sets are transformed and related
  - Reliance on other standards (PROV, VTL, SDTL, etc.)

Foundational Metadata

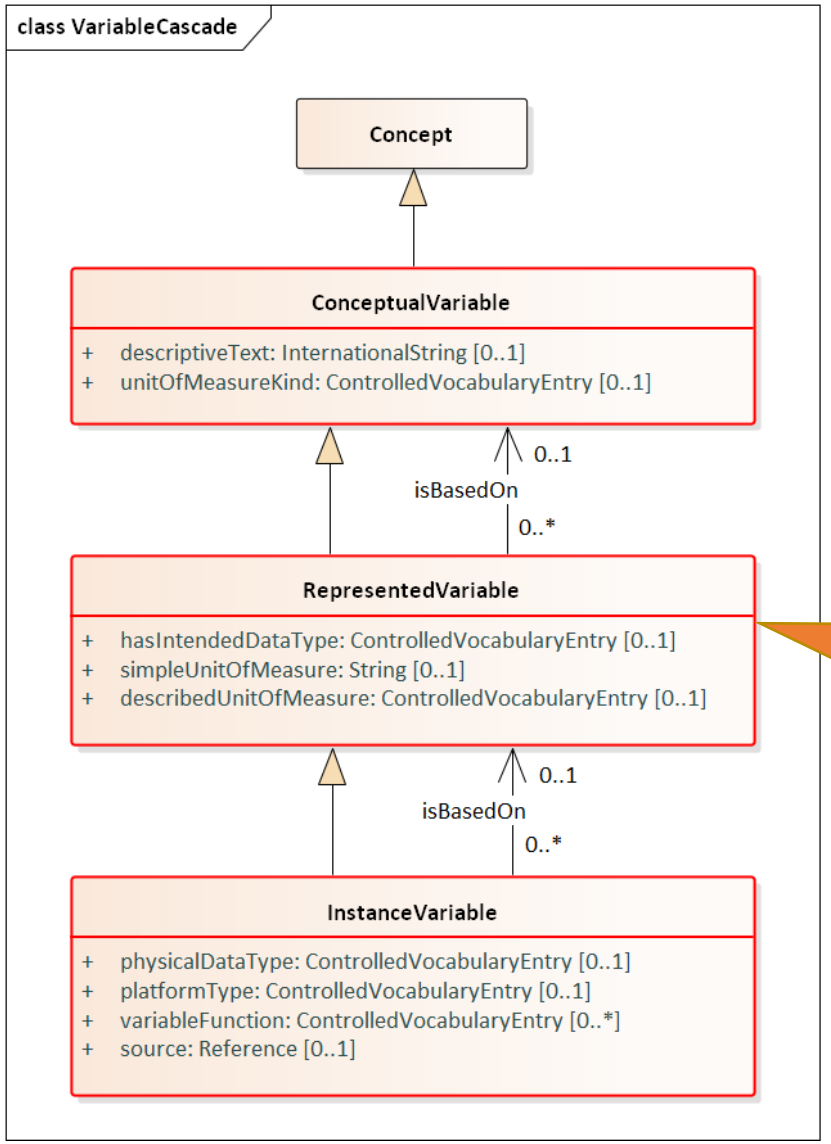
- Draws heavily on GSIM, Neuchatel, etc.
- Integrates the W3C “Simple Knowledge Organization System” (SKOS) and XKOS
- Implements the GSIM variable cascade as a key way of describing data of different types

DDI-CDI variable cascade – Conceptual



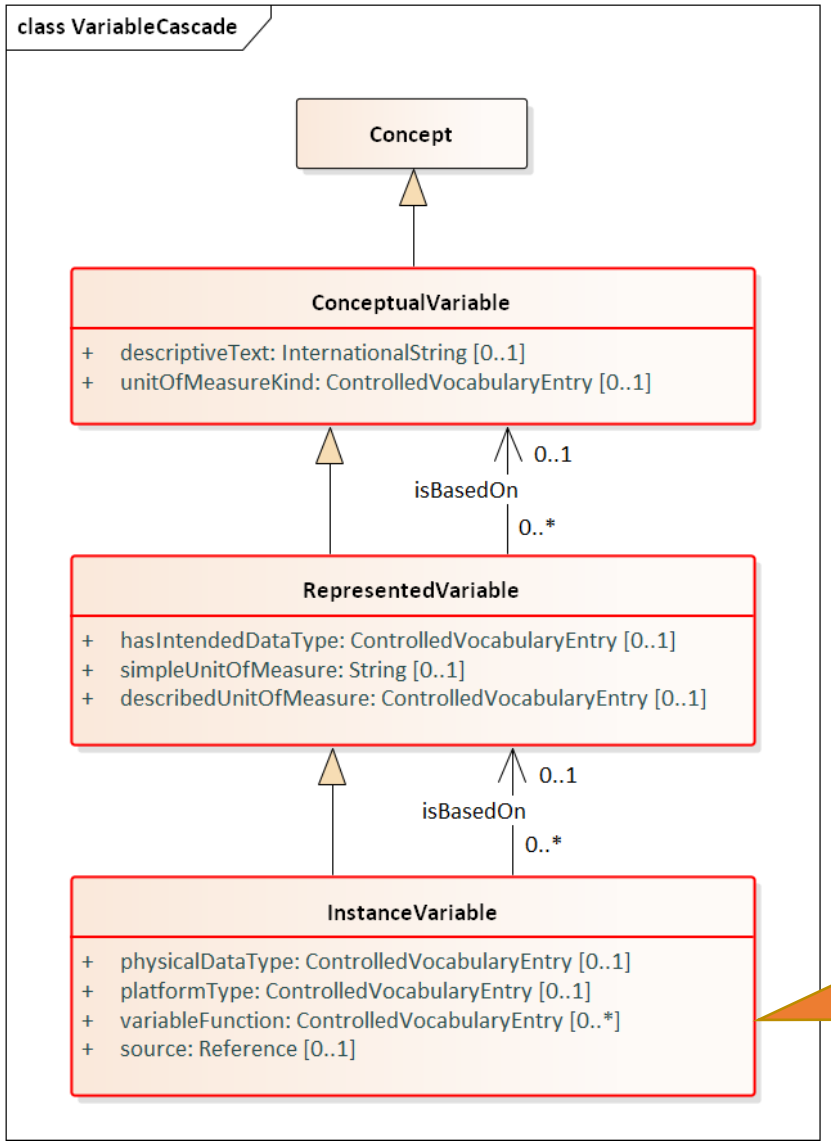
- **Variable descriptions at a high level, e.g. conceptual domains**
- **Early design data capture/ intake**
- **Broad search and discovery**
- **Least specific/Most reusable**

DDI-CDI variable cascade – Representation



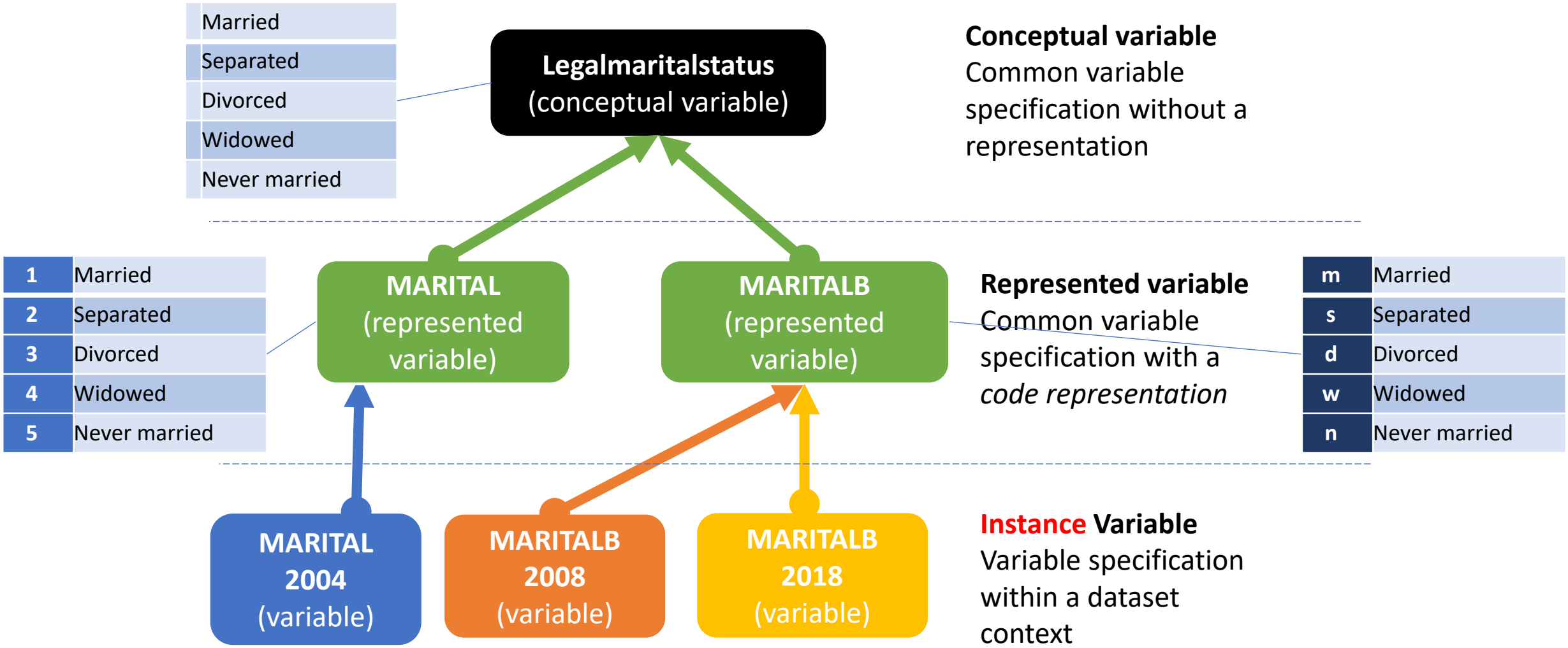
- **Variable descriptions at a detailed level, e.g. value domains**
- **Advanced design for all stages of data lifecycle**
- **Specific search and discovery**
- **More specific/Less reusable**

DDI-CDI variable cascade – Instance



- **Physical data description, e.g. physical data types**
- **Use of a variable in specific data instances**
- **Data search and discovery**
- **No reusable**

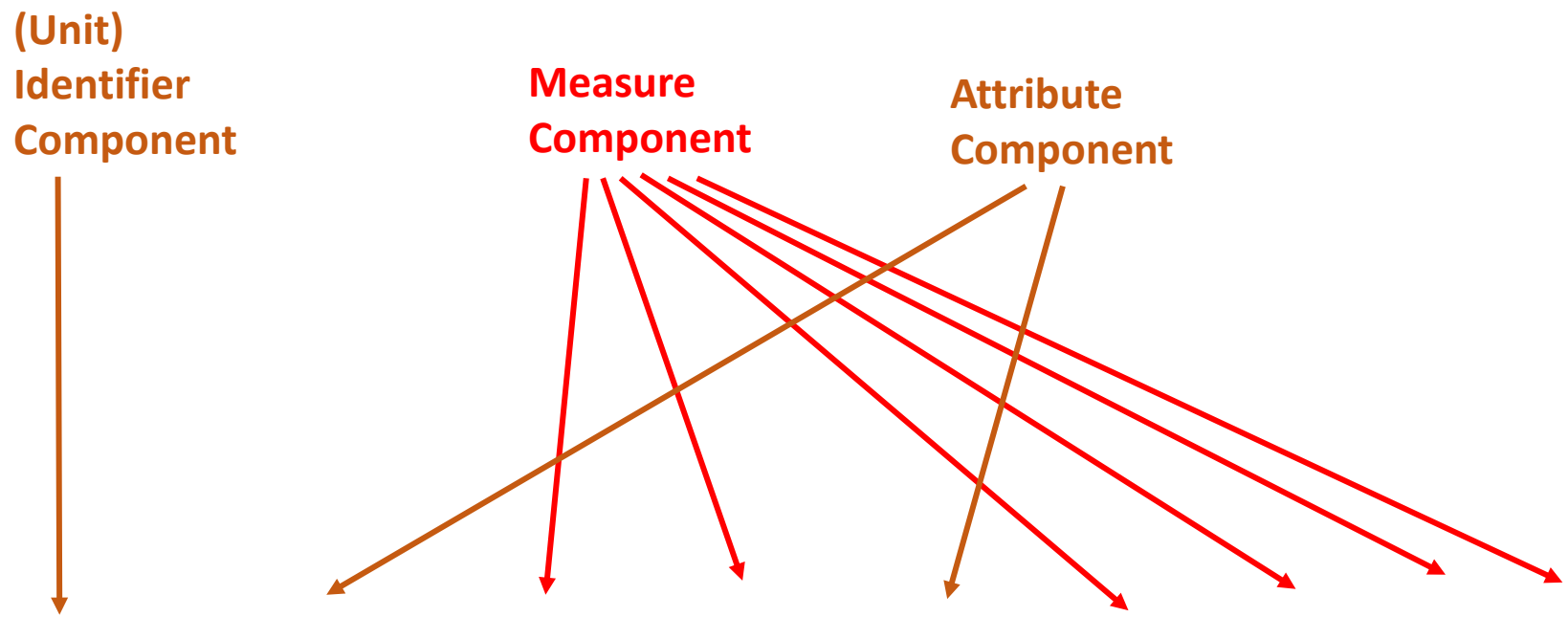
Example: comparability and traceability



DDI-CDI and Data Structure Description

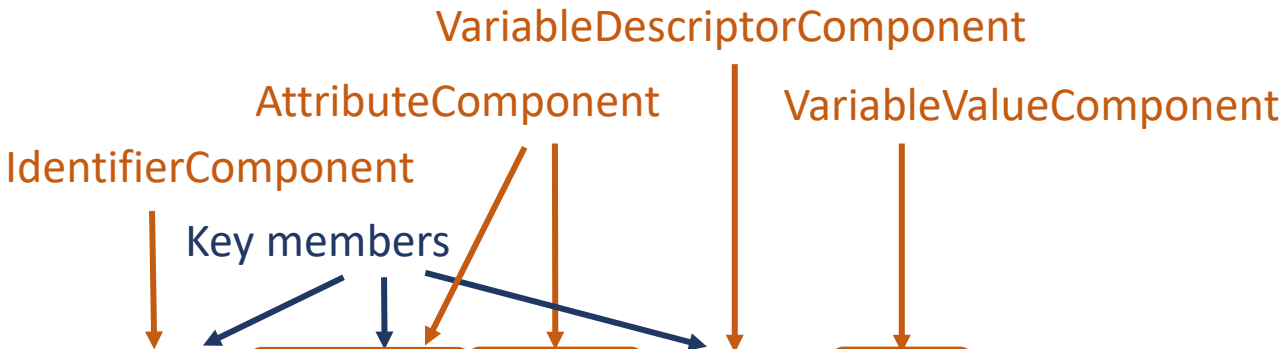
- Assigns roles to the atomic pieces of information within any given data set (identifier, measure, attribute, etc.)
- Associates the represented variables with specific roles, defines keys
- Allows for automatic transformation of data from one structure to another without loss
- Four basic types of data:
  - Wide – as with unit records
  - Long – as with event or stream data, sensor data
  - Key value – as in a key-value store (“big data”)
  - Dimensional – as with aggregate data, also indicators
  - Supports description of SQL databases using tables connected with keys

Example 1: data in wide form



entry	datetime	systolic	diastolic	position	weight	temp	pctO2	pulse
101	2020-07-14T13:54	114	70	2	83914.6	36.44	98	70
132	2020-07-14T14:03	125	86	3	68038.9	37.5	85	92

Example1: data in long form

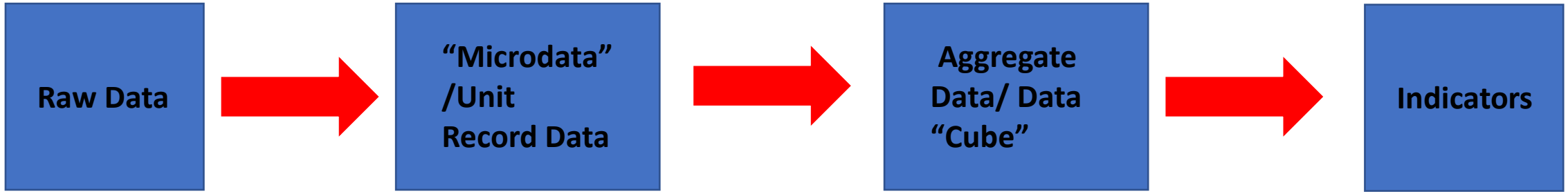


Entry	DateTime	Position	Measure	Value
101	2020-07-14T13:54	2	systolic	114
101	2020-07-14T13:54	2	diastolic	70
101	2020-07-14T13:54	2	weight	83914.60
101	2020-07-14T13:54	2	temp	36.44
101	2020-07-14T13:54	2	pctO2	98
101	2020-07-14T13:54	2	pulse	70
101	2020-07-14T13:54	2	away	n
101	2020-07-14T13:54	2	exposed	n
132	2020-07-14T14:03	3	systolic	125
132	2020-07-14T14:03	3	diastolic	86
132	2020-07-14T14:03	3	weight	68038.90
132	2020-07-14T14:03	3	temp	37.5
132	2020-07-14T14:03	3	pctO2	85
132	2020-07-14T14:03	3	pulse	92
132	2020-07-14T14:03	3	away	y
132	2020-07-14T14:03	3	exposed	n

The Variable Descriptor Component has values taken from the list of non-Unit Identifiers in the wide data set.

The “key” for each value is composed from the Identifier and the Variable Descriptor, and may include non-transposed components, e.g. DateTime.

Typical Data Transformations



- DDI – CDI describes the data at each stage, indicating the roles played by each atomic bit of data ("datum")
- DDI – CDI tracks the processing between each stage (implements PROV), reflecting the relationships between atomic datums (uses other standards for describing specific processes – VTL, SDTL, proprietary)
- Supports both declarative and procedural process description

Some Implementation Examples

- European Social Survey (ESS) Multilevel Application:
  - Pan-European social survey
  - Integrates 30+ “context” variables (Eurostat, OECD, IMF, etc.)
  - Now integrating environment data using DDI-CDI
- US Bureau of Labor Statistics: Indicators
- UK Smart Energy Research Laboratory (SERL)
  - Combines surveys, energy meter data, climate data
- Interstat project: DDI-CDI as intake model for open government data to support NGSI-LD domain models
- Others

https://codata.org/the-role-of-ddi-cdi-in-eosc-possible-uses-and-applications/

Current Status/Looking Forward

- Release anticipated by end of summer 2022
  - Will include XML reference syntax
  - RDF syntax soon to follow
  - Enhanced documentation/implementation guidance to follow
- Will form key part of the “Cross-Domain Interoperability Framework” (CDIF) being developed through the EU-funded WorldFAIR project (https://codata.org/initiatives/decadal-programme2/worldfair/)

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