

Exceptional service in the national interest



Data Modeling for RepMet

Kevin A. McMahon, Manager
Nuclear Waste Disposal Research & Analysis
OECD-NEA RepMet Meeting, October 2015, Paris, France

Presentation Outline

- What is a data model?
- Why “data modeling”?
- Interpreting a data model
 - Entities
 - Relationships
 - Cardinalities
- Simple example (grocery store) to demonstrate understanding of the methods and symbols used
- How did the RepMet data modelling team get to where we are now?
- The current data model
- Future work and metadata development
- Discussions

What is a data model?

(1) A data model is a representation of a real world situation about which data is to be collected and stored. A data model will depict the logical interrelationships among different data elements.

(2) Data models may be created in one of three perspectives:

1. **Conceptual Data Model** - describes semantics of a domain, being the scope of the model...consists of entity classes, representing things of significance in the domain, and relationship assertions about associations between pairs of entity classes
2. **Logical Data Model** - describes the semantics, as represented by a particular data manipulation technology. This consists of descriptions of tables and columns, object oriented classes, and XML tags, among other things
3. **Physical Data Model** - describes the physical means by which data are stored. This is concerned with partitions, CPUs, tablespaces, and the like.

(1) <http://www.businessdictionary.com/definition/data-model.html>

(2) American National Standards Institute. 1975. *ANSI/X3/SPARC Study Group on Data Base Management Systems; Interim Report*. FDT (Bulletin of ACM SIGMOD) 7:2.

Why data modeling?

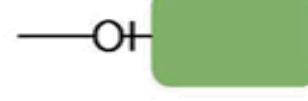
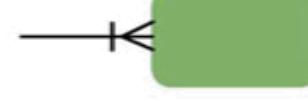
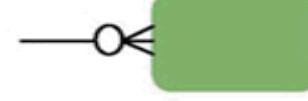
- Data modeling is a ***process*** used to define and analyze data requirements needed to support processes within the scope of corresponding information systems. The process of data modeling should involve:
 - Professional data modelers working closely with
 - System stakeholders, and
 - Potential end-users of the data
- Data models are ***progressive***; there is no such thing as the final data model for an application. Instead a data model should be considered a living document that will change in response to a changing needs
- Data models may be created using relationships amongst entities (***Entity-Relationship Diagram***) or objects (Object-Relationship Diagram)

Interpreting a data model

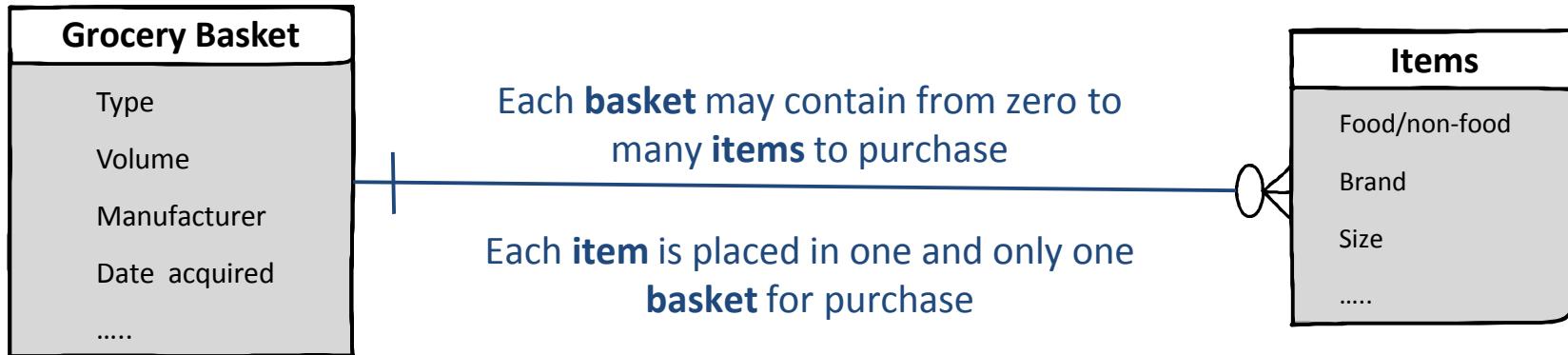
- Entity relationship diagram (ERD) – a data model utilizing several notations to depict data in terms of the entities and relationships described by that data.
 - **Entity** – a class of persons, places, objects, events, or concepts about which we need to capture and store data.
 - **Relationship** – a natural association that exists between one or more entities.
 - **Cardinality** – the minimum and maximum number of occurrences of one entity that may be related to a single occurrence of the other entity.
 - **Attribute** – a descriptive property or characteristic of an entity. Synonyms include *element*, *property*, and *field*

Interpreting a data model (cont'd)

Cardinality notation (may also referred to as multiplicity)

CARDINALITY INTERPRETATION	MINIMUM INSTANCES	MAXIMUM INSTANCES	GRAPHIC NOTATION
Exactly one (one and only one)	1	1	 — or — 
Zero or one	0	1	
One or more	1	many (>1)	
Zero, one, or more	0	many (>1)	
More than one	>1	>1	

Simple example

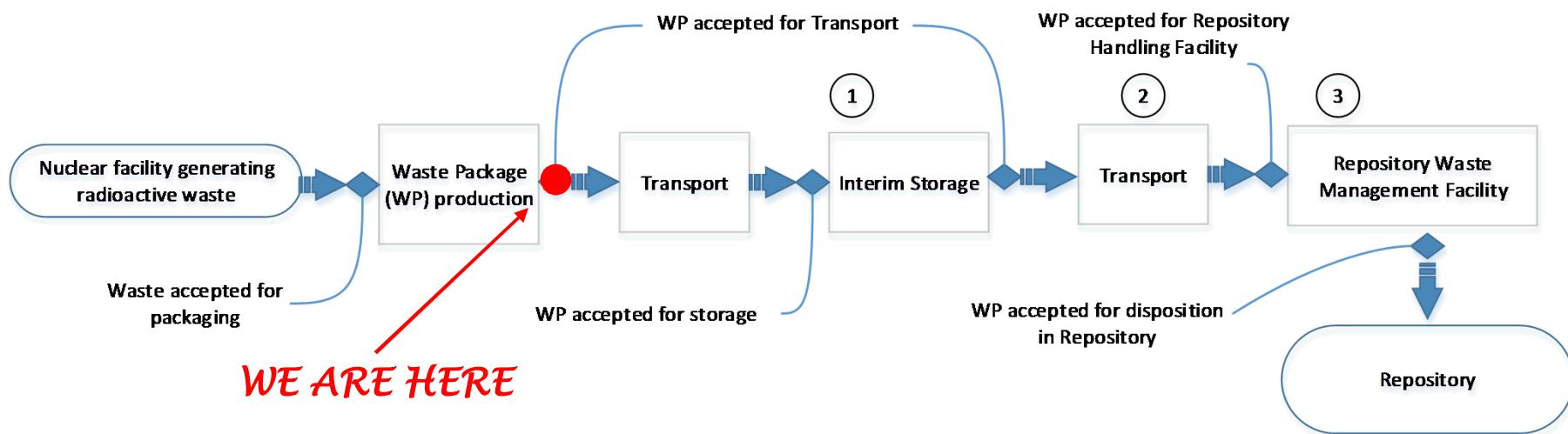


Simple example



RepMet Waste Management Workflow

- RepMet is focusing initially in identify data/metadata about L/ILW Waste Packages ready for final disposal.



- We expect to obtain a complete metadata list for Waste Package ready for final disposal by 2016.

How did we get here?

- A team of RepMet participants worked to create a Conceptual Data Model (CDM)
 - Alexander Carter
 - Massimo Ciambrella
 - Pierre-Henri de La Codre
 - Jozsef Fekete
 - Kevin McMahon
 - Zoltan Nagy
 - Claudio Pescatore
- Multiple iterations of the CDM were developed and discussed amongst the team
- Consideration was given to attempt to ensure various countries' programs would “fit”
- Accomplished by weekly Skype sessions and exchanges of working products

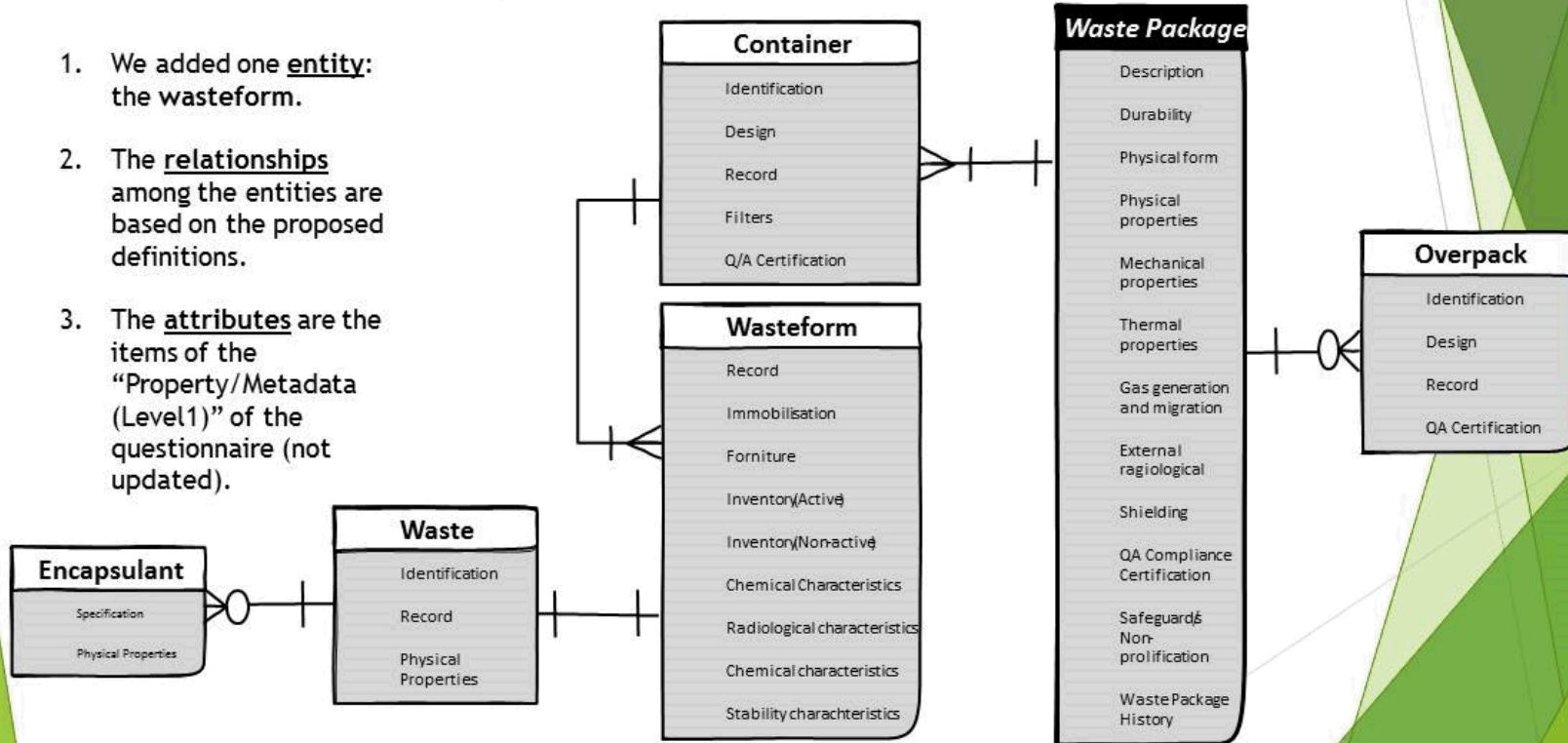
How did we get here? (cont'd)

Iteration #3 from July 15, 2015 - CDM

Conceptual Data Model

Version based on proposed definitions for the entities

1. We added one entity: the wasteform.
2. The relationships among the entities are based on the proposed definitions.
3. The attributes are the items of the “Property/Metadata (Level1)” of the questionnaire (not updated).



How did we get here? (cont'd)

Iteration #3 from July 15, 2015 – Definitions (1 of 2)

Definitions for OECD/NEA RepMet glossary

Proposals in view of the Conceptual Data Model

► **Encapsulant**

Material (or a mix of materials) in which the waste is embedded, either chemically and physically. Note: air or gas may be sometimes the encapsulant.

► **Wasteform**

Solid product obtained after the encapsulation of the waste.

► **Container**

Vessel into which the wasteform is placed and which is in direct contact with the wasteform.

► **Overpack**

Additional vessel into which the container may be placed and which is not in contact with the wasteform.

► **Waste Package**

The smallest unit for which a decision has been made for disposal in a final repository. It is composed, at a minimum, of the wasteform and its container. It may include an (optional) overpack.

How did we get here? (cont'd)

Iteration #3 from July 15, 2015 – Definitions (2 of 2)

Definitions for OECD/NEA RepMet glossary

Background and hypothesis to get them

1. We started from the definitions of the “IAEA Safety Glossary 2007 Edition”:

Wasteform: Waste in its physical and chemical form after treatment and/or conditioning (resulting in a solid product) prior to packaging. The waste form is a component of the waste package.

Container: The vessel into which the waste form is placed for handling, transport, storage and/or eventual disposal; also the outer barrier protecting the waste from external intrusions. The waste container is a component of the waste package.

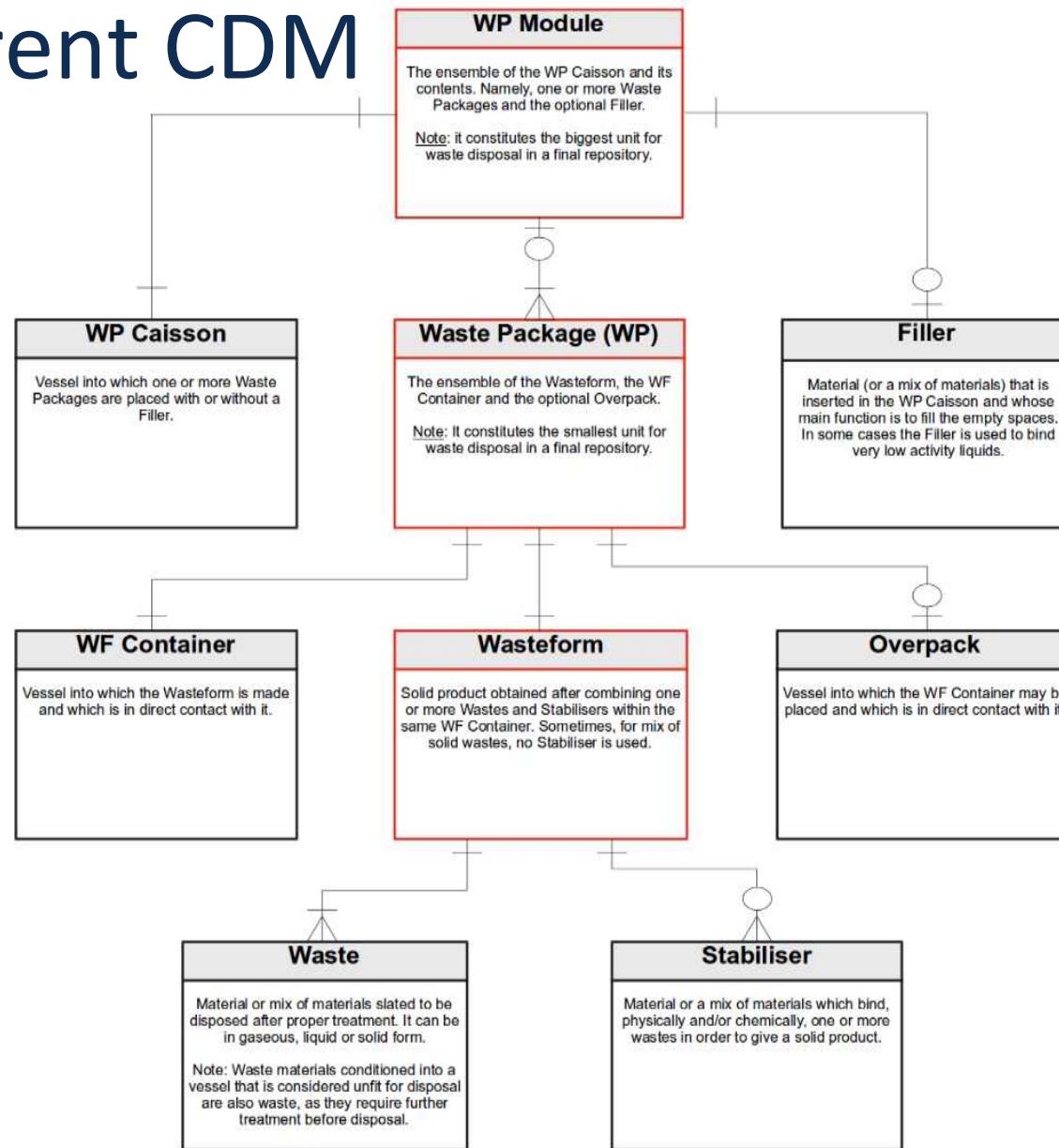
Overpack: A secondary (or additional) outer container for one or more waste packages, used for handling, transport, storage and/or disposal.

Waste Package The product of conditioning that includes the waste form and any container(s) and internal barriers (e.g. absorbing materials and liner), as prepared in accordance with requirements for handling, transport, storage and/ or disposal.

2. We modified them to obtain a more “practical meaning”, in other words in order to:

- don't define, at this moment, other concepts (e.g.: “conditioning” or “packaging”);
- focus our attention only on our boundary conditions (WP ready for final disposal);
- differentiate exactly the container from the optional overpack;
- distinguish the waste package from all the possible outer boxes no aimed at the final disposal.

The current CDM



Future Work and Metadata Development



Discussion

Thank you...

Kevin McMahon
Sandia National Laboratories
Albuquerque, New Mexico USA
Email: kamcmah@sandia.gov
iPhone: +1 505 944 6511