Formal Review Procedures for the Geoscience Knowledge System of IUGS Deep-time Digital Earth Program

by the DDE Standards Task Group, 2020-08-28; 2021-5-25

1. Scope

This document outlines the procedure for reviewing components of the Geoscience Knowledge System established by the Deep-time Digital Earth Working Groups.

2. Document history

Initial draft March 2020: Professor Hu Xiumian, Coordinator of the DDE Knowledge Group, Nanjing Univeristy.

Additions June 2020: Dr Mark Rattenbury, Chair, Geoscience Terminology Working Group, IUGS

Additions June 2020: Dr Tim Duffy, Chief Scientist for Interoperability Standards of the DDE Standards Working Group.

Additions June 2020: Professor Zhang Minghua, co-chair of the DDE Standards Working Group, Drafted the rewritten version of the formal procedures in numbered sections after the suggestion from Dr Alena Rybkina, co-chairs of the DDE Standards Working Group.

Additions June 2020: Francois Robida, co-chair DDE Standards Working Group, Chair, CGI Council, IUGS

Additions June 2020: Dr Tim Duffy, Chief Scientist for Interoperability Standards of the DDE

Additions July 2020: Dr Mark Rattenbury, Chair, Geoscience Terminology Working Group, IUGS

Additions August 2020: Zhang Minghua, after a discussion among Francois Robida, Zhang Minghua, Mark Rattenbury, Tim Duffy, Alena Rybkina, Dr. Harvey Thorleifson from Minnesota Geological Survey and University of Minnesota, USA, and Dr. Liu Rongmei and Prof. Jiang Zuoqin from China Geological Survey.

Additions June 2021: Mark Rattenbury, after a discussion with Hu Xiumian and Zhang Minghua on the revision and update of this document.

3. Background

The Deep-time Digital Earth (DDE) program is a multi-national, multi-institutional initiative of the International Union of Geological Sciences (IUGS) (Wang et al., 2021 NSR). The Geoscience Knowledge System is a comprehensive, digital knowledge system of geoscience terms, concepts and their inter-relationships. The Geoscience Knowledge System has been developed to support the DDE program in understanding of geological processes and events in the Earth's geological history spanning billions of years. The Geoscience Knowledge System consists of a series of formal definitions of geological features, processes and concepts that fall with the DDE program's domain, along with specification of conceptual relationships, including their hierarchical organization. The development of the Geoscience Knowledge System is the role of the DDE Knowledge Group that assembles information supplied by science theme-based

DDE Working Groups. The DDE Knowledge Group is responsible for the description of the knowledge system, including its architecture, knowledge nodes and their inner relationships. While the DDE Standards Task Group is responsible for providing review procedures of the DDE Geoscience Knowledge System to the DDE Knowledge Group and the DDE Working Groups, and monitoring their review process by review and evaluation of their review reports, or by partially taking part in their review whenever necessary. The DDE Standards Task Group will validate the DDE Geoscience Knowledge System in collaboration with the DDE Knowledge Group, the Commission for Geoscience Information (CGI) of IUGS and CODATA.

4. Formal review of the Geoscience Knowledge System

4.1 DDE Geoscience Knowledge System

The DDE Geoscience Knowledge System (short as DDE Knowledge System or DDE KS) consists of three main elements: a hierarchical graph structure of linked concepts (Functionality), lists of terms or nodes that describe the structure's concepts (Science Contents) and Classification Rules.

The concepts are human constructs and as such do not perfectly categorize and organize the natural world. There are always exceptions and indistinct areas in classification. Furthermore, there are differences in concepts imparted by cultural and scientific discipline-based influences. Geological understanding also evolves with time and thus classification and definition of concepts will also change. The most effective and long-lasting knowledge system will have encouraged as much diversity of thought and perspective as possible. Geosciences concepts are best understood by domain specialists and considering input from of many of these specialists is important. The geoscience theme-based[1] DDE Working Groups consist of specialists who are well qualified to define geoscience concepts in their domains. They are, however, only a small fraction of the world expertise in any one of these geoscience domains and different views around concept definitions are inevitable. One process to increase global acceptance of concept definitions is to invite external reviews of them.

4.1.1 The DDE Knowledge Group (DDE-KG) is mainly responsible for the Functionality element, that is, the systematic structure or architecture development of the hierarchical graph structure of DDE geoscience knowledge that consists of knowledge nodes[2] and their interlinked conceptual relationships.

4.1.2 The geoscience theme-based DDE Working Groups (DDE-WGs) are responsible for the

[1] A geoscience theme may contain several domains. And a domain may contain many nodes or just one node. Each node consists of at least one vocabulary or many vocabularies that describe geoscience concepts of the node. And the geoscience concepts of the nodes should be defined by geoscientists and specialists of the relevant geoscience domains.

[2] A knowledge node is a knowledge system component which consists of vocabularies and inner relationships with other nodes.

development of the Science Content element, that is, specific geoscience domain terms and nodes.

4.1.3 The geoscience theme-based DDE Working Groups (DDE-WGs) are also responsible for developing and applying Classification Rules that define concepts and properties of terms.

4.1.4 DDE KG assembles information supplied by geoscience theme-based DDE WGs with special attention to avoid overlaps between WGs.

4.1.5 The Geoscience Knowledge System must remain flexible to different perspectives and perspectives that inevitably will change with time. The adaptiveness of the system will ultimately affect its usefulness and longevity.

4.2 Development of DDE Knowledge System

4.2.1 The compilation of a node vocabularies/knowledge system components will be undertaken by the DDE WGs which consist of specialists who are well qualified to do this.

4.2.2 The DDE Standards Task Group (DDE-STG) recommends the DDE KG and related DDE WGs coordinate the organization of terms/nodes into thematically organized vocabularies wherever appropriate.

The vocabulary compilation involves seeking advice within and outside of the Working Groups for external advice of other specialists in the domain the vocabulary relates to. The vocabularies compilations should utilize and build upon existing material as much as possible, especially the published CGI geoscience vocabularies.

DDE-STG will provide help with the process of vocabulary/knowledge system component compilation when a DDE Working Group needs in developing its knowledge nodes.

4.2.3 The DDE WGs effectively own the vocabularies in its geoscience domain so take on responsibility for them and should have the final decision of their content.

4.2.4 Ultimately the quality and inclusiveness of the review process will determine the value and longevity of the vocabulary, thus the knowledge system – the more consensus and input, the more it will be used and the longer it will be valid.

4.2.5 The finalized vocabularies/knowledge system components of related terms/nodes should be incorporated into the DDE Knowledge System, recognizing, however, that these vocabularies should always be open for reconsideration and further improvement.

4.3 Review of the DDE Knowledge System

There are two parts to the review process of the DDE Knowledge System; one reviews the Functionality element and a second reviews the Science Content and Classification Rules. The Functionality Review is aimed at assessing how well the DDE Geoscience Knowledge System meets its stated intended purpose and function and aligns with international best-practice in terms of international geoscience standards, design and technical implementation. The Science Content and Classification Rules Review is the larger of the two parts in terms of resourcing and longevity. Its review involves the scrutiny of tens of thousands of conceptual terms or "nodes". These nodes have definitions and their interrelationships described; a node be singular or conceptually group or "parent" other nodes like a vocabulary list in a hierarchical structure.

4.3.1 Functionality Review

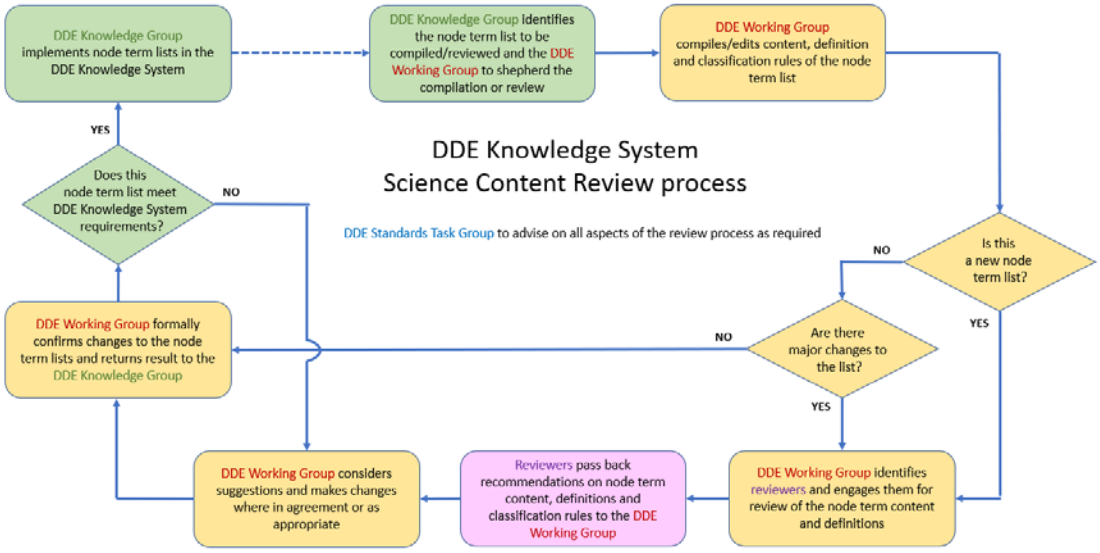
4.3.1.1 The Functionality Review should occur once, relatively early in the system development. If substantial re-design is planned however, then DDE-STG recommends the changes are reviewed.

4.3.1.2 The DDE KG should formally invite the DDE-STG to undertake the Functionality Review of the Knowledge System.

4.3.1.3 The DDE-STG will conduct the Functionality Review by involving specialists in science information management, including those within working groups of the CGI of IUGS and those from CODATA, and provide recommendations for improvement to the DDE-KG.

4.3.2 Science Content and Classification Rules Review

4.3.2.1 DDE-STG defines the formal procedure of the Science Contents and Classification Rules Review here. The procedure is illustrated by the diagram below. The DDE-KG request the DDE-WG compile a list of node terms for a specific part of the DDE Knowledge System where the Working Group has expertise.



4.3.2.2 Once the draft of the nodes vocabularies is complete, then a review process within the DDE-WGs occurs. Geoscience concepts are best understood by domain specialists and considering input from of many of these specialists is important. One process to increase global acceptance of concept definitions is to invite external reviews of them. The adaptiveness of the Knowledge system will ultimately affect its usefulness and longevity.

4.3.2.3 The DDE-WGs would organize their own reviewers, address the recommended changes and publish the result by passing it to the DDE-KG.

DDE-STG provides necessary help to DDE KG on invite reviewers after nominations from DDE KG and WGs.

4.3.2.4 A minimum of two international reviewers is required for one vocabulary to be approved. Those reviewers should be encouraged to seek opinions of others in their field of expertise. The candidate reviewers should have science specialization relating to the vocabulary being reviewed, and a group of reviewers should be multinational and have a good grasp of technical English relating to the domain

4.3.2.5 After receiving the review, the DDE-WG should address its recommendations and make changes wherever in agreement. In the event, the Working Group does not accept some recommendations, these could be debated further with the reviewers if they are still willing to engage. In case of a disagreement between the DDE-WG and one or more reviewers, the DDE-WG view can prevail as they are ultimately responsible for the node term list.

4.3.2.6 Trivial changes after a review to the node vocabularies can be recommended by a Working Group and effected by the DDE- KG. Significant changes proposed by a Working Group should trigger a new review process initiated by the DDE KG.

4.3.2.7 All changes to the node vocabularies by the review should be documented and formally

reported at least annually.

4.3.2.8 Once a DDE-WG decides that there have been enough cycles of editing and the vocabulary is considered mature the vocabulary should be passed onto DDE-KG.

4.3.2.9 On receipt of the DDE-WG node term list, the DDE-KG should check that list is in the required format and complete. The DDE-KG can seek advice from the DDE-STG if required.

5 DDE Knowledge System validation

5.1 Once the node term list by the DDE WG meets the required format and completeness, the DDE-KG implements the node term list within the DDE Knowledge System and notifies the DDE-STG of its implementation.

5.2 The DDE-STG notifies international standards groups such as the CGI-IUGS Geoscience Terminology Working Group of the new node term lists as appropriate.
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