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Biomimetics — Ontology-Enhanced Thesaurus (OET) for biomimetics

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 266, *Biomimetics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

A thesaurus is often used to map terms between different knowledge domains. The Knowledge Infrastructure for Biomimetics project was established to fill the gap between biology and technology. The project originally planned to develop a biomimetic thesaurus and an ontology that would complement such a thesaurus in situations where the thesaurus cannot deliver useful search terms because concepts in the two domains are associated with keywords that lack explicit links. Although work on the biomimetic thesaurus has been postponed, Ontology-Enhanced Thesaurus (OET) does not require a thesaurus and can be used as a standalone tool. For more details see 5.2.

OET addresses a portion of this knowledge infrastructure. It is composed of an ontology of biomimetics and an application named Keyword Explorer that provides an interface to the ontology. OET and Keyword Explorer help designers, engineers, and other bio-inspired design (BID) practitioners by mapping technical terms to biological terms that can then be used to search biological texts to identify biological models (see Figure 3). For example, a traditional thesaurus may relate “stain-resistant” to “self-cleaning” or “soil release”. A biomimetic thesaurus or internet keyword search may additionally return “antifouling”. OET can identify organisms that share functions related to “antifouling” but not directly associated with the term.

In Clause 4, after a brief overview of the current state of the art of tools and systems in biomimetics, OET and Keyword Explorer are positioned in the related work. Clause 5 describes OET together with its design rationale. In-depth description on the implemented ontology in OET is Clause 6 and Clause 7. Clause 8 describes accessing and running the Keyword Explorer prototype in order to get feedback from readers.

NOTE A publicly available version of Keyword Explorer and OET is available at http://biomimetics.hozo.jp/OET/demo.html as a web application — it only includes one function (antifouling) but demonstrates the capabilities of the prototype version. The corresponding ontology can be inspected via “Browsing the Biomimetics Ontology” in http://biomimetics.hozo.jp/OET/, but it is not possible to download it. Paid users of this document can download the prototype version.

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Biomimetics — Ontology-Enhanced Thesaurus (OET) for biomimetics

1 Scope

This document describes prototypes of the Ontology-Enhanced Thesaurus (OET) and the Keyword Explorer interface to OET. Although their design philosophy is described, this document focuses on their value and how they work.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
data
minimum piece of information that is meaningful for its potential readers or users

Note 1 to entry: In many cases, data is a component of larger entity, a data set or a data base. Data can be text as in research papers, simulation models, algorithms, numbers, pictures, figures, voice and video recordings.

3.2
database
set of almost any digital objects, which can be text, picture, sound, video, etc.

3.3
information retrieval service
set of software that allows users to retrieve information from *databases* (3.2)

Note 1 to entry: Quite often, ontologies or thesauri are incorporated in the information retrieval service.

3.4
index
set of key terms (usually arranged in alphabetical order) with pointers to the original source of each term (includes books, research papers, or other forms of writing)

3.5
metadata
data (3.1) that provides information about other data

Note 1 to entry: The keywords in an index are metadata of the body of the text from which the keywords are extracted.

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3.6
ontology
formal, structured, and explicit description of concepts in a domain of discourse and the relations between them in the fields of knowledge management and artificial intelligence

Note 1 to entry: An ontology together with a set of individual instances of classes constitutes a knowledge base.

3.7
taxonomy
orderly classification of things or concepts into groups within a larger system, based on common qualities

3.8
thesaurus
list of words arranged in groups based on similarity of meaning

4 Role of the knowledge infrastructure for biomimetics

4.1 General

In Figure 1, ISO 18457 and ISO 18458 cover the phases from "Analysis" to "Overall evaluation" and ISO 18459 covers the phases from "Project/design of experiment" to "Prototype construction/ manufacturing." The Knowledge Infrastructure for Biomimetics covers "Analysis" and "Analogy/ abstraction", with OET focusing mainly on "Analogy/abstraction". OET is a product of the Knowledge Infrastructure project and is composed of an ontology and the Keyword Explorer interface.

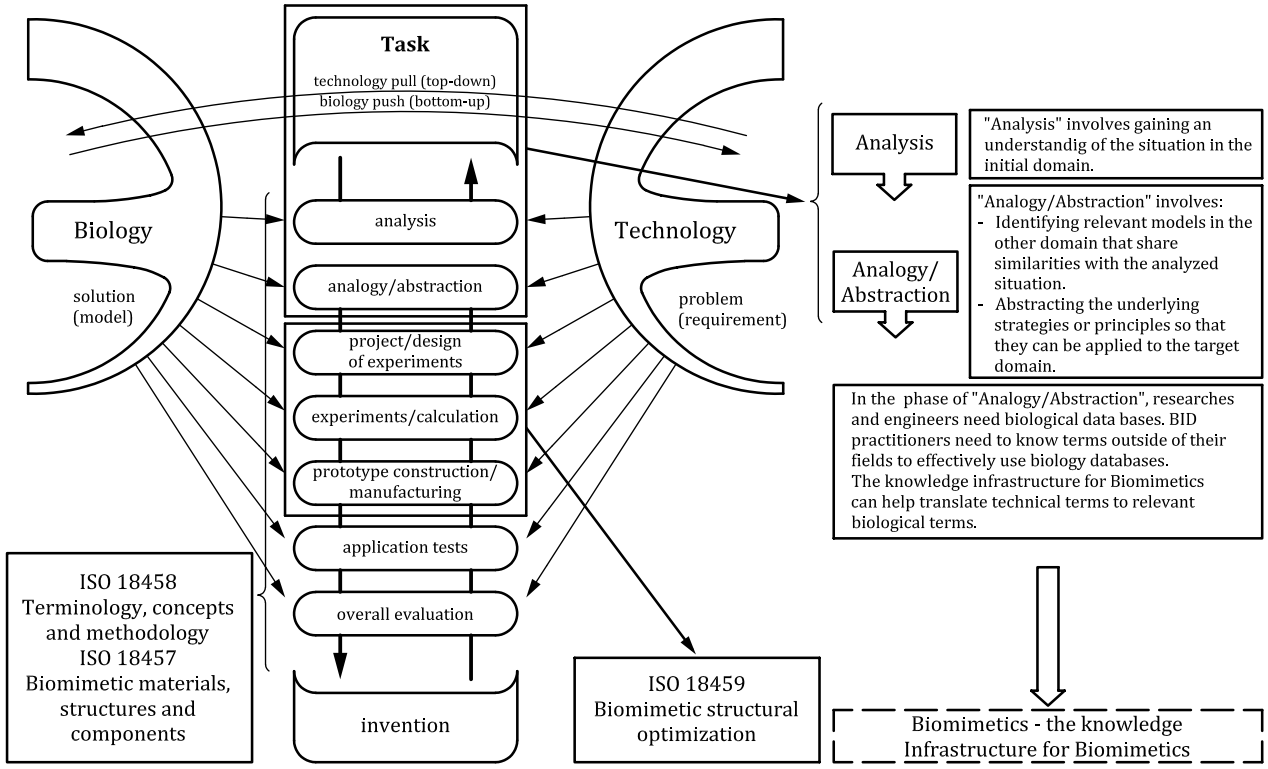

Figure 1 — Simplified flow chart of a biomimetic development process (adapted from ISO 18458)

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