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Biomimetics — Integrating problem- and function-oriented approaches applying the TRIZ method

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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

Building on the success of the Millennium Development Goals (MDGs), the 2030 Agenda for Sustainable Development (the 2030 Agenda) is a set of international development goals to be met by 2030, adopted by the UN Sustainable Development Summit held in September 2015.

Sustainable Development Goals (SDGs) will be the impetus for change as the manufacturing and processing industries around the world are in need of new technology for the development of environmentally-friendly materials and processes. For that purpose, it is indispensable to realize low-energy and highly efficient manufacturing. Living things have a special technology for this aim.

In recent years, researchers have been expanding their work on biomimetic engineering (biomimetics), a field focused on introducing high efficiency and performance biofunctions into material design.[2-6] Biofunction is a development in engineering technology that elucidates the processes of activities related to the functions and life phenomena of animals, plants, and microorganisms, and makes them useful in real life. More and more articles on biomimetic engineering have been reported every year, and expectations that the industry will develop practical applications for such are likewise on the rise. Numerous well-known applications of biomimetics can be cited, e.g. self-cleaning paints based on lotus leaves, easy-to-peel-off tapes inspired by the microstructures in the soles of a gecko's foot, nonreflective films structured like the compound eyes of a moth, shark skin-patterned high-speed swimwear, automobile designs that incorporate ideas taken from a boxfish's skeleton, and labels that use the structural colours of the morpho butterfly. The ranks of companies whose interest in developing materials based on biomimetic engineering principles sparked by news reports about such developments likewise has been increasing.[2] There are more than 7,8 million species of living beings in the world, with an enormous number of distinct functions and behaviours. Whatever biofunction attracts our attention, it is unclear as to which ones will be useful toward developing innovative technologies and materials and lead to an optimal material design. In short, most engineers and researchers are challenged by their inability to focus on a single target owing to the excess of options. Thus, case-by-case material design is the mainstream in biomimetic engineering today. Only a portion of the limitless number of biofunctions are being put to use, and there are no effective means for extracting those technological elements that may be necessary. Furthermore, with ISO/TC 266 currently studying a variety of regulations regarding biomimetic engineering, there is demand for biomimetic products to be created that conform to international standards. According to ISO 18458, developing biomimetic biometric products requires they go through the following process: (1) identify issues with existing technologies and materials, (2) search for biofunctions that can resolve those issues, (3) extract and generalize the principles behind the biofunctions that have been discovered, and (4) create and optimize new technologies and materials. The question also arises of the best approach to take for identifying the functions among the 7,8 million living things said to exist and for optimizing them. This document introduces the database that will support the creation of biomimetics products according to ISO 18458.

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Biomimetics — Integrating problem- and function-oriented approaches applying the TRIZ method

1 Scope

This document describes prototypes of a database for developing biomimetic products with innovative problem-solving methods (TRIZ). The database has a mechanism to obtain the idea of technical problem-solving using the problem- and function-oriented approaches. This document focuses on the use and value of the database, but also describes its design principles.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TR 23845, *Biomimetics — Ontology-Enhanced Thesaurus (OET) for biomimetics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 23845 and the following apply.

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

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

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

3.1
TRIZ
problem-solving, analysis and forecasting method derived from the study of patterns of invention in patent literature

Note 1 to entry: The theory of inventive problem-solving was invented by Genrich Altshuller, who while president of the Inventor's Association of Russia in 1946, discovered that the evolution of technical ideas followed predictable patterns.

3.2
problem-oriented approach
approach used to search for biological functions based on 40 principles using the *TRIZ* (3.1) matrix method

3.3
function-oriented approach
approach used to reach biomimetic solutions from the 40 *TRIZ* (3.1) principles by utilizing a combination of two elements, desired function and state

4 Current status of patents for biomimetics

The Japan Patent Office's *Survey Report on Technology Trends in Patent Applications* gives us a picture of current tendencies in regard to patents focused on biofunctions.[7] It can be inferred from a review of the data for products that are mainly related to biomimetics that at present the number of instances in

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