INTERNATIONAL STANDARD

ISO/IEC/IEEE 24748-7000

First edition
2022-11

This document is a preview generated by EVS

Systems and software engineering — Life cycle management —

Part 7000: Standard model process for addressing ethical concerns during system design

Reference number
ISO/IEC/IEEE 24748-7000:2022(E)

© IEEE 2021

This document is a preview generated by EVS

COPYRIGHT PROTECTED DOCUMENT

© IEEE 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from IEEE at the address below.

Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA

Email: stds.ipr@ieee.org
Website: www.ieee.org

Published in Switzerland

© IEEE 2021 – All rights reserved

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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/IEC documents should be noted (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see https://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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. In the IEC, see www.iec.ch/understanding-standards.

ISO/IEC/IEEE 24748-7000 was prepared by the Systems and Software Engineering Standards Committee of the IEEE Computer Society (as IEEE 7000-2021) and drafted in accordance with its editorial rules. It was adopted, under the "fast-track procedure" defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

A list of all parts in the ISO/IEC/IEEE 24748 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

This document is a preview generated by EVS

© IEEE 2021 – All rights reserved

This document is a preview generated by EVS

IEEE Standard Model Process for Addressing Ethical Concerns during System Design

Developed by the

Systems and Software Engineering Standards Committee
of the
IEEE Computer Society

Approved 16 June 2021

IEEE SA Standards Board

This document is a preview generated by EVS

Abstract: A set of processes by which organizations can include consideration of ethical values throughout the stages of concept exploration and development is established by this standard. Management and engineering in transparent communication with selected stakeholders for ethical values elicitation and prioritization is supported by this standard, involving traceability of ethical values through an operational concept, value propositions, and value dispositions in the system design. Processes that provide for traceability of ethical values in the concept of operations, ethical requirements, and ethical risk-based design are described in the standard. All sizes and types of organizations using their own life cycle models are relevant to this standard.

Keywords: case for ethics, concept of operations, ethical value requirements, ethical values elicitation, ethically aligned design, IEEE 7000™, software engineering, system engineering, value-based requirements, value prioritization

This document is a preview generated by EVS

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2021 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 15 September 2021. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-7687-4 STD24787
Print: ISBN 978-1-5044-7688-1 STDPD24787

IEEE prohibits discrimination, harassment, and bullying.
For more information, visit https://www.ieee.orgabout/corporate/governance/p9-26.html.
No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE Standards documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page (https://standards.ieee.org/ipr/disclaimers.html), appear in all standards and may be found under the heading "Important Notices and Disclaimers Concerning IEEE Standards Documents."

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE SA) Standards Board. IEEE develops its standards through an accredited consensus development process, which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed by volunteers with scientific, academic, and industry-based expertise in technical working groups. Volunteers are not necessarily members of IEEE or IEEE SA, and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE makes no warranties or representations concerning its standards, and expressly disclaims all warranties, express or implied, concerning this standard, including but not limited to the warranties of merchantability, fitness for a particular purpose and non-infringement. In addition, IEEE does not warrant or represent that the use of the material contained in its standards is free from patent infringement. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity, nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: THE NEED TO PROCURE SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE is the approved IEEE standard.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that the presenter's views should be considered the personal views of that individual rather than the formal position of IEEE, IEEE SA, the Standards Committee, or the Working Group.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE or IEEE SA. However, **IEEE does not provide interpretations, consulting information, or advice pertaining to IEEE Standards documents**.

Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its Societies and Standards Coordinating Committees are not able to provide an instant response to comments, or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in evaluating comments or in revisions to an IEEE standard is welcome to join the relevant IEEE working group. You can indicate interest in a working group using the Interests tab in the Manage Profile and Interests area of the IEEE SA myProject system. An IEEE Account is needed to access the application.

Comments on standards should be submitted using the Contact Us form.

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not constitute compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Data privacy

Users of IEEE Standards documents should evaluate the standards for considerations of data privacy and data ownership in the context of assessing and using the standards in compliance with applicable laws and regulations.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under US and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

Photocopies

Subject to payment of the appropriate licensing fees, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400; https://www.copyright.com/. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit IEEE Xplore or contact IEEE. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE SA Website.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE SA Website. Search for standard number and year of approval to access the web page of the published standard. Errata links are located under the Additional Resources Details section. Errata are also available in IEEE Xplore. Users are encouraged to periodically check for errata.

Patents

IEEE Standards are developed in compliance with the IEEE SA Patent Policy.

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE SA Website at https://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

IMPORTANT NOTICE

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. IEEE Standards development activities consider research and information presented to the standards development group in developing any safety recommendations. Other information about safety practices, changes in technology or technology implementation, or impact by peripheral systems also may be pertinent to safety considerations during implementation of the standard. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

Participants

At the time this IEEE standard was completed, the Model Process for Addressing Ethical Concerns during System Design Working Group had the following membership:

Ali Hessami, *Chair*
Sarah Spiekermann, *Vice Chair*
Zvikomborero Murahwi, *Secretary*
Annette Reilly, *Technical Editor*

Lee Barford
James Beetem
Jared Bielby
Barbara Bohr
Noah Brodbeck
Jennifer Costley
Brandt Dainow
Feyzan Dalay
Colleen Dorsey
Andrey Fajardo
Tony Gillespie
Lewis Gray
Beiyuan Guo
Victoria Hailey
Ali Hossaini
Valery Karpov
Edmund Kienast
Vlada Leushina
Ruth Lewis
Gerri Light
Carol Long
Emile Mardacany
Jacob Metcalf
Rod Muttram
Alexander Novotny
Freddy Pirajan
Sridhar Raghavan
Randy Rannow
Dina Salah
Chris Santos-Lang
Robert Schaaf
Sam Sciacca
Giuseppe Spampinato
Ozlem Ulgen
Mark Underwood
Altaz Valani
Michelle Victor
Gisele Waters
Till Winkler

The IEEE 7000 Working Group acknowledges the contributions of John C. Havens.

The following members of the individual Standards Association balloting group voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

M.Victoria Alonso
Amelia Andersdotter
Bakul Banerjee
Lee Barford
Lyria Bennett Moses
Barbara Bohr
Juris Borzovs
Pieter Botman
Gustavo Brunello
Lyle Bullock
Paul Cardinal
Diego Chiozzi
Raul Colcher
Jennifer Costley
Jan de Liefde
Ronald Dean
Robert Donaldson
Hassan El Shazly
Kenneth Foster
David Fuschi
Lewis Gray
Louis Gullo
Beiyuan Guo
Tamas Haidegger
Victoria Hailey
John C. Havens
Ali Hessami
Werner Hoelzl
Piotr Karocki
Stuart Kerry
Edmund Kienast
Dwayne Knirk
Ansgar Koene
Susan Land
Kenneth Lang
Sean Laroque-Doherty
Ruth Lewis
Xiaoru Li
Lars Luenenburger
Javier Luiso
Emile Mardacany
Johnny Marques
Rajesh Murthy
Laura Musikanski
Alan Mustafa
Alexander Novotny
Joanna Olszewska
Mark Paulk
Christopher Petrola
James Pratt
Randy Rannow
Annette Reilly
Maximilian Riegel
Pablo Rivas Perea
Robert Schaaf
Daniel Schiff
Matthew Silveira
Gary Smullin
Sarah Spiekermann
Wayne Stec
Robert Stemp
Walter Struppler
Gerald Stueve
David Tepen
Ozlem Ulgen
John Vergis
David Walden
Kenneth Wallace
Lei Wang
Gisele Waters
Eleanor Watson
Till Winkler
Forrest Wright
Yu Yuan
Oren Yuen
Janusz Zalewski
Daidi Zhong

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

When the IEEE SA Standards Board approved this standard on 16 June 2021, it had the following membership:

Gary Hoffman, *Chair*
Jon Walter Rosdahl, *Vice Chair*
John D. Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Edward A. Addy
Doug Edwards
Ramy Ahmed Fathy
J.Travis Griffith
Thomas Koshy
Joseph L. Koepfinger*
David J. Law
Howard Li
Daozhuang Lin
Kevin Lu
Daleep C. Mohla
Chenhui Niu
Damir Novosel
Annette Reilly
Dorothy Stanley
Mehmet Ulema
Lei Wang
F. Keith Waters
Karl Weber
Sha Wei
Howard Wolfman
Daidi Zhong

*Member Emeritus

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

Introduction

This introduction is not part of IEEE Std 7000™-2021, IEEE Standard Model Process for Addressing Ethical Concerns during System Design.

Organizations are becoming increasingly aware of the need to demonstrate socially responsible behavior when dealing with stakeholders, customers, regulators, and society in general. Socially responsible organizations recognize that their decisions and actions affect not just their financial bottom line but also society and the environment. One of the principles of social responsibility is ethical behavior.

Engineers, their managers, and other stakeholders benefit from well-defined processes for considering ethical issues along with the usual concerns of system performance and functionality early in the system life cycle. Consumers can be unaware of the ethical considerations regarding the products and services they use; it is only by rigorously examining ethical concerns that manufacturers, engineers, and technologists can align products and services with the results valued by acquirers, consumers, and users.

This standard aims to support organizations in creating ethical value through system design. Creating ethical value is a vision for organizations that recognizes their central role in society as shapers of well-being and carriers of societal progress that benefits humanity. Implementing IEEE Std 7000 can help them to strengthen their value proposition and avoid value harms. It is applicable to all kinds of products and services, including artificial intelligence (AI) systems.

IEEE Std 7000 is recommended for use by organizations engaged in concept exploration, requirements definition, or development of new or revised products or services. The standard requires consideration of values relevant to the culture where the system is to be deployed. It is applicable with any life cycle model or development methodology. IEEE Std 7000 is designed to work for all sizes and types of organizations (e.g., large, small, for profit, non-profit) aiming to deliver products that enable the ethical values of their customers and their own organization. The standard can help organizations to build better products with a more refined and nuanced value proposition and with less risk. This standard can be more easily applied in the context of organizational policies that are consistent with the organization's ethical values, such as the following:

— Readiness to include a wide group of stakeholders in the engineering effort

— An open, transparent, and inclusive project culture

— A commitment to quality

— A dedication to ethical values from the top of the organization

— A commitment to allocate sufficient time and resources for ethical requirements definition

IEEE Std 7000 is most effectively applied when organizational leaders and top management are involved in and assume responsibility for the products and services created. Through key roles defined for IEEE Std 7000 project teams, this standard seeks to help align management and engineering activities with stakeholder expectations for ethical values in the operational concept, value propositions, and design features being developed.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

Contents

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

This document is a preview generated by EVS

IEEE Standard Model Process for Addressing Ethical Concerns during System Design

1. Overview

1.1 Scope

The standard establishes a set of processes by which engineers and technologists can include consideration of ethical values throughout the stages of concept exploration and development, which encompass system initiation, analysis, and design. This standard provides engineers and technologists with an implementable process aligning innovation management processes, system design approaches, and software engineering methods to help address ethical concerns or risks during system design.

IEEE Std 7000™ does not give specific guidance on the design of algorithms to apply ethical values such as fairness and privacy.

1.2 Purpose

The goal of this standard is to enable organizations to design systems with explicit consideration of individual and societal ethical values, such as transparency, sustainability, privacy, fairness, and accountability, as well as values typically considered in system engineering, such as efficiency and effectiveness.

Projects conforming to IEEE Std 7000 balance management commitments for time and budget constraints with the long-term values of social responsiveness and accountability. To enable this, the commitment of top executives to establish and uphold organizational values is important.

NOTE—A system is sometimes considered as a product or as the services it provides.[1]

1.3 Applicability and constraints

To reach its goal, this standard primarily supports organizations to identify stakeholder values and to engage in value-based system or service development. It is applicable within any life cycle model or set of methods for systems and software engineering. If organizations have running systems that cause ethical challenges, then the processes in this standard can be used for reiteration of value-based analysis.

[1]Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

Copyright © 2021 IEEE. All rights reserved.

The processes in this standard apply during system conception and design for organizations seeking to uncover, address and monitor value concerns for a system intended for a given context. When organizations use IEEE Std 7000, it is the respective project teams, stakeholder groups, and organizational leaders who determine the values that a system is supposed to address and sustain. The use of IEEE Std 7000 cannot guarantee that the system as designed and subsequently built is ethical, because the ethicality achieved in a system depends on the moral capabilities and choices of those who use the standard and the commitment of the organization offering the system to adhere to the recommendations made as a result of ethically aligned design as stated in the remainder of this clause.

This standard has a number of limitations to its scope, as stated in the remainder of this clause.

Some human values required of systems have been extensively treated in other standards (e.g., health, security, and safety) and are not further detailed in this standard on ethical values. Aesthetic characteristics (such as color or form) are in scope where they reflect social or cultural characteristics with ethical impact.

NOTE 1—The ISO/IEEE 11073 family of health informatic standards specifies numerous engineering solutions for interoperability of health information. The IEEE publishes many safety-related standards and codes, e.g., for electrical safety, nuclear power plant safety. In the area of systems and software engineering, IEEE Std 1228-1994 [B23][2] can be consulted. The ISO/IEC 27000 family of standards includes close to a hundred standards on information security techniques, including privacy engineering.

The processes described in this standard do not prescribe what is ethical and what is unethical. While the standard is intended to be consistent with the IEEE Code of Ethics [B24], it does not provide ethical guidance for individual engineers in their personal ethical judgements regarding their professional work or specific rights or wrongs, nor advice to whistleblowers on how to address ethical lapses in an organization. As further discussed in C.4, the IEEE code of ethics (one example of professional ethics) has general applicability, but no specific requirements for applying ethical values in system design.

This standard does not prescribe any specific organizational ethical policies. Organizations also commonly develop ethical principles related directly to workplace ethics, consistent with legal and regulatory employment requirements. This standard focuses rather on how to operationalize ethical values that are commonly at stake in technology design and deployment. The use of IEEE Std 7000 does not imply that an organization following its processes is ethical in all other aspects of its mission, product or service development, or discharge of its social responsibility. However, adoption and implementation of ethical value processes in the design and deployment of new products and services or modification of existing legacy systems are illustrative of an organization that is cognizant of its social responsibility and the impact of its endeavors on the values of its stakeholders.

IEEE Std 7000 allows organizations to make their value choices transparent to anyone who uses the system as well as to auditors, potential certifiers, or governmental agencies. Moreover, IEEE Std 7000 provides processes for organizations that assume accountability for the ethical decisions they take. This standard helps organizations in the following:

— Understanding and anticipating value implications and consequences of their systems and taking investment decisions based on them

— Identifying ethical value requirements (EVR) and priorities for system design to be integrated into system requirements

— Choosing system design alternatives according to value priorities while avoiding or mitigating value harms or ethical pitfalls

— Keeping control of the long-term value-based sustainability of a system through ongoing supervision and information management

— Creating transparency and responsibility for the choices made and the system's resulting functionality

[2]The numbers in brackets correspond to those of the bibliography in Annex J.

Copyright © 2021 IEEE. All rights reserved.

This document is available generated by EVS

This standard is most applicable to organizations that are building a system for a known context or at least known typical use cases for the products, services, and systems they build.

NOTE 2—IEEE Std 7000 does not challenge the ethicality of fundamental research.

1.4 Process overview

This standard can also be applied during the enhancements or modifications of existing legacy systems. The enhancements and modifications to products, services, and systems can adopt and conform with the requirements depicted in this standard. For example, it can be used by a device manufacturer building a care robot for a nursing home. It can be used for an artificial intelligence (AI) chat system that is employed in a specific use context, such as medical advice, teaching a language, or recommending music. This standard can be less usable for building a generic product, service, or system for which the deployment context is indefinite, such as a generic camera system or a computer chip usable in multiple ways. This standard can be more effective in specific application of products, services, and systems where the context of application and the stakeholder impact is discernible and amenable to clearer specification and analysis.

This document establishes a set of processes for organizations and projects that address the ethical values of software-based systems (and services) during design and development. The processes can be aligned with any system or software engineering methods, life cycle model, and engineering management style that an organization or project uses for design and development. The processes can be used for new design and development and for improvement of the ethical attributes of existing systems. Systems of interest are not limited to particular industries, sectors, applications, or system sizes. The processes can be used by organizations of all types and sizes, including small and innovative organizations.

Engineers, technologists, and other project stakeholders need a methodology for identifying, analyzing, and reconciling ethical concerns of end users and other stakeholders at the beginning of systems and software life cycles. The processes in this standard enable the pragmatic application of this type of value-based system design methodology. This standard provides engineers, technologists, and other members of the organization with implementable processes aligning innovation management processes, IT system design approaches, and software engineering methods to address ethical concerns in their systems that can affect their organizations, stakeholders, and end users. The processes of IEEE Std 7000 provide organizations with ethical requirements and design activities that enable systems engineering to support human wellbeing. By positively addressing the values of direct and indirect system stakeholders, organizations can attain more than mere legal compliance. They can attain ethical practices that engage with the original spirit of laws, human rights, or other social values in the specific context of a system's use as detailed further in 5.7.

Figure 1 illustrates the processes presented in this standard. These processes occur during the concept exploration and development stages of the product life cycle and are detailed in Clause 7 through Clause 11 of this standard.

The importance of considering potential values and harms during concept exploration and development of the concept of operations (ConOps) sets the context for the remaining processes. This process supports initial identification of values and an extensive feasibility analysis, which can help to refine the ConOps as well as anticipate value-based system requirements.

During the Ethical Values Elicitation and Prioritization Process, a wide range of stakeholders identify potential positive and negative system consequences, stakeholder virtues, and ethical duties that are impacted by the system concept. These are typically expressed by stakeholders in unstructured form (e.g., in terms of harms and benefits) but have underlying values that people care about. Consequences, virtues, and duties are identified with the help of ethical theories; specifically, utilitarianism, virtue ethics, and duty ethics, along with other culturally appropriate value systems or ethical theories. Values are prioritized with the help of an activity where the top management of an organization evaluates the importance of the value to the system of interest

This document is a preview generated by EVS

Copyright © 2021 IEEE. All rights reserved.

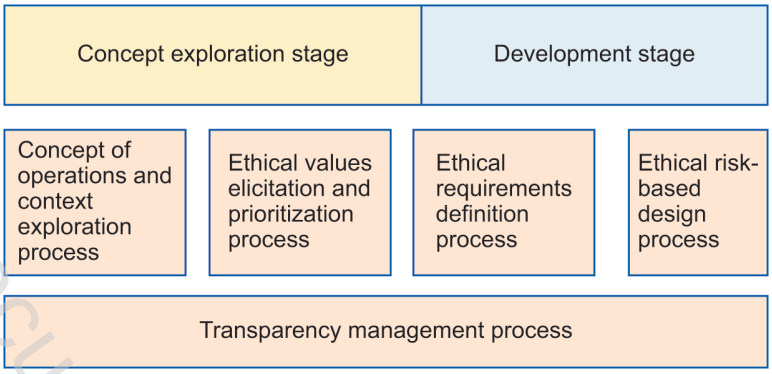

Figure 1—Relationship of processes and stages in IEEE Std 7000

(SOI). Once values are identified and prioritized, they are scrutinized again with a view to potential legal expectations and internationally applied ethical guidelines. The result is a list of value priorities for the system.

These value priorities are then analyzed more systematically and conceptually as the basis for the Ethical Requirements Definition Process, which generates EVR and value-based system requirements.

IEEE Std 7000 is compatible with many existing development practices, including iterative and incremental life-cycle models and agile methods. The Ethical Risk-Based Design Process translates value-based requirements into design characteristics and determines controls that can mitigate risks to values. Controls are system requirements or organizational policies and procedures. As EVRs are instantiated in the system design, the value dispositions are validated for incorporation of the specified values.

The value-based engineering processes include Transparency Management, based on the Information Management process of ISO/IEC/IEEE 12207:2017 [B40] and ISO/IEC/IEEE 15288:2015 [B41]. In this standard, the Transparency Management Process is refined to consider the special requirements of value-based engineering in communicating more openly with relevant stakeholders.

In this standard, the focus on concept analysis, requirements engineering, risk-based design, validation, and monitoring of a product's design, characterize it as deeply embedded into system engineering thinking. Its alignment with established system engineering processes is indicated in Annex A; the relationship of processes in IEEE Std 7000 and in ISO/IEC/IEEE 12207:2017 [B40] and ISO/IEC/IEEE 15288:2015 [B41]. Those standards provide processes without the special focus on ethical values.

1.5 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).[3,4]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred, but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (can equals is able to).

[3]The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.
[4]The use of *will* is deprecated and cannot be used when stating mandatory requirements, *will* is only used in statements of fact.

Copyright © 2021 IEEE. All rights reserved.

This document is a preview generated by EVS

2. Normative references

This standard has no normative references.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause. [5]

NOTE—For additional terms and definitions in the field of systems and software engineering, see ISO/IEC/IEEE 24765 [B45], which is published periodically as a "snapshot" of the SEVOCAB (Systems and Software Engineering Vocabulary) database and is publicly accessible at <computer.org/sevocab>.

acquirer: Stakeholder that acquires or procures a product or service from a supplier.

NOTE—Other terms commonly used for an acquirer are buyer, customer, owner, purchaser, or internal/organizational sponsor.

acquisition: Process of obtaining a product, service, or system.

activity: Set of cohesive and purposeful tasks of a process.

agreement: Mutual acknowledgment of terms and conditions under which a working relationship is conducted. *Example:* Contract, memorandum of agreement.

architecture: <system> Fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution (ISO/IEC/IEEE 42010:2011 [B49]).

audit: Independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria (ISO/IEC/IEEE15288:2015 [B41]).

NOTE—The scope includes professional and industry codes of practice.

benefit: Positive outcome that is voluntarily or involuntarily created by a system or process.

NOTE—Benefits correspond to one or more underlying desired values.

concept of operations (ConOps): Verbal and/or graphic statement, in broad outline, of an organization's assumptions or intent in regard to an operation or series of operations (ISO/IEC/IEEE15288:2015 [B41]).

NOTE—The concept of operations ConOps frequently is embodied in long-range strategic plans and annual operational plans. In the latter case, the ConOps in the plan covers a series of connected operations to be carried out simultaneously or in succession. The concept is designed to give an overall picture of the organization operations. *See also*: **operational concept**.

concern: <system> Interest in a system relevant to one or more of its stakeholders (ISO/IEC/IEEE 42010:2011 [B49]).

NOTE—Concern pertains to any influence on a system in its environment, including developmental, technological, business, operational, organizational, political, economic, legal, regulatory, ecological, and social influences.

[5] *IEEE Standards Dictionary Online* is available at: http://dictionary.ieee.org. An IEEE Account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.

Copyright © 2021 IEEE. All rights reserved.

This document is a preview generated by EVS