System- og softwareudvikling – Livscyklusledelse – Del 7000: Standardiseret modelproces til adressering af etiske hensyn i forbindelse med design af systemer

Systems and software engineering – Life cycle management – Part 7000: Standard model process for addressing ethical concerns during system design

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Danish Standards Association

Göteborg Plads 1
DK-2150 Nordhavn

Tel: +45 39 96 61 01
dansk.standard@ds.dk
www.ds.dk

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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

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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

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

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

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Annette Reilly, *Technical Editor*

Lee Barford
James Beetem
Jared Bielby
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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
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Robert Donaldson
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Kenneth Foster
David Fuschi
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Tamas Haidegger
Victoria Hailey
John C. Havens
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Kenneth Wallace
Lei Wang
Gisele Waters
Eleanor Watson
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Forrest Wright
Yu Yuan
Oren Yuen
Janusz Zalewski
Daidi Zhong

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Howard Wolfman
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*Member Emeritus

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.

Contents

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.

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.

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

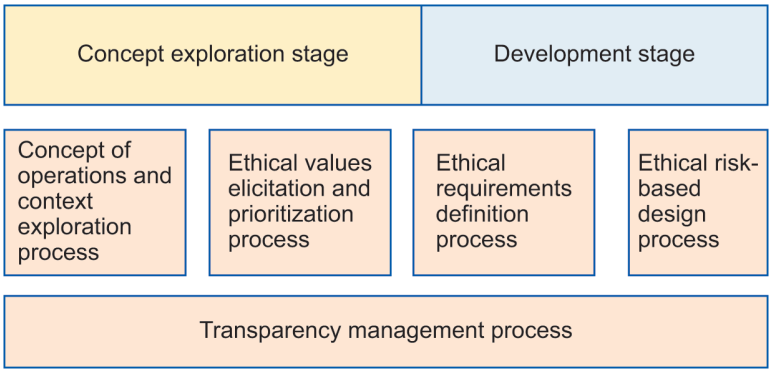

Figure 1—Relationship of processes and stages in IEEE Std 7000

(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.

2. Normative references

This standard has no normative references.