

INTERNATIONAL  
STANDARD

ISO/IEC/  
IEEE  
21841

First edition  
2019-07

Corrected version  
2019-09

---

---

**Systems and software engineering —  
Taxonomy of systems of systems**

*Ingénierie système et logiciel — Taxonomie des systèmes de systèmes*

iTeh Standards  
(<https://standards.itih.ai>)  
Document Preview

[ISO/IEC/IEEE 21841:2019](https://standards.itih.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019)

<https://standards.itih.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019>



Reference number  
ISO/IEC/IEEE 21841:2019(E)

© ISO/IEC 2019  
© IEEE 2019

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

[ISO/IEC/IEEE 21841:2019](https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019)

<https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO/IEC 2019

© IEEE 2019

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 either ISO or IEEE at the respective address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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

Email: [stds.ipr@ieee.org](mailto:stds.ipr@ieee.org)  
Website: [www.ieee.org](http://www.ieee.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
3.1 General terms.....	1
3.2 SoS types.....	2
<b>4 Concepts and application</b> .....	<b>3</b>
4.1 Overview.....	3
4.2 Importance of taxonomies to SoS.....	3
4.3 Use of SoS taxonomies.....	3
<b>5 Taxonomies for systems of systems</b> .....	<b>4</b>
5.1 General.....	4
5.2 Taxa: directed, acknowledged, collaborative and virtual.....	4
5.2.1 Overview.....	4
5.2.2 Description of the taxa.....	4
5.2.3 Examples of potential application of the taxa.....	5
5.2.4 When to use.....	5
5.2.5 How to use.....	5
5.2.6 Why to use.....	6
5.2.7 Limitations.....	6
5.2.8 Benefits of use.....	6
<b>Annex A (informative) Summary of SoS taxonomies</b> .....	<b>7</b>
<b>Bibliography</b> .....	<b>8</b>
<b>IEEE notices and abstract</b> .....	<b>9</b>

[ISO/IEC/IEEE 21841:2019](https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019)

<https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019>

## 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 documents should be noted. This document was drafted in accordance with the rules given in the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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](http://www.iso.org/patents)) or the IEC list of patent declarations received (see <http://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](http://www.iso.org/iso/foreword.html).

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Systems and software engineering*, in cooperation with the Systems and Software Engineering Standards Committee of IEEE Computer Society, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

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](http://www.iso.org/members.html).

This corrected version of ISO/IEC/IEEE 21841:2019 incorporates the following correction:

- The publication date on the cover page has been corrected.

## Introduction

Systems of systems engineering (SoSE) is a concept that is increasingly thought of as a discipline important for the realization and sustainability of large and persistent sociotechnical systems in areas as diverse as healthcare, transportation, energy, defense, corporations, cities and government.

While SoSE applies broadly to hardware, software, middle-ware as well as embedded, cyber-physical and digital systems, the importance of SoSE has been heightened in the last fifteen years by the rapid increase in the pervasiveness of information technology (IT), illustrated by new technologies and paradigms such as Sensor Networks, Cloud Computing, the Internet of Things, Big Data, Smart Devices and Artificial Intelligence. It is, for instance, the application of these technologies to cities that transform them into “smarter” cities.

This pervasiveness of IT was not only driven by the availability of these technologies, but also more importantly by the requirements in our resource and environmentally-constrained world for increased and sustainable economic development and, ultimately, personal well-being.

SoSE goes well beyond IT and potentially applies to all types of systems, including hardware and cyber physical systems where IT is an enabler. SoSE addresses functionality, performance and interdependencies of the systems as well as their connectivity. The interconnectivity of systems has become pervasive in large command and control systems, defense systems, communications systems, transportation systems and medical/health systems, among others. The accelerating need to share information and leverage capabilities from other systems has changed how systems need to be viewed and engineered.

Taxonomies provide a means in many fields to classify and describe the relationships among the relevant elements being studied. The elements of a taxonomy, or taxa, form a partitioning or means of classification within that body of knowledge. In the context of systems of systems (SoS), the relevant elements of the system of interest are, by definition, systems themselves. Using essential characteristics to partition the various types of SoS provides an abbreviated nomenclature for thinking about SoS. Based on taxonomies, different approaches to the engineering of systems of systems are possible, improving the efficiency and effectiveness of systems of systems engineering.

<https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019>

<https://standards.iteh.ai/catalog/standards/iso/68695796-d0e8-4dd2-8b34-9a5f05e70671/iso-iec-ieee-21841-2019>

