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A. TITLE AND SCOPE OF TC 56

Title

The current title of TC56 is "Dependability".

Scope

The purpose of TC 56 is to prepare international standards in the field of dependability, in all appropriate technological areas, including those not normally dealt with by IEC Technical Committees. Dependability is the ability to perform as and when required and is time dependent in application. Dependability can be expressed in terms of core attributes of availability, reliability, maintainability and supportability that are tailored to application-specific functional and service attributes.

The standards cover generic aspects on:

- dependability programme management;
- testing and analytical techniques;
- software and system dependability;
- life cycle costing;
- technical risk assessment.

This includes standards related to products, processes and management activities. The standards provide systematic methods and tools for dependability assessment and management of equipment, services and systems throughout their life cycles.

The application of these standards may raise safety related issues, though the standards themselves do not cover safety. They may be applied to business risk analysis but these risk areas are not dealt with by TC 56.

Dependability is a technical discipline and is managed through life cycle processes involving availability and its core performance attributes of reliability, maintainability and supportability, as well as application specific performance attributes such as recoverability, survivability, integrity and security for products and service dependability evaluation.

Dependability has been formally linked to quality by being included as a characteristic of quality and by having a dual logo ISO/IEC standard on dependability management although this dual logo has now been deleted.

Background

Initial meetings were held starting in 1965 following a German proposal. TC 56 was formally approved by IEC in late 1966 as Technical Committee 56 "Reliability of electronic components and equipment" with the first meeting held in 1967. The title was later changed to "Reliability and maintainability". This title was then changed to "Dependability" in 1989 to better reflect the technological evolution and business needs on a broader scope of applications based on the concept of dependability. In 1990, following consultations with ISO, it was agreed that the scope of TC 56's work should no longer be limited to the electrotechnical field, but should address

generic dependability issues across all disciplines.

In the beginning, the committee was oriented primarily towards testing of electronics and statistical methods associated with testing, for example, test plans. Soon standards in availability and maintainability were added and later management aspects of dependability were included. In 1988, the standards of TC 56 were restructured on the so-called "toolbox principle". The idea was that a number of standards, called "application guides" should give guidance to non-expert users and point to a number of "tool" standards. An expert user would be able to go directly to the "tool" standards. Due to the slow process of revising existing standards, the "toolbox" structure was not fully implemented until year 2000. With the emphasis by SMB on self-contained standards, TC 56 is restructuring standards to be more self contained, so the user does not have to buy several standards in order to perform a task.

When the US MIL standards ceased to be mandatory, a new situation developed, since TC 56 offers international standards that to a large extent cover the same areas. These standards are reviewed and updated at least every 5 years, while few of the MIL standards are maintained any more.

Technical development expanded the activities of TC 56 to cover maintenance support as well as technological risk. Therefore the title "Reliability and maintainability" no longer covered the scope of the committee. The term "dependability" was therefore introduced as an "umbrella term" which like the term "quality" covers a lot of aspects, some of which are quantifiable and some are not. The term dependability now covers reliability, availability, maintainability, maintenance, maintenance support and technological risk.

The activities of TC 56 were expanded to cover more than electronics. Non-electronic equipment and systems were included as well as software and human aspects. Today TC 56 covers areas from components to complex systems, networks and open systems and from management aspects to manufacturing. From being mainly focused on Test Analysis and Fix (TAAF), TC 56 is now also working with standards covering dependability aspects of product development, design integration, maintenance, risk assessment and obsolescence.

Emerging trends
Dependability concepts are critical for modern trends in an increasingly integrated world that is more and more dependent on interconnected technologies such as open systems and the Internet of Things. Dependability promotes clean energy technology applications which encourage energy conservation, include information technology, embrace design principles to reduce, recycle and reuse, advocate the interoperability of system components to achieve simplicity in designs, adopt reusability and utilize applicable commercial-off-the-shelf (COTS) products. In addition to proven dependability tools and techniques, TC 56 is now challenged to provide new or improved methods to deal with the high dependability demands that society now expects.

B. MANAGEMENT STRUCTURE OF THE TC

Management structure

TC 56 has the following Working Groups which act as maintenance teams for existing standards and support the work on new standards by providing experts who have experience in dependability applications and standard development. Several Advisory Groups assist with the management of the Committee.

WG1 *Dependability terminology*:

- produces new and maintains existing terms and definitions related to dependability for inclusion in the IEV;
- advises Project Leaders on terminology for writing clear and unambiguous standards and promoting clear communications, for example in contract situations;
- ensures that the terms defined clarify any linkages to terms used in other fields, for example,

quality;

- liaises with other TCs on IEC terms and definitions, as appropriate.

WG2 *Dependability techniques* develops and maintains standards on:

- reliability tools and techniques;
- test and analysis methods;
- statistical procedures associated with these techniques and methods (applied statistics).

WG3 *Management and systems* develops and maintains standards on:

- management of dependability;
- maintainability, supportability and maintenance;
- technological risk assessment;
- systems engineering and human aspects.

WG4 *Information systems* develops and maintains standards on:

- dependability of information systems including open systems, Internet of Things (IoT), Systems of Systems (SoS).
- dependability of IT security.

TC 56 has the following Advisory Groups that assist the Committee with specific aspects.

The Strategic Advisory Group (SAG):

- advises the Chair of TC 56 on industry requirements and dependability standards needed to serve those needs;
- coordinates the work of the Working Groups. Convenors and deputy convenors (secretaries) of the Working Groups, as well as invited experts from the member bodies, participate in the meetings;
- provides on-going guidance on strategic issues and long range planning.

The Legal Advisory Group (LAG):

- advises the Chair, convenors and project leaders on the legal implications of TC 56 standards;
- responds to inquiries and reviews working drafts of documents as to legal implications to provide input to the Working Groups before documents are circulated;
- maintains a working knowledge of laws, regulations and important court decisions pertinent to the work of TC 56 in order to perform the above tasks.

The Communication Advisory Group (CAG):

- advises on managing communication of TC56 dependability activities and application through the website;
- advises on facilitating communication with liaison partners;
- organizes seminars to promote the value of dependability to stakeholders.

Liaison activities
TC 56 maintains liaison activities with a number of ISO and IEC TCs and SCs and some external organizations:
IEC/TC 1 Terminology
IEC/TC 9 Electrical equipment and systems for railways
IEC/TC 44 Safety of machinery – Electrotechnical aspects
IEC/SC 45A Instrumentation and control of nuclear facilities
IEC/TC 47 Semiconductor devices
IEC/TC 65 Industrial-process measurement and control

IEC/SC 65A Industrial-process measurement and control – System aspects
IEC/TC 104 Environmental conditions, classification and methods of test
|EC/TC 107 Process management for avionics
IEC/PC 118 Smart grid user interface
ISO/TC 67 Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries
ISO/TC 69/SC 1 Applications of statistical methods – Terminology and symbols
ISO/TC 108/SC 5 Mechanical vibration and shock – Condition monitoring and diagnostics of machines
ISO/TC 159/SC 4 Ergonomics of human-system interaction
ISO/TC 176/SC 1 Quality management and quality assurance – Concepts and terminology
ISO/TC 176/SC 2 Quality management and quality assurance – Quality systems
ISO/TC 199 Safety of machinery
ISO/TC 251 Asset management
ISO/TC 262 Risk management
ISO/IEC JTC 1/SC 7 Information technology – Software and systems engineering
CEN/TC 319 Maintenance
IEC ACOS
International Institute of Obsolescence Management (IIOM)

C. BUSINESS ENVIRONMENT

Market relevance

The dependability of a product or system implies that it is trustworthy and capable of performing the desired service upon demand to meet business objectives and user needs. Dependability is an engineering discipline to assure integrity, achieve performance, ensure availability and sustain interoperability of diverse products and services selected for system integration. Dependability attributes affect cost-effectiveness in business operations and influence successful outcomes of the system life cycle to achieve optimal performance. System dependability deals with error avoidance, fault tolerance and failure prevention techniques. It provides industry best practices to enhance the applications of dependability characteristics which are critical to system design and implementation. Dependability characteristics are well sought by business enterprises for global standardization to facilitate international trade.

Dependability is becoming increasingly important in a modern society, since all of society depends on technology and services for survival, comfort, security and entertainment. Without dependable products and services, electricity would be frequently unavailable, transportation not meeting service levels and information missing or obsolete. Without dependability, there would be numerous car, train, aeroplane and ship accidents and numerous medical maltreatments every day. There is an increased focus on physical asset management practices where TC 56 standards provide a significant component of how it is implemented.

Sales of standards through IEC

Sales figures for TC56 standards only cover a minor part of total sales as they list only standards sold by IEC in Geneva. Most National Standardisation Bodies also sell TC 56 standards, in some cases in translation, and all TC 56 standards are confirmed as European Standards (EN) through the process of parallel voting. Many standards are now being sold through subscription services. The sales figures in Table 1 for 2015, 2016 and 2017 year-to-date until August can therefore only be used to compare as a rough indication of the interest for the different standards and should not be taken as the actual sales volume. The table below shows the top standards that have been sold in the past few years with the total of all standards sold for this time period amounting to 618 standards.

Table 1 – Sales figures for the top TC 56 standards sold through IEC

TC 56 Standard	2015	2016	2017-08 ytd	Total
IEC 60812:2006 ed. 2.0	56	53	54	**163**
IEC 61025:2006 ed. 2.0	13	12	18	**43**

IEC TR 62380:2004 ed. 1.0	15	19	7	**41**
IEC 62402:2007 ed. 1.0	12	16	4	**32**
IEC 61882:2016 ed. 2.0		9	12	**21**
IEC/ISO 31010:2009 ed. 1.0	7	5	8	**20**
IEC 61709:2011 ed. 2.0	12	6	1	**19**
IEC 62506:2013 ed. 1.0	9	6	3	**18**
IEC 61078:2016 ed. 3.0		4	11	**15**
IEC 61882:2016 RLV ed. 2.0		9	6	**15**
IEC 60300-1:2014 ed. 3.0	7	5	2	**14**
IEC 60300-3-11:2009 ed. 2.0	6	4	4	**14**
IEC 61882:2001 ed. 1.0	10	2		**12**

Regulatory compliance

Dependability standards are not directly intended for use in regulations but they may be referenced as best practice for complying with regulations.

D. Market Demand

Market demand of dependability standards covers a broad range of industry sectors, such as computers and electronics, communication networks, process controls, transportation and distribution, energy, safety and security, educational and academic institutions and government agencies. These stakeholders all have vested interests in assuring stability, trustworthiness and safety in their systems, products and services. Dependability is knowledge driven and instigates technology research and development for practical implementation to meet user needs. Global competition fuels the market demands for incorporation of dependability characteristics into systems, products and services. Dependability has emerged from its traditional quality roots as an enabling mechanism for system design assurance, provides fault tolerant design options, and advocates risk mitigation processes to reduce failure occurrences and impact consequences. Dependability has become an important criterion for business strategies to guide new acquisitions and the cost-effectiveness in system ownership and operations for return-on-investment.

TC 56 will produce and maintain standards on dependability with a wide application, but not product specific standards. This delimits TC 56 from component design, test and manufacturing standards as well as standards on safety and product standards for software.

E. Trends in Technology and in the Market

Trends in technology

Technology trends over the past decade have indicated a rapid growth and application of Information Technology (IT) in most technology-based industries, which demand the need for dependability engineering and methodology standardization. This is evident in the merging of the telecommunications, computers, and entertainment industries due to technology convergence and industry collaboration, to deliver value-added systems, products and services. The increase in broadband access and high speed computing capabilities has resulted in the dominance of internet services and web development. Technology diffusion and innovative software architectures have enabled the use of third-party software functionality over the internet to permit cross-platform, cross-provider and cross-domain applications. The software engine has become the driving mechanism to realize complex system operations. However, systems containing software are prone to virus attacks and security intrusion. Technology utilizing dependability techniques is a viable solution for virus prevention and security protection to assure sustainable system operation. Dependability plays a critical role in robust hardware and software designs to reduce system risk exposures and minimize network vulnerability. Dependability facilitates the achievement of viable e-businesses for seamless integration and enterprise process

management. This paradigm shift has put the global business communities in a situation of relying heavily on software intensive systems to sustain business operations. System dependability influences the success of system performance and guarantees data integrity.

Components today are highly integrated and very complex like "systems on a chip" and nano-technology. The reliability requirements of components are extremely high and increasing. TC 56 realises that the technology is so complex and fast changing that TC56 will not be able to standardize qualification tests for components or publish and update failure rate data. TC 56 therefore concentrates on guidance standards as well as technical guidelines on how to collect relevant data and how to use modern components in a design process

Trends in the market
Market trends reflect rapid technology evolution and user adaptation, hence fostering industry awareness and needs for dependability guidelines and methodology applications. The new generation of dependability standards has to fill the technical gaps to provide a generic framework and technical guidance for establishing dependability design standards and application criteria. They are critical for most technology-based systems, products and services. Dependability principles have expanded beyond classical reliability theory for realization in engineering applications and implementation of technical practices. The standardization focus is on development of relevant dependability methods and techniques suitable for system and network applications. Emphasis is placed on software intensive systems and their software elements as the target driving force for dependability performance achievements in new product introduction and sustainable service provision.

Today’s society is so dependent on technological systems that the demand for dependability is very high and increasing. High dependability requirements and quick time to market make it very difficult to verify dependability targets by testing. Therefore analysis methods, design methodology and management aspects are increasing in importance.

Even though the dependability requirements are very high, life cycle costs, especially warranty costs, which are mainly associated with dependability issues, are increasing, making dependability activities highly profitable. Standards produced by TC 56 help companies reduce warranty costs through analysis, testing and maintenance. Appraisal costs are reduced by standards on testing and prevention costs are minimized by standards on analysis and management of dependability. For software, costs of testing can be estimated as 26% and prevention to 8% of the development costs. In addition, there are life cycle costs not covered by warranty, as for example maintenance costs and costs for maintenance support.

TC 56 standards can be used by all companies from large companies to medium size and even small companies. The number of such companies worldwide is very large. Outsourcing increases the demand for clear and unambiguous standards as a basis for contracts and cooperation. This ensures healthy competition ("a level playing field") and reduces transaction costs (the costs to set up, monitor and if needed enforce a contract).

F. SYSTEM APPROACH ASPECTS (REFERENCE - AC/33/2013)

The system approach for dependability engages the fundamental principles of systems engineering and application of life cycle processes for activity identification and resource allocation, evaluates the internal and external environments to assess associated impacts, establishes the customer and supplier relationships and coordinates the transition activities of the supply-chain. It integrates the technology knowledge-base and experience-data sharing for collaboration. The system approach advocates the planning, design and implementation of relevant processes to engineer dependability into systems, assesses and measures the performance results to assure dependability achievement. It incorporates the appropriate enabling mechanisms to optimize the desirable system objective outcomes subject to technical constraints and resource limitations.

The system approach includes dependability management systems under the total life cycle

process as well as dependability for items, complex systems, stand alone systems, equipment, components and devices. For dependability, a system includes hardware, software and human aspects.

G. Conformity Assessment

TC 56 standards are generally intended to provide guidance and not generate requirements related to confirmity assessment. Compliance with requirements in a TC 56 standard is voluntary, unless the standard is called out in a contract, in the quality management system of the company/organisation, or listed by the manufacturer for compliance with a CE-mark. TC 56 does provide a number of standards that could be used reliability testing and screening.

Standards can be used for certification e.g. ISO 9001 and ISO 55001, if a standardisation body offers such certification. If a company/organisation chooses to be certified, compliance with the standard that the certification is based on is of course required. But more standards may be used to comply with specific clauses in the certification standard. For example, for the life time of a product (ISO 9001 Clause 8.5.5), IEC 61649 Weibull analysis may be used. For determining if an asset is improving or deteriorating over time (ISO 55001 requirement) IEC 61710 Power law may be used. TC56 therefore supplies tools that may be utilized to comply with specific requirements (clauses) of certification standards such as, for example, ISO 9001 and ISO 55001. However, it must be emphasised that companies/organisations are free to use other methods that they choose themselves, if in that way they can show sufficient compliance with the certification

H. 3-5 Year Projected Strategic Objectives, Actions, Target Dates

Strategic Objectives 3-5 years	Actions to support the strategic objectives	Target Date(s) to complete the actions
1. Improve communication of the value of TC56 standards to major stakeholders.	1.1 Establish a new Advisory Group on Communications to manage delivery of information to stakeholders, primarily through the website	2017
	1.2 Strengthen liaison with ISO TC251 Asset management by providing formal updates, attending meetings and participating in Working Groups	3 years
	1.3 Enhance the TC56 website to better provide relevant information to different stakeholders	2018
	1.4 Improve reporting to liaison groups with structured reporting depending on the nature and importance of the liaison	2018
	1.5 Continue offering seminars where meetings are being held and investigate other opportunities for sharing the work of TC56	Ongoing
2. Review and improve TC56 standards to better meet stakeholder requirements	2.1 Review the current structure of TC56 standards (such as shown in Annex A of IEC 60300-1) and revise as necessary to provide a clear	2018

	view of standards to various stakeholders	
	2.2 Update IEC 60300-1 on dependability management and processes to obtain consistency with other core standards	2017-2019
	2.3 Update IEC 60300-3-4 specification of dependability requirements to obtain consistency with other core standards	2017-2019
	2.4 Update standards on the core characteristics of dependability (reliability, maintainability and supportability) with links to availability	2017-2019
3. Make sure that TC56 standards cover all relevant technological fields	3.1 Investigate the application of TC56 standards for current trends in technology such as security, renewable energy and the internet of things (IoT)	2018
	3.2 Merge and revise standards where possible to accommodate changes in technology and meet stakeholder requirements	Ongoing
	3.3 Identify which standards need to include the non-constant failure rate and update where relevant as standards come up for revision	Identify by 2018 Update ongoing
4. Reduce the time for TC56 deliverables	4.1 Promote early consensus on new standards or revisions and restrict later major technical changes	Ongoing
	4.2 Ensure first CD has no editorial issues and this is maintained for subsequent documents	Implement by end of 2017 and then ongoing
	4.3 Increase use of web conference collaboration to accelerate progress on standard development	Ongoing
Note: The progress on the actions should be reported in the RSMB.		