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Strategic principles for future IEC and ISO standardization in industrial automation

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Strategic principles for future IEC and ISO standardization in industrial automation

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

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STRATEGIC PRINCIPLES FOR FUTURE IEC AND ISO STANDARDIZATION IN INDUSTRIAL AUTOMATION

FOREWORD

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standards. 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.

Guides are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

Draft Guides adopted by the responsible committee or group are circulated to national bodies for voting. Publication as a Guide requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this Guide may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC Guide 75 was prepared by the IEC Sector Board 3 (SB 3), *Industrial automation systems.*

This Guide may be revised in due course on the basis of practical experience. Committees writing standards are invited to inform the ISO Central Secretariat or the IEC Central Office of any difficulties encountered with the implementation of its provisions.

One aspect of this Guide requires particular comment.

> "Future ... standardization" indicates that these proposals are forward-looking. However, existing standards are also affected.

SB 3's terms of reference and the experience of its members both restrict the formal domain of these recommendations to that of industrial automation. However, the members are of the unanimous opinion that the recommended principles could have much wider application because many of them are generic, and could thus be relevant to many other industrial sectors.

The text of this guide is based on the following documents:

Approval document	Report on voting
C/1407/DV	C/1442/RV

Full information on the voting for the approval of this Guide can be found in the report on voting indicated in the above table.

STRATEGIC PRINCIPLES FOR FUTURE IEC AND ISO STANDARDIZATION IN INDUSTRIAL AUTOMATION

1 Scope

This Guide is applicable to IEC and ISO standardization for the industrial automation sector. It provides strategic principles for use by the various technical committees and subcommittees working in different domains within the sector, as well as other bodies within IEC and ISO with interests in the work of these committees.

2 Introduction

Not all standards-related documents (referred to in what follows by the generic term standards[1)] have the same purpose or the same consequences, or are subject to the same constraints. For example, a standard that facilitates business in an application domain and a standard defining safety requirements have little in common. Therefore, the relevant strategic principles may vary, depending upon the different *segments* into which standards fall.

It is therefore proposed to segment standards according to three criteria: the *purpose*, the *actors concerned*, and the *technology involved*.

Concerning **purpose**, the grouping could be

- safety and/or compatibility;
- interoperability;
- performance; and
- comprehension and/or best practices.

Concerning the **actors**, one may distinguish

- governmental, representing the interests of the country and the public; and
- end-users, vendors and integrators organized in a supply chain.

Concerning the **technology involved**, the distinguishing factor is rate of change (fast or slow):

- intensive use of IT (or other fast-changing technologies); or
- no or limited use of IT (or any other fast-changing technology).

By combining the above elements, for the purposes of this document, a *segmentation of standards*, shown in Table 1, may be derived.

1) The term “standard” as used in this document thus includes publications which are not necessarily full-consensus documents.

Table 1 – Standards segmentation

Segment	Types of "standards"	Comments
Segment 1	Safety-, functional safety- and/or compatibility-oriented	Will incorporate more and more IT techniques applied to automation. Should be objectives-oriented rather than methods-/techniques-oriented
Segment 2	Fast-changing technologies	Include technologies such as IT, telecom, power electronics, wireless communications, as applied to the automation and control world
2a	Interoperability-oriented	As technology changes, standards should focus on methods and functions
2b	Performance-oriented	
Segment 3	Mature technologies, performance- or interoperability-oriented	Example 1: performance-oriented standards: defining appropriate frameworks enabling evaluation of products against requirements Example 2: electromechanical products: electrical compatibility, mechanical compatibility
Segment 4	Engineering recommendations	

The main purpose of the segmentation is to provide the context for obtaining quickly standards or other IEC/ISO products that may have a short lifetime.

Segment 1 standards generally involve governmental actors as well as market players. The role of the Supplier's Declaration of Conformity and, where the market forces or regulations require it, certification, is very important for market access.

Segment 2a standards need to be global and stable over time because their effectiveness depends on their use by suppliers, integrators *and* end-users.

Segments 2b and 3 standards are, in a sense, private between vendors or between vendors and users.

Segment 4 standards are not true standards but a collection of best practices that can be used as a reference. There will be little consideration of segment 4 in this document.

After Clauses 4 and 5, which provide the background and rationale for these recommendations, Clause 6 gives recommendations common to all standards segments, and Clauses 7 to 9 give ones specific to segments 1, 2 and 3 respectively. Clause 10 deals with conformity assessment.

3 Abbreviations

EMC	Electromagnetic compatibility
IEC/CAB	IEC Conformity Assessment Board
IS	International Standard
ISO/CASCO	ISO Conformity Assessment Committee
IT	Information technology
ITA	Industry Technical Agreement
IWA	International Workshop Agreement
NC	National Committee
PAS	Publicly Available Specification
SDO	Standards Development Organization
SDoC	Supplier's Declaration of Conformity
SME	Small and medium-sized enterprise
TC	Technical Committee
TR	Technical Report
TS	Technical Specification
TTA	Technical Trend Assessment

4 New environment

The industrial world has changed greatly since the process of standards-writing began. The **new environment** is characterized by the following.

4.1 Globalization

Elements of society are becoming increasingly interdependent on a global basis. Globalization in industrial automation systems implies standardization across global supply and knowledge chains, involving extended enterprises.

4.2 Spread and dynamism of information technologies

The amount and complexity of the knowledge inherent in industrial products and services have increased by several orders of magnitude. This knowledge (technology) is changing and invading new domains faster than the time needed for a set of independent parties to develop a single, proven interface specification for interoperability across their respective system elements in the traditional standardization process.

4.3 Rapid innovation in other technologies

These include materials processing, energy generation and storage, and bio/ecosystem management and control.

4.4 Systems

While a need remains for the standardization of individual elements using both traditional and advanced technologies, there is increasing emphasis on the ability to integrate elements into systems of varying complexity. These integrated systems are further expected to be sustainable, portable, dependable and scalable.

4.5 Exploitation in other sectors

Many traditional standards groups are seeking to deliver digital definitions of the products that are the subject of their standards. Industry demands a consistent approach across these groups, which should be encouraged to utilize the existing industrial automation standards to develop such definitions.

4.6 Various market demands

Conflicting needs are often expressed by users of products: on the one hand, there is an increasing interest in the use of standards to enable free choice among an ever-greater diversity of more and more complex products which implies that these products must match all the interfaces required by the user's automation system; on the other hand, there is a trend towards requiring more responsibility from the system integrator, ranging from efficient integration to a guarantee of performance, dependability and results.

4.7 Various vendor answers

Producers no longer require uniformity for their very survival; instead, competitive forces determine survival. However, while smaller market actors (for example, product specialists) require standards for better interoperability and interchangeability, larger ones targeting the system market are less interested in opening up the architectures they have invested in and more interested in differentiation.

4.8 Various system integrator answers

The needs of system integrators may also be divergent: using proprietary specifications may help deliver cost-effective one-stop-shop, turnkey solutions (as well as protect a competitive

position), whereas the use of widely applied international standards allows better management of risks. Overall, the challenge is to find solutions which benefit *all* stakeholders.

4.9 Liberalization

Many areas which used to form the subject of government monopolies or closed oligopolies (telecommunications, air transport, energy) no longer do so; almost all markets are open and competitive. This liberalization is an enabler of the globalization mentioned in 3.1.

4.10 Changing relationships between governments and SDOs

In more and more countries, SDOs are no longer under government control but delegated to associations with the public and the private sector represented. This is partly thanks to confidence in the results obtained by ISO and IEC in the past.

Industry as a producer of goods and services (producers), no matter how capital-intensive or how advanced technologically, requires less government leadership than it once did, while still welcoming government support.

Some regional economies and their governments continue to use regional or national standards as a basis for technical barriers to trade.

Producers and exporters are seeking for regulation and conformance to standards to be less and less governmental and more and more market-based and industry-driven regulatory functions. Small producers and users are concerned that this may result in a new kind of central force controlling the markets, jeopardizing broader societal interests.

5 Evolution of requirements

The new environment leads to the following concrete **reasons** why the principles behind standardization, in the industrial automation and similar systems areas, must in some cases evolve.

5.1 System-oriented versus product-oriented

The more the systems approach is of concern (segment 2 standards), the less adequate the traditional function/component-product oriented topics of standardization are. New standardization approaches are needed, for example:

- enabling "plug and play" of elements into systems, thanks to proper (relevant, open, stable) interfaces and associated tools;
- allowing re-use of past proven work, thanks, for example, to standard object-oriented/encapsulation/library and database techniques;
- streamlining the necessary exchanges between individuals and organizations cooperating in the same project ideally: "write information once, use it everywhere", at no extra cost.

5.2 Timely development of standards

IEC and ISO develop standards too late. This is particularly true and a sensitive issue for segment 2 standards, where the key market values are the capability to be ready on time and to innovate.

The track record of ISO and IEC work is clear: the bigger the IT content, the bigger the chances that a document will be obsolete, at least in part, at the date of publication. In addition to speeding up, another potential solution to this is to segment functionally rather

than by technology type, since this makes the standards less vulnerable to technological obsolescence.

5.3 Limits to the applicability of the consensus method

The consensus method of achieving ISs, in the traditional ISO and IEC manner, is not relevant in all cases.

The agreement of almost all parties concerned, or the agreement of public bodies or **nationally** grouped interests, is not relevant in all industrial domains or for all possible subjects of standardization and especially not for all segment 2 and segment 3 standards.

5.4 Applying the consensus method to safety standards

At the same time, the consensus method is the only relevant one in some cases.

Information technology pervades all domains, particularly the ones requiring safety features. However, it must be kept in mind that, as far as public safety is concerned, the consensus in a standard between public and industry representatives cannot be avoided even if it is time-consuming.

Thus, in order to speed up the development of purely industry-driven standards, the safety requirement should be isolated and placed in safety standards, and these standards should be explicitly referenced in industry-driven (segment 2 and 3) standards.

5.5 Limits to the efficiency of the consensus method

Even when it is relevant, the IEC and ISO method of assessing consensus is not always efficient enough.

Although international standards are increasingly being recognized as eliminating barriers to trade, the slow, formal, traditional process of standardization cannot efficiently determine that a consensus has been achieved between the major forces represented in the market. Any other method independent of IEC and ISO based on a flat, unweighted approach may similarly be too slow.

5.6 Relationship of standards to regulations

IEC and ISO leave the door too wide open for governments to introduce additional compulsory regulations based on purely industry-driven standards.

When not dealing with the public interest health, safety or the environment the development of a standard by industry should not in itself be taken as a reason by governments, which are of course sovereign in these matters, to enact a corresponding regulation. However, whenever a regulation is necessary by law to protect the public interest, it should be based on an IEC or ISO International Standard where applicable, developed on a consensus basis by industry and public representatives and enacted with the consent of industry but outside IEC or ISO.

5.7 Conserving the values inherent in IEC and ISO

Nevertheless the IEC and ISO represent values of worldwide importance which must be conserved for the benefit of all the industrial market actors.

Among these key values are:

IEC's and ISO's reputation as international, neutral, non-profit organizations;

IEC's and ISO's status as standardization organizations recognized by the World Trade Organization as significantly contributing to the improvement of world trade in goods and services;

their highly appreciated track record due, among other factors, to the standards-making process's ability to guarantee the following for all technical specifications (especially in the segment 3 domain):

– their quality;
– their maintenance;
– their stability.

6 Recommendations for new standardization principles common to all segments

These recommendations apply primarily to the industrial automation and similar systems sectors with extensive high-technology contents. Their pertinence to each segment is mentioned. Their relevance to other industrial or service domains should form the subject of further consideration.

6.1 Take full advantage of having different IEC and ISO products addressing clear segmented needs

IEC and ISO have a variety of products ranging from true ISs to others such as TSs, PASs including pre-standards, and ITAs. All these products should be positioned, engineered and supported so that they may address clearly segmented needs, in a manner understood by all interested parties.

6.2 Position the right type of product for the right type of need

This product portfolio must be applied to the kind of standards which industry needs, which can where segment 2 is concerned be developed in a matter of a few months, as is done by many consortia. Discussion and development may be different and take longer when segment 1 or segment 3 is addressed.

6.2.1 Develop/adapt the procedure appropriately for each of these products (addressing the full life cycle)

Procedures must also be made consistent with the segment addressed, with a voting or acceptance process which is fair to an equitable set of industry representatives. These are the true stakeholders, and not necessarily national standards bodies.

6.2.2 Make clear to all those interested (for example, NCs, TCs, industry) what the key differences between these products are

There is much left to do to keep all interested parties (including SMEs, government bodies, the NC and so on) clearly informed. Special emphasis is needed on bodies *not familiar at all* with the work of IEC and ISO.

6.2.3 Create full ISs only where they enable trade among producers, integrators, users, etc. and across national boundaries

There is a clear need for neutral, international organizations to provide processes for the development and maintenance of open standards that enable free markets among producers and users, and across national boundaries.

6.2.4 ISs should not cover good engineering practice (segment 4) or any similar domain

Where simpler types of specification or free competitive conditions may apply, creating a full IS has little relevance.

6.3 Concentrate on four areas for ISs

ISs should be focused on the following selected domains:

safety, environmental, EMC, and other generally accepted regulatory domains (segment 1);

IT standards specifying tools and product definition information employed at different stages in the product life cycle and required for successful interoperation (segment 2a);

product requirements and assessment (segment 3, segment 2b);

conditions of service, installation and transport (segments 2, segment 3), only where they are needed to satisfy the system integration conditions shown in 8.1 below, or in other cases where these are required to be uniform in order to be useful.

6.4 Ensure standards are testable and implementable

Start development of a standard only if conformance to it can later be tested; verify the usability of standards before approving them; and ensure that standards are actually tested and applied before being officially published

As industry has often shown us, a demonstration, proof-of-concept or prototype enormously increases the credibility of a new solution. Even more, in some high-technology areas where the market does not yet exist, standardizing only after industrial-strength products or systems are already on the market is neither realistic nor useful, and very often too late.

In these high-technology areas, the quality and implementability of a specification cannot necessarily rely on previous manufacturing or market experience, and must be guaranteed by other methods. Therefore, pre-standards for example, PASs and ITAs are strongly recommended for use early in the process, in order to ensure verifiability of conformance, implementability and market acceptance.

Approval of interface specifications for complex systems should occur only after prototypes have been demonstrated and have actually passed compliance tests.

Whatever the standard, it ought to provide for an associated method of practical and cost-effective verification. This verification should be obtained by objective test methods which can be performed either by the manufacturer itself or witnessed by a third party where explicitly requested by the user.

This implies that full ISs must not be approved in the absence of fully specified, open conformance tests.

6.5 Manage each IEC and ISO project the same way industry manages its projects

6.5.1 Strengthen industry feedback procedures

Lessons from consortia and multi-party research projects, where industry feedback exists, show that it is possible to achieve satisfactory results without undue waste, argument or disproportionate effort.

To get this result, feedback should be sought as a full task in its own right, with surveys of manufacturers and users. Sector Boards are precisely the beginning of this effort in the IEC.

Industry groups may be involved directly in providing their requirements on electronic business through the ISO/IEC/ITU/UN-CEFACT Memorandum of Understanding.

One essential result to be obtained is the regular review of standards in order to withdraw all obsolete, irrelevant, incorrect or conflicting standards.

6.5.2 Apply industry methods and rules to IEC and ISO projects

Projects should not be effectively launched before

a market has been identified that justifies the investment;

the objectives are clearly defined;

a complete and realistic development plan has been produced; and

all resources required (including the project manager) have been identified and allocated, with the proper commitment from industry. Since a project in the standardization domain is “open” and the investment benefits all, ways and means should be invented in order to fund the required development effort. Multi-party research project models could be used to set up agreements between the sponsors and the IEC or ISO.

One implication is that IEC and ISO must review the management of new work item proposals. Another is that projects should be subjected to *true* periodic reviews (strategic and technical).

Industrial project management tools should be used to achieve the effective planning and successful completion of projects, coping properly with time, money and other resources.

Standards should be as short as possible. Among other things, they should contain only a *minimal* amount of non-normative text.

6.5.3 Avoid irrelevancies and redundancies in the IEC and ISO catalogues of standards

6.6 Exploit the value inherent in existing solutions

6.6.1 Encourage use of existing standards for new work

Other SDOs should be encouraged to submit their standards for adoption as IEC or ISO ISs, either in the normal way, on the Fast Track, or as PASs according to the existing PAS processes.

For new standards projects including revisions SDOs should offer the right of first refusal to IEC and ISO, and if the proposal is accepted by IEC or ISO withdraw their own standards after a transition period.

IEC and ISO should encourage specifications of emerging technology from other fields to be applied in the field of industrial automation, after assessment of their applicability.

Conversely, generic, widely reusable resources should be identified – for example, object types, interface description methods, dynamic behaviour description methods, automation-programming languages, networking, techniques to improve dependability. Their development should be concentrated in one place, utilizing relevant expertise from the different application areas, and the results reused wherever useful, for example, for robots, numerically controlled machines, coordinate measurement machines, programmable controllers, and other industrial automation devices.

6.6.2 Eliminate parallel standardization within IEC and ISO

IEC and ISO should provide for much better means and procedures to avoid various groups preparing concurrent or overlapping standards. This represents much waste of energy for industry, at every phase of the life cycle from standards development to implementation.

6.6.3 Encourage adoption of IEC and ISO standards without local changes or additions

IEC and ISO should actively encourage national and regional standards bodies to adopt ISO and IEC standards once these provide acceptable results. National and regional bodies are recommended to specify differences from or clarifications to an IEC or ISO standard only where required to support essential differences in requirements.

6.6.4 Recognize coexisting industry (*de facto*) standards if this adds real market value

Where the users have no requirement for a single standard but may have a need for multiple alternatives (for example, different points in the cost/function/performance space), there seems to be no value added by proposing an IS aimed at replacing existing industry specifications.

IEC and ISO should consider recognizing alternative (competing) specifications only in the cases where this adds real value for system integrators and/or end-users, compared to leaving the subject untouched.

6.6.5 Encourage traditional standardization groups to use existing industrial automation standards for digital product definition

Many traditional standards groups should be encouraged to utilize the existing industrial automation standards to develop digital definitions of their products.

6.7 Avoid development of standards which encourage inappropriate regulation

IEC and ISO TC management and members should analyse whether a standard proposed for development runs the risk of encouraging inappropriate regulations to be introduced by governments. If this is the case, appropriate remedial measures should be taken before the standard is developed.

7 Recommendations for new standardization principles specific to segment 1

7.1 Maintain and enhance the current consensus method

For standards relating to safety, there is still a need for consensus-based methods. The standards will support government bodies in particular in ensuring that products meet environmental and safety requirements. IEC and ISO have in the past proved to be the type of neutral forum that has wide and balanced representation for the creation and approval of standards.

These methods must still be improved in order to speed up the development cycle of standards, so that the process remains credible to industry and government. This is particularly critical where technology is fast evolving, which makes the existing, accepted standards obsolete.

7.2 Develop and promote the use of only one generic safety standard

As safety standard development is usually time- and resource-consuming, the development of such documents should as far as possible be limited to one generic safety standard and some sector safety standards when strictly necessary.

The generic safety standard should be comprehensive and objective-oriented rather than method- or technique-oriented. It should allow safety certification and be sufficiently robust to sustain the fast evolution of IT for several years.

Promoting the single generic safety standard and getting its official recognition by all the sector regulators in every country, is a condition *sine qua non* for facilitating cost-efficient use by industry of certified generic subsystems in safety sector applications (nuclear, avionic, railway, road transport, marine engineering, etc.). Otherwise, the development of the generic standard would have been a waste of time.

7.3 Develop limited sector safety standards only where relevant

Sector safety standards are to be found in sectors which already had well-developed safety cultures and specific safety approaches before the development of the generic safety standard. Publications for these sectors should be limited to the specific features which deviate from the generic approach. The sector publications should point out their differences from the generic approach, identify the points where the generic approach can be used (for example, for subsystems) and how the generic safety approach and the sector safety approach can be consistently applied together.

8 Recommendations for new standardization principles specific to segment 2

8.1 Develop all facets involving the streamlining of system integration (plug and play, re-use, data exchange and sharing)

Integration of a product into a subassembly or of a subassembly into a larger system to ensure a mission (segment 2a) brings with it a growing set of key issues, which may find resolution in ISs or other products. The following elements are anticipated:

identification of the relevant interfaces within the system;

description and representation of the products or subsystems concerned, throughout their life cycle (which may be very long);

unambiguous description of functions and data for aspects such as set-up, operations and maintenance;

description of the dynamic behaviour of the interworking system elements in order to achieve the required performance;

stability of interface definitions over time;

tests to verify conformance to other requirements contained in ISs;

classification methods and levels of performance to guarantee correct product specification;

conditions of service, installation and transport.

8.2 In areas of rapid innovation where system integration is of key concern, focus early standardization on relevant *interoperability interfaces only*

In more and more different application and industry areas, the principal developments depend on the interconnection of different elements, rather than just on the increased sophistication of the individual elements themselves. The clear need resides in properly documented, proven and maintained open interfaces. The following criteria should be considered to identify a relevant interface subject to standardization:

the existence of a stand-alone (independent) market for an element of the system;

the expectation that the interface(s) of concern for it will (may) remain stable;

the feasibility of testing both sides of the interface for conformance to the standard;

the feasibility of verifying usability of the specification before approving it as a standard.

8.3 Encourage non-IS products (PASs, ITAs, TSs, TRs, Guides, TTAs, etc.) where they are relevant

ISO and IEC should pursue closer collaboration with industrial fora, consortia, universities and user groups in the formulation, adoption, testing and standardization of specifications, especially in the industrial automation domain and in other cross-sector domains.

PASs, ITAs (IEC) and IWAs (ISO) are examples of promising new products from IEC and ISO, as alternatives to traditional ISs in areas of rapid technological innovation (segment 2), where business and trade may not require full ISs at market launch. They should now be developed and experimented with. IEC and ISO should

clarify and develop the corresponding decision processes (initial acceptance of project, project reviews, final adoption of project results, subsequent revisions), which must be fair and consistent with industry needs for example, final decisions taken by true stakeholders and not necessarily only through national standard bodies, minimized delays, etc.;

publish widely the procedures for generating and using PASs, ITAs and IWAs, and check users' acceptance of them;

wait for the results of some carefully selected pilot tests before generalizing these products.

9 Recommendations for new standardization principles specific to segment 3

For this segment, ISO and IEC possess a capital of goodwill and value, recognized world wide, which must be conserved and enhanced. The current consensus method may have reached its limit where mostly or exclusively industry players are concerned. Thus IEC and ISO should also consider adapting their processes.

10 Conformity assessment and marking common to all segments

From industry's point of view, standards, and the conformity assessment and marking which are based upon them, form a single system. Consequently, a greater degree of coordination is required between the technical committees developing standards and the conformity assessment schemes which base their activity on those standards (and which if necessary may write related conformity assessment specifications).

The IEC/CAB and the ISO/CASCO are invited to take the following principles into account as representing the needs of the industrial automation sector.

10.1 Principle of *one* standard/*one* test, with a certificate or Suppliers' Declaration of Conformity[2)] accepted *world wide*

As ISO and IEC obtain enhanced status under the rules of the World Trade Organization agreement on Technical Barriers to Trade, their processes should become more relevant to the needs of the global market-place. These process improvements include

updated voting procedures that reflect market impact and influence;

streamlining and prioritizing procedures;

no costs beyond what is necessary.

One standard means designing a product to a set of globally accepted standards.

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2) Supplier's Declaration of Conformity (SDoC) will not apply in some regulated areas such as safety.