



ISO/IEC JTC1/SC7
Software & System Engineering
Secretariat: CANADA (SCC)

ISO/IEC JTC1/SC7 N2573

2002-01-12

Doc. Type	Report
Title	Report from the Study Group on System Engineering
Source	JTC1/SC7 WG7 Convener
Project	
Status	Final
References	Resolution 646
Action ID	FYI or ACT
Due Date	
Mailing Date	2002-01-12
Distribution	SC7_AG, P & O Members
Medium	Acrobat
No. of Pages	8
Note	To be reviewed, discussed and further actioned at the upcoming Plenary.

Document type	Working Group report
Title	Systems Engineering Study Group report
Source	ISO/IEC JTC 1/SC 7/WG 7 Convener
Status	Final
Reference	SC 7 Resolution 646
Action ID	FYI or ACT

Executive summary

Introduction

Many organizations are discovering that the development of their products or services become more and more complex, and may even reach a point where the development efforts, needed to develop these product or services, are beyond their capabilities. At this point, the notions of products or services disappear, to the advantage of the notion of “system”, which is defined as “*a combination of interacting elements organized to achieve one or more stated purposes*”.

Becoming an organization capable of dealing with “Systems” is a long and difficult path, which often leads to deep changes in the culture of companies.

State of the art in System Development practices

Thousands of documents, papers, articles, books exists on systems and on how to develop them. However, normative documents are still rare and it is hard to find documents that are applicable to systems. This situation becomes even more problematic when the systems are being developed by large international organizations involving many different disciplines.

The normative sources for those candidate organizations willing to become “systemers” are usually contained in three documents i.e. IEEE 1220, EIA 632 and ISO/IEC 15288.

These three documents have different scopes and provide different levels of guidance to implement the practices needed to develop systems. Unfortunately, these three documents are not consistent and using them together is difficult and subject to countless pitfalls.

Recommendation

Considering that:

1. The number of experts in Systems Engineering is limited,
2. It is not possible to gather all of them within a single organization,
3. IEEE 1220 and EIA 632 already have a well established scope and exposure,

the recommendation is to fast-track IEEE 1220 and EIA 632 as Technical Reports and then to create a Harmonization Group that would control revisions of these documents.

This report proposes to create a Harmonization Group that would express harmonization requirements for a set of revised documents. The revisions by themselves would be done by the originating organizations (namely IEEE, EIA and ISO/IEC) and when completed, the revised and harmonized documents would be fast tracked as ISO/IEC standards.

At this point, the organizations will have a set of normative documents that will help to establish good system development practices.

Time table

Implementation of the recommendation can be done during the May 2002, Seoul plenary meeting. The work to fast-track the documents can start immediatly, leading to fast track the two non ISO/IEC documents in 2003. The harmonization can be done in a 2 or 3 years time, leading to a completed work in 2005 or 2006.

System Development Practices

Introduction

ISO/IEC JTC 1/SC 7 following its Madrid plenary in May 2000 resolved to conduct a study of System Development Practices. At the SC 7 Nagoya plenary in May 2001, the study group was assigned to Working Group 7 in SC 7 Resolution 646 - Systems Engineering Study Group as follows:

JTC 1/SC 7 extends its Systems Engineering Study Group, and assign it to its WG 7. The Systems Engineering Study Group is instructed to:

- Complete its report in liaison with WG 7, integrating in its analysis the coming guide on Systems Engineering Life-Cycle and relevant INCOSE work, and send it to the Secretariat for Member Bodies Balloting by 2001-12-01.
- Negotiate with the EIA and IEEE the contribution to JTC 1/SC 7 of pdf formatted version of their relevant Systems Engineering documents for the purpose of assisting JTC 1/SC 7 national bodies and liaisons in elaborating national position. Permission must be granted for JTC 1/SC 7 member bodies and technical committees of ISO and IEC to reproduce these documents for purposes of developing a national position. These documents should be released by 2001-12-01.

Terms of Reference

The objectives of the Study Group are to:

- Assess industrial, government, professional and academic needs;
- Prioritize these needs with emphasis on areas where resources and base documentation are available;
- Determine if there are documents developed by professional, or other, organizations that could be fast-tracked by SC 7;
- Draft a plan for follow-on work.

References

- ISO/IEC JTC 1/SC 7 N2239 Letter ballot – Terms of Reference for an Initial Study Period on System Development Practices.
- ISO/IEC JTC 1/SC 7 N2280R Letter ballot summary on the Terms of Reference for an Initial Study Period on System Development Practices.
- N0377 Systems Engineering Body of Knowledge
- N0378 WG 7 Systems Engineering Body of Knowledge response

Purpose of the Study Group

ISO/IEC JTC 1/SC 7 is currently handling several efforts related to systems, with the most visible one being the ISO/IEC 15288 standard on “Systems Life Cycle Processes”. Beyond this work, SC 7 wants to investigate if other efforts are needed or expected by the community in this system field.

The goal is to define a roadmap to deliver the standards that will be needed in the future.

Scope of the study

The scope of the study period was to assess international standardization opportunities in Systems Engineering, initially focussing on System Development Practices. This includes issues related to a Systems Engineering Body of Knowledge and to those related to the communication between systems engineering and other disciplines.

Study Group membership

Jean-Philippe LERAT (FRA), Chair

Marcello PESSOA (BRA)

Valery VASIUTOVITCH (RUS)

Anatol KARK (CAN)

Foreword on Engineering / Development

For many people, the words “Development” and “Engineering” sound alike but they address different notions.

“Development” covers all the activities that are done to bring a system to life. It encompasses all the technical and management activities, regardless of their efficiency and relevancy.

“Engineering” is a discipline that aims to predict the nature and type of activities that are necessary to develop a system, trying to optimize the overall efforts before executing the necessary activities.

System Development practices

The standard ISO/IEC 15288, “Systems Life-Cycle Processes”, has been under development since 1996 and is expected to become an International Standard during 2002.

This effort spanned several years because of the huge scope of the work to be done. It also came to the attention of the experts that, in several aspects, ISO/IEC 15288 does not cover all the processes at the same level.

If the ISO/IEC 15288 meets its requirements in terms of establishing the Processes for a System Life Cycle, it does not cover the entire needs of an organization facing systems and having the need for a set of processes to deal with those systems.

By definition, systems are combinations of interacting elements organized to achieve one or more stated purposes. As the different nature of elements can be hardware, software, human, chemical effects, mechanical assemblies etc. there is no single discipline that can handle a system. The need for a discipline that deals with a wide variety of techniques, engineering disciplines and cultures is mandated to achieve modern systems.

In many cases, organizations do not volunteer to become “Systemers”. The insertion of a new technology, a sharper constraint, an extension for the operation field, or any other reason can push companies into the system field that are product manufacturers and are not ready to deal with systems.

When those companies are facing systems, they must implement not only the processes given by ISO/IEC 15288, but they also need to set up a whole “System approach”, which requests the comprehension of more practices than those described in the ISO/IEC15288 standard alone.

System Development practices and current state

The sources for implementing system approaches within an organization typically come from three major documents:

1. IEEE 1220, published first in 1994 and revised in 1999.
2. the various drafts of the ISO/IEC 15288 and
3. EIA 632 published in January 1999.

Some more specific documents exist, coming from specialized sources such as ARP4754 (Avionics Systems), NASA Standards, ECSC-010 (European Space Agency), etc.

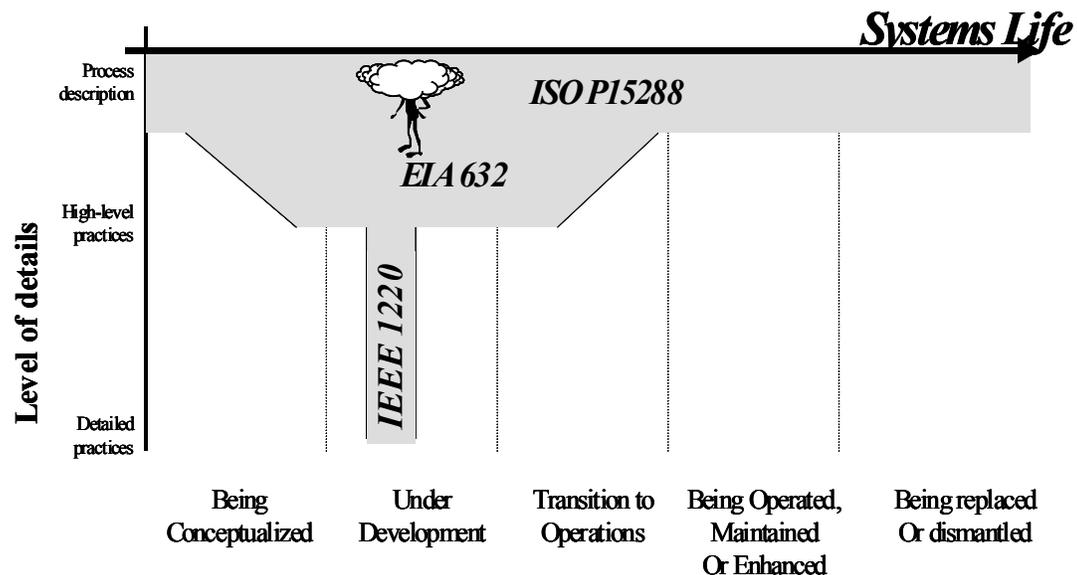
The three “generalist” documents provide organizations with materials to be tailored to create a set of processes that will help them to efficiently deal with systems and develop them.

IEEE 1220 primarily deals with the Systems Engineering Process. It provides a detailed description of the different tasks and activities to be done when doing the system design.

ISO/IEC 15288 primarily deals with the different processes that an organization is likely to establish in order to build complete and efficient life cycle models.

EIA 632 primarily deals with the activities mandated to conduct the effort of engineering a system, which implement all the processes described by the two other standards.

Unfortunately, these three documents are not consistent and, in some areas, are at least extremely confusing and, at worst conflicting. Their areas of overlap are fuzzy and several concepts are treated differently amongst the documents.



This situation drastically increases the efforts needed for a company to establish the correct set of processes to deal with systems.

Proposed approach to improve System Development

Considering the quality and the use of these three documents, JTC 1 does not consider that it is worthing launch New Work Items to replace these documents with new ones.

However, JTC 1 aims to create the conditions to harmonize these three documents, providing organizations with a set of consistent documents, easy to implement within companies and that do not carry their own inconsistencies within organizations.

By result, JTC 1 would provide the marketplace with a set of three consistent standards that would provide a safe, reliable and cost effective framework to implement the system approach that will fit their needs.

By a side effect, this set of documents will ease the relationship between systems engineering and other engineering disciplines. JTC 1 can also host some works for Technical Reports or International Standards dealing with the relationships between Systems Engineering and other disciplines such as software engineering, mechanical engineering, safety, human factors, production, financing, etc.

This last point has a certain importance since there is no place where different engineering disciplines can work on their interfaces with system engineering teams.

Current relationship with other organizations

The IEEE has approved the current proposition and is willing to move forward, by fast-tracking IEEE 1220 as a Technical Report with Mr James Moore as the IEEE liaison.

The EIA G-47 committee is aware of the approach and the proposed liaison, Mr Ron KOHL, has expressed his interest for, and is wishing to go forwards in a positive manner.

Options

There are different approaches that ISO/IEC JTC 1/SC 7 can take, that is:

- Create a New Work Item for a new standard that would encompass the scope of the three documents.
- Create a New Work Item for two new standards having respectively the IEEE 1220 and EIA 632 as source documents.
- Fast Track IEEE 1220 and EIA 632 as ISO/IEC standards and create a New Work Item for a Guiding document on how to use the three standards.
- Create a Harmonization Group that controls the revision of the documents and produces a document on how to use the three documents, separately or together.

Harmonization recommendations

Since developing a new standard encompassing all the needed activities is a huge project for which a good result is not assured, the fast and safe way to achieve such a goal is to harmonize the three documents (IEEE 1220 and EIA 632 and ISO/IEC 15288) and have them able to be implemented together.

The harmonization of the documents, by itself, would be made either by the originating organization using their own revision process, or by ISO/IEC. When the revised documents become available, they can be elevated to the level of an ISO/IEC standard using the fast-track procedure.

The Harmonization Group will produce a statement about the use of the three standards, either together or separately. This document itself could be a Guide published as a Technical Report.

The recommendation should also provide capabilities, for the Harmonization Group, to initiate or control Technical works dedicated to interface a System approach, other engineering disciplines and other specialities, especially in the field of:

- How their requirements and constraints are expressed
- How they can contribute to verify and validate the system-level models
- How they can contribute to verify and validate the system itself
- Etc.

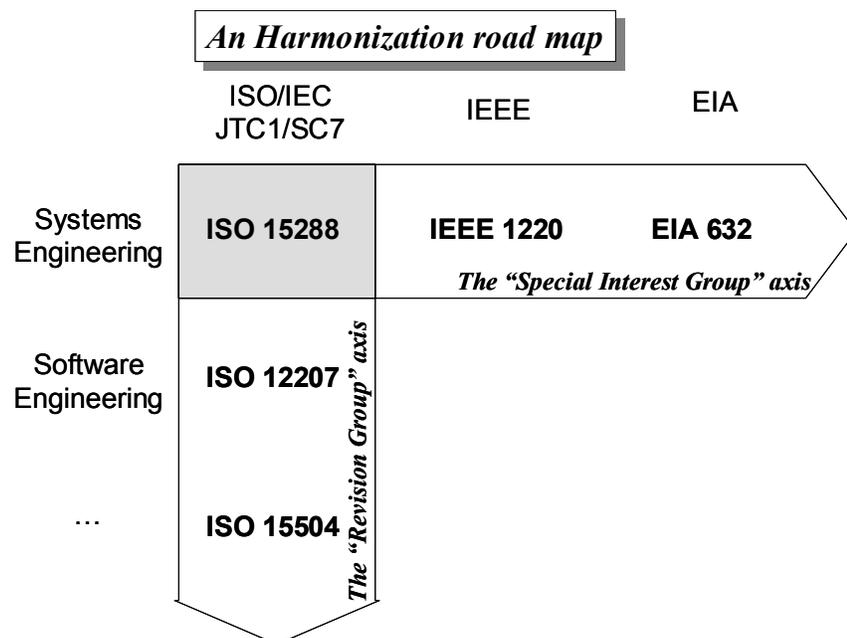
Relation with other SC 7/WG 7 efforts

This effort of harmonization is inline with other efforts by ISO/IEC JTC 1/SC 7/WG 7 to harmonize the other WG 7 international standards. Both efforts can benefit from each other, as both of them address different and related problems.

The other harmonization effort made by WG 7 will revise the different standards of WG 7, such as ISO/IEC 12207 and ISO/IEC 15288, and can be seen as a “vertical” harmonization activity toward WG 7 and its relationship within ISO/IEC.

Our harmonization activity can be seen as a “horizontal” effort that goes out of ISO/IEC towards other professional bodies involved in System Development practices.

The different harmonization axis can be shown as below :



Time frame

The Harmonization group can start at the next plenary meeting, since the targeted organizations have currently been solicited and have expressed, at least informally, a positive feedback.

Provided that such a harmonization group is created at the next plenary meeting in South Korea in May 2002, the work can start in 2002 or 2003, and a completion of the harmonization work can be envisioned in a timeframe of 2 to 3 years (2005 or 2006).

Depending on new work that can be launched in the interfacing of systems approaches and other engineering disciplines or specialties, the lifetime for the Harmonization Group can be longer.

A candidate timetable can be drawn as follows:

