



ISO/IEC JTC1/SC7
Software and Systems Engineering
Secretariat: CANADA (SCC)

ISO/IEC JTC1/SC7 /N2994

2004-03-08

Document Type	Study Group Report
Title	Report of the Study Group on System Life Cycle Process Assessment Model.
Source	Study Group Chair
Project	
Status	Final
Reference	Resolution 732
Action ID	FYI or ACT
Due Date	
Distribution	AG
No. of Pages	9
Note	To be discussed at the SC7 Brisbane Plenary

Address reply to: ISO/IEC JTC1/SC7 Secretariat
École de technologie supérieure – Département de génie électrique
1100 Notre Dame Ouest, Montréal, Québec Canada H3C 1K3
secretariat@jtc1-sc7.org

www.jtc1-sc7.org

Study Group Report on a System Life Cycle Process Assessment Model

1 Summary

This is a report from the Study Group constituted to recommend future SC7 action on a project to develop a system life cycle process assessment model, or models, compliant with the provisions of ISO/IEC 15504. Several possible courses of action were identified and considered. These are outlined in this report.

The Study Group was not in a position to recommend a clear-cut course of action at the end of the requested reporting period. The range of options, and the issues they raise, require further study before such a recommendation can be made.

It is therefore recommended that the Study Group continue with their task, with a view to concluding their deliberations at a Workshop prior to, or during, the Brisbane SC7 Plenary Meeting, at which all Study Group members are expected to be present. The aim of this Workshop will be to arrive at a specific, recommended course of action. If the recommendation were to be to undertake a project, then it would provide a Requirements Document and an illustrative example of an International Standard/Technical Report that could launch project activities.

2 Report Background

At the Closing Plenary of the Montreal SC7 Meeting April 2003, SC7 established a Study Group on assessment models for systems life cycle processes. The terms of reference for this Study Group were to make recommendations regarding a project to create an International Standard (or Technical Report) that enables ISO/IEC 15504-compliant system life cycle process assessments to be performed.

This study was motivated by past SC7 actions that led to the Technical Report on a software assessments model and indicator guidance, ISO/IEC TR 15504-5, the current action on an International Standard on an exemplar process assessment model for software, ISO/IEC 15504-5, and the correspondence between ISO/IEC 12207, *Information technology – Software life cycle processes* (a basis for ISO/IEC 15504-5), and ISO/IEC 15288, *Systems engineering – System life cycle processes*.

In undertaking this the Study Group was requested to take into consideration:

- The software and systems life-cycle harmonization work currently done by WG7,
- The UK contribution on Software and Systems Quality Framework,
- The existing ISO/IEC 15504 standards and working documents,
- ISO PAS 18152 - assessment of human-system issues during the life cycle of a system.

The Study Group consists of Alec Dorling (UK), Anatol Kark (Canada), Jean-Philippe Lerat (France), Harold Lawson (Sweden), Kiyoshi Ogawa (Japan), Marcelo S.P.Pessoa (Brazil), Garry Roedler (US), Matthew Young (Australia) with Stuart Arnold (UK) as its Chair. During the study period, it was recommended that the group be joined by Won-Hee Lee (Korea) and an invitation was extended.

3 Study Options

During the period of the study, the Study Group members variously outlined four primary courses of action that could be followed in order to furnish users of ISO/IEC 15504 with a system life cycle process assessment model, or a sufficient set of International Standards/Technical Reports that would provide necessary assessment information. In addition to these four options, the 'do nothing' option was added, not as a default, but as a reasoned, purposeful 'course of action'.

An example of how an additional Part to ISO/IEC 15504 might look, based on WG10N469, was developed. This work gave helpful insight into the task of developing a set of ISO/IEC 15288-compliant life cycle process work products.

The five options were supported or rejected by a range of arguments, expressed in terms of the issues in favour of or against them, and these are detailed as follows:

3.1 Option A

"It is recommended that SC7 should establish a project to create an International Standard or Technical Report that defines a System Life Cycle Process Assessment Model for use in ISO/IEC 15504-compliant assessments, implementing it as a Part of the currently evolving ISO/IEC 15504 multi-Part set."

3.1.1 Issues in favour of Option A

ISO/IEC 12207 and ISO/IEC 15288 are products of the same working group, and are subject to similar requirements and development constraints. It is thus natural to consider ISO/IEC 15288 as the preferred model for ISO/IEC 15504-compliant assessments of life cycle processes for a product or service viewed from an holistic perspective. This perspective provides the natural and unifying complement to technology or realization medium-dependent viewpoints, for example, that expressed in ISO/IEC 12207 for software.

Whilst the intended complementary nature of ISO/IEC 15288 and ISO/IEC 12207 may currently show inconsistencies, their future harmonization is an SC7 commitment. The current ISO/IEC 12207 addresses software life cycle processes, and is the basis for the evolving Part 5 of the multi-Part ISO/IEC 15504. From this, it logically follows that the current ISO/IEC 15288 should be the basis for a ISO/IEC 15504 'Part 6' that address the system life cycle processes. Ultimately, when harmonization between ISO/IEC 15288 and ISO/IEC 12207 has been achieved, revisions of Part 5 and 'Part 6' would be initiated.

The strong similarity in the requirements, if not in solution, shared by ISO/IEC 15288 and ISO/IEC 12207 suggests that the two International Standards should also share a similar relationship with ISO/IEC 15504. Given that ISO/IEC 12207 continues to be represented in a Part 5 of ISO/IEC 15504, the natural step is to create a 'Part 6' to match the provisions of ISO/IEC 15288 with ISO/IEC 15504 in a similar way to ISO/IEC 12207 and ISO/IEC 15504.

ISO/IEC 15288 has already been used with success as an assessment model for system life cycle processes. In addition, the experience gained with ISO/IEC 12207 is largely transferable to system life cycle assessments, in part because there is (of necessity) a measure of common process definition in the system and in the software life cycle models. A project to develop a 'Part 6' to ISO/IEC 15504 is thus low risk

Study Group on a System Life Cycle Process Assessment Model

(compared with some past WG10 and WG7 projects) and substantially constrained (and preceded) by existing standards.

This option had been seen (maybe prematurely) as the most obvious option and for this reason I undertook to assist a decision on it by preparing a representative and incomplete 'Part 6' text based on Part 5 (N469, 2003-2-13). The detail is probably not the important issue, but it gives a feel for how a 'Part 6' might begin to look

3.1.2 Issues against Option A

The arguments that no 'Part 6' is necessary echo past comments that ISO/IEC 15504 does not require a Part 5 for software life cycle processes. For example, the approaches in Option C and Option D below would have been a more appropriate approach for software.

Broadly the arguments against assessment models being a part of ISO/IEC 15504 are:

- Make ISO/IEC 15504 a generic process assessment instrument and avoid its direct association with software (or any other domain of organisational responsibility).
- Process models are subject to continual evolution and thus a decoupling from the evolving assessment principles and methods favours more effective management and responsibility attribution.
- Life cycle process models can be used in conjunction with assessment standards and methods other than ISO/IEC 15504, thus ISO/IEC 12207 and ISO/IEC 15288-driven assessment models should not be uniquely defined as a part of the ISO/IEC 15504 family.

ISO/IEC 12207 is of necessity rooted in the implementation technology of software. Its viewpoint conveys the terminology, nature of process transformations and work products, a life cycle profile and implementation medium attributes that characterise the medium of software. Its processes look to the detail of activities and into the further detail of tasks.

Conversely, ISO/IEC 15288 views the life cycle at a higher level of abstraction, taking little more than an exemplary view of the implementation media that comprise a system. Accordingly, it provides links to the implementation-dependent issues in ISO/IEC 12207, ISO 18152 and yet-to-be-developed implementation technology life cycle models. It does not look down to activities but up to stages, and how they relate to business management control of products and services.

ISO/IEC 15288 and ISO/IEC 12207 harmonization is thus more about building complementary, contrasting models to explain the differences across a continuum of concepts as it is about duplicating the similarities in that continuum. The view that a harmonised ISO/IEC 15288 and ISO/IEC 12207, and ISO/IEC 15504 Part 5 and a 'Part 6', will exhibit simple symmetry is a challenge yet to be faced.

3.2 Option B

"It is recommended that SC7 should establish a project to create an International Standard or Technical Report that defines a System Life Cycle Process Assessment Model for use in ISO/IEC 15504-compliant assessments, implementing it as a stand-alone document that identifies ISO/IEC 15504 as a Normative Reference."

3.2.1 Issues for Option B

ISO/IEC 15504 process assessment is no longer limited to the software life cycle processes. Users are free to move into the assessment of different process domains provided they are defined in terms of assessment models that comply with the provisions of ISO/IEC 15504 Part 2.

In time, assessment models for use in conjunction with ISO/IEC 15504 are likely to be common currency. Each such model can address an individual area of organisational concern. This trend is already evident in the recently ratified ISO 18152, 'Assessment of human-system issues during the life cycle of a system'. This Technical Report, created through a TC 159 project, addresses process assessment across the organisation from a human factors perspective. It is a valuable indicator of how ISO/IEC 15504 may be applied to an ever-widening range of process domains. It also illustrates a solution route that has been followed elsewhere in the ISO community, i.e. a separate document in the form of a Technical Report.

For example, ISO 18152 could in principle sit as a Part of ISO/IEC 15504, however the remit of, and level of liaison between, TC 159 and SC7 WG10 favoured separate, complementary (effected through Reference in ISO 18152) standards. Taken to the extreme, any compliant assessment model could be a Part of ISO/IEC 15504. This approach appears untenable and unnecessary. Part 5 could thus remain alone as a reference example for the definition of other assessment models.

It is of note in the context of this study that ISO 18152 is not only compliant with the provisions of ISO/IEC 15504 but also those of ISO/IEC 15288. This later International Standard brings the life cycle and system structure dimensions to the framework used by ISO 18152 in order to describe human-system issues.

There is thus evidence of the value and practicability of using ISO/IEC 15504 in conjunction with stand-alone process assessment models, and of the value of ISO standardising such models for its user community.

3.2.2 Issues against Option B

The similarities and synergies between the requirements and the substance of ISO/IEC 15288 and ISO/IEC 12207 do not encourage different strategies for the application of the two International Standards, especially since they are products of the same Committee. As long as Part 5 remains within the ISO/IEC 15504 family, so should the system life cycle counterpart.

The most generic view of products and services is currently presented in ISO/IEC 15288. Given that a process assessment model forms a part of the past and present definitions of ISO/IEC 15504, then ISO/IEC 15288 (as the 'top level' holistic view of products and services) should take precedence over ISO/IEC 12207 (and any other process assessment models, such as ISO 18152).

Establishing an ISO/IEC 15288-based assessment model outside the ISO/IEC 15504 multi-Part family, whilst retaining the ISO/IEC 12207-based model within it, brings an implementation technology distortion to what is otherwise a generic process assessment instrument. An ISO/IEC 15288-based assessment model should only exist outside ISO/IEC 15504 if Part 5 is redrafted as a separate, stand-alone International Standard or Technical Report.

3.3 Option C

“ It is recommended that SC7 should not establish a project to create a System Life Cycle Process Assessment Model and should depend on ISO/IEC 15288:2002 ‘Systems engineering – System life cycle processes’ together with the impending ISO/IEC 15289 ‘Information technology—Systems and software engineering—Content of systems and software life cycle process information products’ applied according to ISO/IEC 15504 Part 2 in order to undertake ISO/IEC 15504-compliant assessments.”

3.3.1 Issues for Option C

ISO/IEC 15288 may already be useful as a system life cycle process assessment model, but it does not define the work products and this is a clear weakness. Work products contribute to uniformity across assessments. They have been defined for ISO/IEC 12207 and are key to the effective use of ISO/IEC 15504 Part 5. A comparable set of ISO/IEC 15288 process work products has not as yet been defined (other than as part of this Study Group work and by WG2).

Work has been underway for many years to publish an International Standard – ISO/IEC 15289 – that defines the information products of processes. By title, this standard appears to cover a restrictive work product set, since it excludes materials and artefacts. However, the material and artefact (inputs and) outputs to processes can be represented in term of their descriptions, i.e. information products. This then enables the present scope of ISO/IEC 15289 to address, if not define, physical inputs and outputs. In a future revision of ISO/IEC 15289, the scope could include material and artefact work products.

WG2 is thus developing work product descriptions that should complement the ISO/IEC 15288 process transformation descriptions (as described in the Activities). There is indirect definition of the nature, and in some cases an identifier, of these work products in the text of ISO/IEC 15288. Where gaps or inconsistencies exist in ISO/IEC 15288 implied work products, then ISO/IEC 15289 can define a more complete and consistent set.

3.3.2 Issues Against Option C

ISO/IEC 15289 has been ‘on the ISO books’ for seven years and has as yet to deliver to its intended user community. Reliance on the definition of work products from outside ISO/IEC 15504 or ISO/IEC 15288 (as in Option D) must be seen as a significant, unnecessary threat. The role of a future ISO/IEC 15289 introduces a further dependency; one that could take this option beyond reasonable risk levels.

Even assuming ISO/IEC 15289 delivery, it is attempting to do what ISO/IEC 15289 and ISO/IEC 12207 have avoided – common definition in a single standard. The mixing of system process work products and software process work products may have no particular benefit. It may simply produce two conjoined litanies based on process models that have deliberate and meaningful differences.

A consequence of ISO/IEC 15289 will be that life cycle processes defined primarily by their transformations will be found in two International Standards, whereas the same processes defined primarily by their work products will be found in one International Standard/Technical Report. The logic and management of this situation adds further complexity to the problem of harmonizing distinctly different views of each process.

Study Group on a System Life Cycle Process Assessment Model

The skills required to create an assessment model from two sources of information (three if Part 2 is included) are not widespread. Understanding and experience of ISO/IEC 15288 and ISO/IEC 15289 (and ISO/IEC 15504 Part 2) would be required

3.4 Option D

“It is recommended that SC7 should not establish a project to create a System Life Cycle Process Assessment Model for use in ISO/IEC 15504-compliant assessments and should depend on the application of ISO/IEC 15504 Part 2 and a future ISO/IEC 15288 “Systems engineering – System life cycle processes” in which the system life cycle processes are defined more rigorously in terms of the transforms they perform and the input/output work products they act on/deliver.”

3.4.1 Issues for Option D

Part of this study deduced the work products from ISO/IEC 15288's text and then mapped these to the transformation definitions of each ISO/IEC 15288 process. This mapping exposed gaps, duplications and idiosyncrasies within ISO/IEC 15288 process descriptions.

On balance, this analysis confirms the effectiveness of the ISO/IEC 15288 process architecture (something already reported by users applying ISO/IEC 15288), but it points to quality issues in the transformation description detail. Comparing the dual process descriptions of transformation and work product provides evidence of inconsistency in each process definition and suggests design-by-committee effects.

A conclusion of this analysis, at least for ISO/IEC 15288 (though it would seem applicable to any organisational process), is that the quality of life cycle process definitions benefits from the intrinsic duality of transformation and work product descriptions. As the two process representations are progressively developed, the one view is mapped to the other and iteratively the inconsistencies can be resolved. This means that both descriptions should be concomitant, and not divided between two standards that address the same processes from different points of reference.

A corollary of this is that ISO/IEC 15288 would benefit from the inclusion of work products in order to fully describe each process. It is of interest to note that this duality of representation is indeed contained in Part 5 (though an assessment of their self-consistency or their mutual consistency was not performed).

It could be thus be argued that ISO/IEC 15504 Part 5 contains a more rigorous software life cycle process definition than ISO/IEC 12207, and that both documents are not required. Continuing this argument for system life cycle processes, embarking on a 'Part 6' would be unwise. Rather, ISO/IEC 15288 should be revised to include process work products, and the mutually interdependent descriptions of transformation/work product refined to achieve coherence. ISO/IEC 15288 would then provide a more rigorous definition of its system life cycle processes than it presently does, and in so doing act as a more effective assessment model.

3.4.2 Issues against Option D

If ISO/IEC 15504 Part 5 remains, then this Option would lead to a divergence of approach in the assessment models for system life cycle processes and software life cycle processes.

The introduction of work products into ISO/IEC 15288 would impact the harmonization project. If work products were not introduced into ISO/IEC 12207 as well, the different approaches for systems and for software would be undesirable.

The inclusion of work product information in ISO/IEC 15288 may still not result in a wholly effective assessment model and additional content may be necessary to meet all of the provisions of ISO/IEC 15504 Part 2. This would then push ISO/IEC 15288 toward looking like an assessment model and move it away from being a process model that appeals to a range of management and technical functions across the organisation. In short, it could destroy the attraction and influence ISO/IEC 15288 is beginning to enjoy, and could undermine a very important ISO and IEC standard.

3.5 Option E

“It is recommended that SC7 should not establish a project to create a System Life Cycle Process Assessment Model for use in ISO/IEC 15504-compliant assessments and should depend on the development of system life cycle assessment models by first, second or third party users of ISO/IEC 15504, or on their selection of an alternatively sourced assessment model.”

3.5.1 Issues for Option E

Since tailoring of the ISO/IEC 15288 and ISO/IEC 12207 process models by organisations is anticipated in both standards (by the provision respectively of a Tailoring Process), their use verbatim may be the exception rather than the rule. Typically, an assessment may be more focussed than the International Standard's process scope, or may require the definition of additional processes for fresh emphasis. For example, attention may be given to specific aspects of a trading agreement, technology maturity or areas for improvement.

The consequence of this is that off-the-shelf process assessment models may be limiting, even inappropriate. The constraints (real or implied) of a specific process model may inhibit the creation of assessment models with profiles that are more appropriate to each specific situation.

Users of ISO/IEC 15288 already see sufficient structure and content in its text to guide the system life cycle assessment model developer towards achieving effective and ISO/IEC 15504-compliant models. The content of a system-specific assessment model is already exemplified in ISO/IEC 15288, and extrapolating or interpolating this to target particular business situations is within the capability of many organisations.

Third Party provision of customised assessment models and Second Party stipulation of specific models, such as for supplier qualification, may become commonplace. Assessment service providers (in some cases within the customer organisation) may be the most appropriate source of high quality assessment models, at lower cost and in shorter time scales, and they may offer this in combination with the skills and experience necessary to achieve trustworthy and consistent assessments.

3.5.2 Issues against Option E

Common quality values and uniform levels of assessed capability are the bedrock of assessment. The availability of ISO-developed system life cycle assessment models provides the best assurance of an internationally acceptable and consistent

Study Group on a System Life Cycle Process Assessment Model

approach. The consultative project regime required in the development of ISO standards and the objective method of their ratification is the soundest assurance of common, acceptable values of assessment.

Whether assessment results are used for organisational improvement or qualification, it is important that they provided absolute measures on a universally agreed scale. International standardisation is the best safeguard of these attributes, and ISO/IEC project action is the most effective route to achieving this.

Explicitly, or worse implicitly, ceding the responsibility for assessment standards to commercially oriented enterprise attracts distinct risks. In the case of system life cycle processes, these risks are unnecessary and a waste of existing ISO and IEC knowledge and talent.

4 Views of the Study Group

Of the 10 Study Group members, three favoured Option B above, though each of these identified constraints and risks associated with this course of action. One member favoured Option A with constraints. Two members were wholly clear that the range of options needs further discussion and should now be considered against a well-defined and consistent set of achievement criteria, with associated weightings. This, in effect, would define requirements with measures of performance against which to objectively judge each proposed solution approach. The remaining four members of the Study Group reserved expressing a preference of option or views at this point in time.

There was thus no decisive direction to the Study Group views and a further period of study is required before a unity of view can be arrived at. Nevertheless, some important issues were raised, in particular:

- the relationship, even traceability, of an assessment model to the CMMi modelling work of the Software Engineering Institute,
- some of the challenges (timescales and scope) yet to be met in the Harmonization Project mitigate against dependence on it in any solution strategy,
- reservations about the existence of any engineering-specific assessment model in ISO/IEC 15504 document Parts,
- the current scope of ISO/IEC 15289, its gaps in a complete range of system life cycle process work products, and a dependence (noted above) on another project,
- the collective definition of relevant, common evaluation criteria against which to rate each Option (noted above),
- the development of life cycle process models in which software systems are more clearly identifiable as compositional elements of a heterogeneous system, thereby simplifying life cycle process assessment,
- enhancement or extension of the ISO/IEC 15288 Enterprise Process category to include the general activities for performing process assessments.

5 Recommendation

This report of the Study Group is by nature a status report; namely, that the Study Group proposes to continue its deliberations, with a view to forming a consensus recommendation and submitting a Final Report by the end of the Brisbane SC7 Plenary meeting.

Study Group on a System Life Cycle Process Assessment Model

Specifically, this goal will be achieved by defining criteria for option selection and holding a half-day workshop at Brisbane, transferring ISO/IEC 15288 life cycle process definitions and derived work products into WG10N502 to inform discussions. This will be undertaken with the expectation of arriving at a specific recommendation to SC7. If this recommendation is to undertake a project, then this will be supported by a set of requirements that define the project outputs and constraints, together with the provision of an example of an International Standard or Technical Report that illustrates the nature of the primary project deliverable.