Project Performance International

Application Guidance on ISO/IEC 15288 (IEEE Std 15288-2008)-
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Systems and software engineering – System Life Cycle Processes

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1. Background

ISO/IEC 15288:2008 is a process standard of considerable significance, intended to help:

- an organization establish an environment of desired processes.

- a project select, structure and employ the elements of an established environment to provide products and services.

- an acquirer and a supplier develop an agreement concerning processes and activities. Via the agreement, the processes and activities in the International Standard are selected, negotiated, agreed to and performed.

ISO/IEC 15288:2008 is also intended for use by process assessors — to serve as a process reference model for use in the performance of process assessments that may be used to support organizational process improvement.

The experience of the author is that process standards do not necessarily always achieve the objectives established for them. Years of participation in ISO/IEC and other standards development efforts in the field of systems engineering leads the author to conclude that process standards almost always represent the lowest common denominator of agreement amongst participants. Further, process standards are often developed in highly political environments replete with political agenda. As a consequence, published standards may be less than perfect.

The purpose of this paper is to provide information for consideration by any user, or potential user, of ISO/IEC 15288:2008, with a view to maximising value that can be achieved in relation to ISO/IEC 15288:2008 practices, and minimising any loss that could arise from use of ISO/IEC 15288:2008 practices.

2. ISO/IEC 15288:2000 Application Guidance.

Application guidance is provided in tabular form, keyed to the paragraph numbers of ISO/IEC 15288:2008 against which guidance is provided.

15288 Para	Application Guidance
1.1 Scope	The standard states that it may be applied at any level in the hierarchy of a system's structure, and may be configured with hardware, but then goes on to say "when the system element is hardware, refer to other international standards outside the scope of SC7". The statements appear to be contradictory. Apart from unitary elements that have no internal structure, e.g. a conventional coin formed from a material, hardware elements (including information technology) are invariably systems, in accordance with 15288 and dictionary definitions. The exclusion of purely hardware elements from coverage of the standard, if intended, is unfortunate, as some of the most effective implementations of systems engineering that I have found have been in companies who engineer hardware products, and use systems

	engineering as a major tool for achieving customer satisfaction and commercial success. Severity: 8
4.9 enabling system	The definition in ISO/IEC 15288:2008 of an "enabling system" admits the possibility of an "enabling system" contributing directly to the function of the system-of-interest, and therefore being a part of the system of interest. The verb "supports" admits any system which interoperates with the system-of-interest. For these reasons, the definition is inappropriate. The definition is at odds with the concepts of concurrent engineering (also known as simultaneous engineering), a concept which the concept of enabling systems is fundamentally intended to support. Only the example in ISO/IEC 15288:2008 of a production system as an enabling system helps correct the impression conveyed by the definition. A more suitable definition of an enabling system is "a system which enables one or more phases of the life-cycle of the system-of-interest, whilst not itself being a part of the system-of-interest" NOTE 3. The consequence of a system-of-interest/enabling system relationship is that the internal design of one depends on the internal design of the other, often leading to the practice of concurrent engineering. Severity: 6
4.22 qualification	The definition of qualification fails to differentiate between the management action of deeming an item qualified, usually for a defined purpose, and the technical activity of verifying that an item complies with the requirements which apply to that item. The ISO/IEC 15288:2008 definition of qualification is inconsistent with the Oxford English Dictionary (OED) and therefore in conflict with the ISO Directives (the rules for developing ISO standards). The distinction between qualification and verification is very, very useful in managing technical projects, but is lost in ISO/IEC 15288:2000. Severity: 4
4.27 security	The inclusion in ISO/IEC 15288:2008 of reliability within the definition of security is highly unconventional and not supported by the OED. The disciplines of reliability engineering and security engineering are substantially different as to knowledge base and methods. Severity: 2
4.31 system	The definition in ISO/IEC 15288:2008 of "system" is in fact a definition of an engineered system, not a definition of a system in general. The definition is flawed as a definition of an engineered system by limiting to "for a stated purpose". Is a system engineered to a known but unstated purpose not a system? Severity: 1
4.34 task	This is an obtuse definition not well supported by OED. Severity: 1
4.37 validation	The definition of validation, by invoking the flawed ISO 9000:2005 definition, creates the same problem that exists with ISO 9000:2005

	and ISO 9001:2008. Validation is a sub-category of verification under this ISO 9000:2005 definition. The definition departs from the vastly more widely used, and highly beneficial distinction between verification and validation: verification – does the item comply with the requirements for the item (OED definition of requirement); validation – does the item satisfy the need for the item (OED definition of need). This distinction between verification and validation comes about because of the reality that requirements can be wrong, and requirements are inevitably incomplete. Thus, it is possible to satisfy requirements, but fail to satisfy the need. To develop successful systems, we must be concerned with both meeting requirements and satisfying need. Severity: 10
5.1.2 Systems	The reference to "its architecture and its system elements" is confusing and lacks logic, since the identification of the system elements is a part of the (physical) architecture of a system. Severity: 2
6.1.1.1 Purpose (of Acquisition Process)	The purpose of the Acquisition Process is not only to obtain a product or service in accordance with requirements (imperatives); it is also to acquire the most overall effective (best) amongst solution alternatives. Severity: 6
6.1.1.3 a) 2)	Goals and value relationships need also to be included, where goals exist. Severity: 6
6.1.2.3 a)	The heading of 6.1.2.3 a) is incorrect. The supplier responds to a request for tender (or request for proposal) with a tender. The acquirer responds to the tender (proposal) by accepting it, rejecting it, or negotiating change. Severity: 3
6.1.2.3 b)	There are many circumstances where it will be entirely appropriate for a supplier to prepare a response that does *not* satisfy the solicitation, e.g. where some requirements in the solicitation are infeasible or conflicting, or where the supplier's interests are best served by making a counter-offer. A supplier, to be able to claim compliance with ISO/IEC 15288:2008, must only submit fully compliant tenders. That is absurd. Severity: 8
6.2.2.1 Purpose (of Infrastructure Management Process)	This paragraph needs to emphasize the status of the infrastructure elements as elements of one or more enabling systems (e.g. Project System, Production System, Maintenance System), the elements needing to form part of an optimum design of each respective enabling system, complementing and in balance with the human elements of the enabling system, and subject in their development to the practice of concurrent engineering. This critically important relationship is ignored, except for an oblique reference in 6.2.2.3 b) 2). Severity: 6
6.2.4.1 Purpose	This paragraph needs to emphasize the status of human resources as

(of Human Resource Management Process)	elements of one or more enabling systems (e.g. Project System, Production System, Maintenance System), needing to form part of an optimum design of each enabling system, complementing and in balance with the infrastructure elements of the enabling system, and subject in their development (e.g. by training) to the practice of concurrent engineering. This critically important relationship is ignored. Severity: 7
6.2.5.3 b) 2)	Basing quality objectives on stakeholder requirements alone relies on those requirements being consistent with, and an adequate statement of, stakeholder needs. This is rarely the case. Quality objectives must be based on stakeholder requirements, *values and needs*, to best serve the stakeholders.
6.3.1.1 Purpose (of Project Planning Process)	The status of the Project System as an enabling system, subject in its development to the practice of concurrent engineering with respect to the system(s) to be engineered, needs to be emphasized. This critically important relationship is ignored. Many a project has been seriously compromised by plans and technical realities/decisions never having been aligned, or by becoming misaligned. Severity: 7
6.3.1.3 c) 1)	In requiring *a* plan for technical management and execution of the project, as opposed to *one or a set of* plans, ISO/IEC 15288:2008 rules out the use of empowered Integrated Product Teams (IPTs), that have been so successful in shortening timeframes, reducing cost, and increasing product quality. An empowered IPT will do its own planning, within enterprise-wide and project wide constraints, and consistent with higher level planning which generates the tasking of the IPT. Severity: 7
6.3.3 Decision Management Process	Placing decision management as a Project process can convey the impression that technical decisions can and should be referred to, and made by, those in a project management role. This is at odds with the principles of IPTs, which have been enormously successful. Real IPTs are empowered to make decisions within their bounds of assigned responsibility for realization of a system or a system element. This Decision Management process needs to link strongly into the technical processes that involve decision making. Severity: 5
6.3.4 Risk Management Process	Notwithstanding its ISO/IEC 16085-AS 4360 heritage, this whole section of the standard is poor indeed, primitive, missing the point regarding risk, and regarding effective risk management: • risk is expected loss, not a thing that could go wrong (that's a threat) • risk is with reference to a defined level of valued outcome, e.g. cost, schedule, capability, safety, national security, social benefit, political outcome, etc • risk has the ingredients of the value of the outcome, what can go wrong that threatens that outcome, and how vulnerable we are if that threat is realized. When these

	ingredients and their probabilities are convolved, we end up with a relative probability of different degrees of loss with respect to a valued outcome, due to a set of threats relevant to that outcome. In a major project, there are usually thousands of threats conttributing to the level of risk with respect to a valued outcome (e.g. contributing to the cost risk). • effective risk management begins with an understanding of risk! • effective risk management then involves ensuring that uncertainties (leading to risk and opportunity) are factored into all project decisions, regardless of who makes them • effective risk management relies on people who are making decisions, doing so on an expected value basis (value, taking into account balance of probabilities), either informally, or for important decisions, formally. Severity: 9
6.4.1.1 Purpose (of Stakeholder Requirements Definition Process)	The statement of purpose needs to include the resolution of conflicts between stakeholder requirements, especially conflicts between the requirements of different stakeholders. Severity: 4
6.4.1.2 Outcomes	The statement "Stakeholder requirements for validation are identified" is ambiguous and incomplete. The statement should read "Stakeholder requirements for system verification and system validation are identified and specified" Severity: 5
6.4.1.2 Outcomes	Stakeholder measures of effective, goals and value relationships are also an important outcome. Without this information, developers of solution can have no sound basis for selecting between feasible solution alternatives, and no basis for solution optimisation. Severity: 7
6.4.1.3 Activities and Tasks	The section needs to recognize and reflect primary stakeholders (the stakeholders that the supplier is serving – e.g. their company or shareholders), versus secondary stakeholders (the stakeholders who are not primary stakeholders, but whose interests influence the interests of the primary stakeholders – e.g. customers, operational users). Otherwise, once MOEs and goals are recognized, the standard can have the effect of requiring the supplier to act as a charity. To fail to acknowledge and deal with these realities considerably reduces the real-world relevance of ISO/IEC 15288:2008. Severity: 6
6.4.1.3 a) NOTE	The statement "Stakeholder requirements describe the needs, wants, desires, expectations and perceived constraints of identified stakeholders" is very damaging to ISO/IEC 15288:2008, because it is totally at odds with the English language as defined by the Oxford English Dictionary. As a result, the statement violates the ISO rules for developing ISO standards. Requirement: an order, a demand, an imperative (OED) Need: a condition of lacking or acquiring some necessary thing, either physically or psychologically (OED) Want: wish for possession of (OED) Expectation: an instance of expecting or looking forward (OED) Constraint: A limitation or restriction (OED).

	Severity: 9
6.4.1.3 a)	This section has many points of language, detail, and incompleteness which diminish its value. Severity: 4
6.4.2 Requirements Analysis Process	If the "system" referred to in 6.4.2 is the same system as referred to in 6.4.1, then the "Requirements Analysis Process" is a duplication of 6.4.1.3 b) and c), now saying, in effect, "having done 6.4.1.3 b) and c) poorly, now do 6.4.1.3 b) and c) properly. This section refers to a "technical view", "from the supplier's perspective". "Technical" means "relating to technology" or "relating to technique". So in what sense it the view "technical"? This process has the supplier telling the acquirer what the acquirer's requirements are, creating the opportunity for the supplier to manipulate the agreement to supply what the supplier wants to supply, reflecting the worst aspects of non-performing acquisition systems worldwide. Yes, 6.4.2 refers to satisfaction of stakeholder requirements, but with stakeholder requirements made purposefully vague under 6.4.1 (implicitly not measurable, since the Requirements Analysis Process is to result "in measurable system requirements". The Requirements Analysis Process is conspicuous in its absence of reference to satisfaction of stakeholder needs. It is not altogether clear that the system referred to in 6.4.2 is the same system as referred to 6.4.1. Stakeholders generally seek to achieve outcomes. End-use items, engineering systems, production systems, transition systems, maintenance systems and disposal systems (for example) are all a part of the means of doing so, i.e. are a part of solution. The term "product solution", referred to in 6.4.2.2 but not in 6.4.1, is commonly used to refer to an end-use product alone. If the references to "system" in 6.4.1 and 6.4.2 are not intended to be references to the same system, then 6.4.2 is mandating a "then a miracle occurs" process, as did its predecessor, ISO/IEC 15288:2002. This latter view of the world has been one of the three primary contributors to most failures of large projects. Severity: 10
6.4.2.3 a) 1)	This content essentially duplicates 6.4.1.4 b) – if the same system is being referred to. Severity: 10
6.4.2.3 a) 1)	"Mass" is neither an interface constraint nor is it involved in defining the functional boundary of a system. Mechanical and thermal flows may be involved in defining requirements other than behavioural requirements of the system at its boundary. Severity: 3
6.4.2.3 a) 2)	2) overlaps in content substantially with 1). Sub-para 2) is a much more sound statement of good practice in requirements analysis than is 1), however, 1) contains some valid additional content.

	Severity: 3
6.4.2.3 a) 3)	"Unavoidable solution limitations" not introduced in (valid) stakeholder requirements are not system requirements, just because they are unavoidable – or thought to be so. This requirement of ISO/IEC 15288:2008 violates the principle of maintaining a clear distinction between problem and solution, destroying any basis for design and system verification, and leaving the designer in ignorance of what can be changed in a design, and what cannot be changed in design, if the system requirements change. Severity: 6
6.4.2.3 a) 4)	The note is misleading. Critical performance measures may or may not be measures of effectiveness. In the former case (where more or less with respect to some measure is better), critical performance measures are not *associated* with measures of effectiveness, they *are* measures of effectiveness. This note gives weight to the theory that different systems are being referred to in 6.4.1 and 6.4.2. If that is the case, the critical performance measures are derived measures of effectiveness of one or more sub-systems. The note also seems to be mixing up what are conventionally called Technical Performance Measures (TPMs), used to instrument a project primarily for purposes of risk management, with Measures of Effectiveness, used to evaluate and select between feasible design alternatives, and for design optimization. Severity: 7
6.4.2.3 a) 5)	The paragraph says "specify system requirements and functions", implying that system requirements and functions are somehow mutually exclusive. Where does that leave functional requirements? Severity: 4
6.4.2.3 a) 5)	The note seems to muddle up problem and solution. The principle of maintaining a clear distinction between problem and solution applies no less to safety requirements and safety solution, and similarly security, for the same reasons as previously stated. Severity: 5
6.4.2.3 b) 2)	This requirement confirms the suspicion that the standard is advocating that the supplier, in performing requirements analysis, invent requirements information, then seek stakeholder acceptance of the inventions. The standard should, in fact, be advocating the identification in requirements analysis of each requirements issue, followed by dialogue with the relevant stakeholder(s) on that issue, to resolve the issue. If the supplier is delegated responsibility by the acquirer to invent requirements on behalf of the acquirer (which usually involves a conflict of interest in commercial transactions), the standard should be advocating the use of design processes, not requirements analysis processes, for doing so. Severity: 9
6.4.3 Architectural	Calling this process the "Architectural Design Process" conflicts with the definition of architecture in the standard, and in OED, and in use

Design Process	throughout engineering. The naming is an unfortunate throw-back to ISO/IEC 15288:2002, which defined "architecture" as design at high physical levels, as contrasted with design at low physical levels. Meanwhile, the rest of the world has used the word "architecture" to mean design at a conceptual level of detail, as distinct from an implementable level of detail. The process should be read as, and called, "Design Process". Subsequent comments are predicated on this interpretation. Severity: 9
6.4.3.2 f)	The standard needs to distinguish between building the system in system integration, and building the system in production. For some systems, these builds are identical, e.g. a one-off air traffic management system. For other systems, the two build structures can be very different, e.g. a commercial aircraft. The Design Process is concerned with establishing a basis for both system integration builds and production builds. The latter necessitates concurrent engineering practices, which in turn impact on the system integration build structure (or should do so). Severity: 5
6.4.3.3 a) Activities and Tasks, Define the Architecture	6.4.3.3 a) is missing the fundamental activity of conceptualisation of physical solution alternatives, perpetuating the misunderstandings and misinformation in IEEE 1220 that has done so much damage to enterprises that have tried to follow that standard. The relationship between logical and physical (structural) design – two sides of the same coin - is missing. The words in 2) "Partition the system functions identified in requirements analysis … Generate derived requirements as needed for the allocations." and the words of 1) mean exactly the same thing, placing in question the credibility of this standard. Severity: 10.
6.4.3.3 a)	The words "partitioning" and "allocating" are used loosely. Severity: 3
6.4.3.3 a)	This section talks about "*the* architecture", rather than the divergent process of conceptualizing design alternatives, and the convergent process of making decisions between design alternatives, progressively from high levels of abstraction to implementable level of abstraction (i.e. from architecture to detailed design of the system-of-interest with reference to a physical level one level below the system of interest) Severity: 8.
6.4.3.3 a)	This section totally ignores the role of non-functional requirements in framing alternative architectures and detailed designs. Severity: 8
6.4.3.3 b) 1)	This paragraph and the related note are without meaning. The "design criteria" for each element were defined in the activity of 6.4.3.3 a) Severity: 4
6.4.3.3 b) 2)	This paragraph is spurious. The activity has already been performed

	in the activity of 6.4.3.3 a) – or should have been. Also, the paragraph seems to get into trouble with the distinction between use, and operation by an operator. Severity: 4
6.4.3.3 b) 3)	This activity is an integral part of 6.4.3.3 a) Severity: 4
6.4.3.3 b) 4)	This paragraph has alternative "design solutions" – whatever that means – being evaluated, without having been created. Evaluation of, and selection between, alternative designs (or alternative solution descriptions, the same thing except for non-developmental solutions), each capable of meeting requirements, is a very good idea provided the expected benefit exceeds the expected cost of the evaluation. The decision-making between design alternatives in is Project Processes – not helpful. Severity: 6
6.4.3.3 c)	The words are somewhat obtuse and detract from the usefulness of the standard. Severity: 2
6.4.4.1 Purpose (of Implementation Process)	Specified behaviour and interfaces *are* implementation constraints (*all* requirements are implementation constraints). Severity: 1
6.4.4.1 Purpose (of Implementation Process)	The term "design requirement" is used for the first time, apparently to mean "requirement". If the term "design requirement" is used to mean "requirement", every requirement is a "design requirement". That is not really very useful! Severity: 4
6.4.4.1 Purpose (of Implementation Process)	This paragraph states: "This process results in a system element that satisfies specified design requirements through verification and stakeholder requirements through validation." The statement is absurd – verification provides evidence, not the means, of satisfaction of requirements. Validation provides evidence, not the means, of satisfaction of stakeholder needs. Severity: 4
6.4.4.2 a) Outcomes (of the Implementation Process)	The definition of an implementation strategy (i.e. implementation system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. An implementation system, e.g. production system, is a system like any other system, but is also a subsystem of the bigger system, of which production is a part of the solution. The process of defining an implementation system design is covered therefore under 6.4.3.

	Oh, what a mess in this paragraph! In applying this muddled part of the standard, Implementation Process should be confined to 6.4.4.2 c) and 6.4.4.2 d) Severity: 7
6.4.4.3 a)	Please see comments on 6.4.4.2 a). The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 7
6.4.4.3 b) 2)	A system element does not normally meet supplier agreements, etc. , unless design is specified in requirements. The aim is that the system element be consistent with meeting such agreements. Severity: 3
6.4.5.1 Purpose (of Integration Process)	The statement needs to make it clear that the purpose is to assemble the system in development, and excludes assembly in production, for cases where more than one instance of a system is to be produced. Severity: 5
6.4.5.2 Outcomes (of Integration Process)	The definition of an integration strategy (i.e. integration system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. An integration system is a system like any other system, but is also a subsystem of the bigger system, of which integration is a part of the solution. The process of defining an integration system design is therefore covered under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, Integration Process should be confined to 6.4.5.2 c) and 6.4.5.2 d) Severity: 7
6.4.5.3 a)	Please see comments on 6.4.5.2 a). The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 7
6.4.6.1 Purpose (of Verification Process)	The term "design requirement" is used, apparently to mean "requirement". If the term "design requirement" is used to mean "requirement", every requirement is a "design requirement". That is really unhelpful! Severity: 4
6.4.6.1 Purpose (of Verification Process)	Limiting the Verification Process to system verification is illogical, and inconsistent with good practice in engineering. All work products are candidates for verification. Work products should be verified where the risk reduction benefit exceeds the verification cost, and limited resources cannot be employed in a more beneficial way. Severity: 9
6.4.6.2	The definition of a verification strategy (i.e. verification system

Outcomes (of Verification Process)	conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. A verification system is a system like any other system, but is also a subsystem of the bigger system, of which verification is a part of the solution. The process of defining a verification system design is covered therefore under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, Verification Process should be confined to 6.4.6.2 c) and 6.4.6.2 d) Severity: 7
6.4.6.3 Activities and Tasks (of the Verification Process)	It is unfortunate that the standard makes no provision for verification requirements, meaning that verification design is carried out in a vacuum. The practical effect is usually either insufficient verification, or excessive verification. Either way, stakeholder value is reduced.
6.4.6.3 a)	Please see comments on 6.4.6.2 a). The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 7
6.4.6.3 b) 2)	Again the term "design requirements" is used. Previous comments apply.
6.4.7.1 Purpose (of Transition Process)	By including installation of relevant enabling systems in the purpose of the Transition Process, ISO/IEC 15288:2008 double-counts the enabling systems with respect to transition. This is because 5.1.4 (correctly) states that an enabling system can be considered to be a "system-of-interest", and each enabling system, therefore, is also subject to the transition process in its own right. What a mess!
6.4.7.2 Outcomes (of the Transition Process)	The definition of a transition strategy (i.e. transition system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. A transition system is a system like any other system, but is also a subsystem of the bigger system, of which transition is a part of the solution. The process of defining a transition system design is covered therefore under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, Transition Process should be confined to 6.4.7.2 b) to f). Severity: 7
6.4.7.3 a)	Please see comments on 6.4.7.2. The valid content of 6.4.1 to 6.4.3

	inclusive relates. Severity: 7
6.4.7.3 b) 6)	This paragraph doesn't allow for enabling systems that have ceased to be relevant, e.g. development systems and production systems. Worse, again this paragraph is at odds with 5.1.4 which correctly states that an enabling system can be considered to be a "system-of-interest". Showing that an end-use system is sustainable by the relevant enabling systems is an act of system integration of the parent (capability) system, not an act of transition of the system-of-interest. Severity: 7
6.4.8.1 Purpose (of Validation Process)	Limiting the Validation Process to system validation is illogical, and inconsistent with good practice in engineering. All work products are candidates for validation. Work products should be validated where the risk reduction benefit exceeds the validation cost, and limited resources cannot be employed in a more beneficial way. Severity: 7
6.4.8.2 Outcomes (of Validation Process)	The definition of a validation strategy (i.e. validation system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. A validation system is a system like any other system, but is also a subsystem of the bigger system, of which validation is a part of the solution. The process of defining a validation system design is covered therefore under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, the Validation Process should be confined to 6.4.8.2 b) to d) Severity: 7
6.4.8.3 a)	Please see comments on 6.4.8.2. The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 7
6.4.8.3 b) 2)	The reference for validation should be need, not requirements. Otherwise, validation ceases to serve a purpose if verification is performed. In making this comment, I am using all terms in accordance with the Oxford English Dictionary, and also reflecting very widespread practice in engineering, including areas subject to regulation such as aviation and medical products.
6.4.8.3 b) 4)	Diagnosing the cause of invalidity is a problem-solving action outside of the scope of validation. Diagnosing the cause of invalidity is within the scope of 6.4.1 and 6.4.2 if caused by defective requirements, 6.4.3 if caused by defective design, and other processes if caused by failures in those processes.
6.4.9.1 Purpose (of Operation Process)	The reference to analysis of operational problems is not (or should not be) within the scope of the Operation Process. Diagnosing the cause of operational problems is within the scope of 6.4.1 and 6.4.2 if caused by defective requirements, 6.4.3 if caused by defective design,

	and other processes if caused by failures in those processes.
6.4.9.2 Outcomes (of Operation Process)	The definition of strategy for operation is stated to be an outcome of this process. However, designing how to operate a system and definition of skills and other attributes required of operators should be done integral with the design of the technology aspects of the solution. Also, it is commonplace to place operating procedures within the boundary of the system, but operators outside of that boundary. For example, for an aircraft system developed and supplied by Airbus or Boeing, the operating procedures are inside the boundary but the operators (aircrew) are outside of the boundary. By contrast, the aircrew are system elements within an air transportation system. In applying this muddled part of the standard, the Operation Process should be confined to 6.4.9.2 b) and d) Severity: 10
6.4.9.3 a)	Please see comments on 6.4.9.2. with respect to operational infrastructure. The valid content of 6.4.1 to 6.4.3 inclusive relates. Please see also the entry relating to a missing System Management Process. Severity: 9
6.4.9.3 c)	Please see comments on 6.4.9.2. with respect to operational infrastructure. The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 9
6.4.10.2 Outcomes (of Maintenance Process)	The definition of a maintenance strategy (i.e. maintenance system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a "system-of-interest" to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. A maintenance system is a system like any other system, but is also a subsystem of the bigger system, of which maintenance is a part of the solution. The act of designing the maintenance system is covered therefore under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, the Maintenance Process should be confined to 6.4.10.2 c) to f) inclusive. Severity: 10
6.4.10.3 a)	Please see comments on 6.4.10.2. with respect to the maintenance system. The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 10
6.4.10.3 b) 1)	Obtaining the enabling systems, system elements and services to be used during maintenance is not an act of maintenance, but an act of (maintenance) system integration. Severity: 4
6.4.10.3 b) 2)	Implementing problem reporting and incident recording is not an act of maintenance, but an act of (maintenance) system integration.

	Severity: 4
6.4.10.3 b) 5) NOTE	The acquisition, training and accreditation of personnel to maintain operator numbers and skills is not an act of maintenance, but an act of system re-implementation. Severity: 3
6.4.11.1 Purpose (of Disposal Process)	If the Disposal Process is limited in scope to ending the existence of a system entity, the set of life cycle processes defined in ISO/IEC 15288:2008 does not allow for sale or other transfer of responsibility for a system. That omission could be covered within a (missing) System Management process.
6.4.11.2 Outcomes (of Disposal Process)	The definition of a disposal strategy (i.e. disposal system conceptual design) is stated to be an outcome of this process. But 5.1.4 correctly states that an enabling system can be considered to be a “system-of-interest” to an entity responsible for its implementation, whilst 5.1.3 correctly emphasises the recursive nature of development of systems and subsystems. A disposal system is a system like any other system, but is also a subsystem of the bigger system, of which the means of disposal is a part of the solution. The act of designing the disposal system is covered therefore under 6.4.3. Oh, what a mess in this paragraph! In applying this muddled part of the standard, the Disposal Process should be confined to 6.4.10.2 c) to e) inclusive. Severity: 10
6.4.11.3 a)	Please see comments on 6.4.11.2. with respect to the disposal system. The valid content of 6.4.1 to 6.4.3 inclusive relates. Severity: 10
6.4.11.3 b) 1)	Acquiring the enabling systems or services to be used during disposal is not an act of disposal, but an act of (disposal) system implementation or integration. The paragraph conspicuously trivialises the implementation of infrastructure for use in disposing of the elements of the system-of-interest. Severity: 6
General Comment	The standard lacks a system management process. System management is the discipline and activity concerned with managing the operation, sustainment, evolution, and retirement of a system.