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| **CONTRIBUTION** |
| **Source:** | Symantec Corporation |
| **Title:** | Proposal for a New Work Item for Recommendation: “Architecture Standardization: Design Principles and Best Practices” |
| **Purpose:** | Discussion |
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| **Keywords:** | Architecture; Design Principles, Design Criteria, Design Best Practices |
| **Abstract:** | This contribution proposes to establish a lightweight, pragmatic and proven approach to architectural design principles and best practices. Indeed, standardisation is at the very beginning of a whole cycle that starts with definitions, continues with design, build, etc. Any suboptimal choice at definitions (standardisation) step will have consequences on the whole downstream part of the cycle and therefore this contribution can be used as a tool to systematically review the quality of the design, ensuring that every step of the cycle was checked as well as achieve some extra benefits. |

# Introduction

## Context

Standardisation is at the very beginning of a whole cycle that starts with definitions which is then used by industry to design, build, test, stage, certify, release, migrate, run and finally terminate a product or a service.

Each of these steps will inevitably generate a specific set of meta data as it will:

* come with their own lessons learnt, best practices
* mature to then possibly express their own inferred requirements, limits and constraints
* inspire new innovative ideas to improve the outcome
* discover new abstraction patterns opening entirely new areas of solutions

In a given domain, unless completely new, this cycle would have been put in practice repeatedly across all the domain constituencies. Yet, finding consolidated, qualified documentation of any of the above metadata is, if it exists, most of the time incomplete, partial, sometimes immature, and may not be shared for any secrecy reasons.

And when some of the documents happen to be well described and done, yet their language, abstractions, categories are most of the time ‘adhoc’ because, say, the architect who developed them has his own capabilities, limits and constraints which happen to be for very deep conscious or unconscious reasons.

These metadata, however are an essential loopback input to the overall process and having access to these meta data would significantly help standardisation to codify the right description at definition level. Again, as each practitioner comes with his own way to document it is difficult to organize all of these input in a uniform ‘standard’ manner to simply evaluate these inputs, compare them when there are multiple alternatives or even put them in a way that one can start an optimisation process from these inputs to finally improve significantly the overall standard.

The ‘negative’ view of the above is that a ‘mistake’ or ‘incompleteness’ at definition level may have massive implications on any subsequent phase down the cycle. If the ‘user’ of the standard is more experienced than the team who produced the standard and understands the negative implications, the standard will not be adopted.

As now a standard can be of many types (ontology, taxonomy, definition, framework, architecture, detailed architecture, specification, test, etc.), standards may map on various aspects of the cycle too.

Yet the critical articulation will happen when the standard is ‘being used’ as the first cycle step the standard ‘will meet’ is the design step. In this articulation a designer will have to turn the standard into an instantiated design and the designer will produce various deliverables (vision architecture, general architecture and detailed architecture) that will be then handed over to a project team that will go through the next steps of the cycles until release in production and then it will follow the rest of the cycle (and those not make any assumption on waterfall/agile/methodologies)

Designers have therefore a critical job as they need to ensure that their design will be a good fit for all the rest of the cycle and make sure they produce an optimal design choice in the requirements, limits and constraints that will fit as best as possible to all the steps downward the cycle.

So, an approach to architecture standardization that would be lightweight and could deliver design principles and best practices could:

* not only help the designer to ensure that what he is delivering is giving enough guarantees that it provides the best possible solution to the problem and documents what will be the limits of his proposed solution,
* but it could help too standardisation to systematically review, upfront, the fit of its purpose against the same design principles
* and most of the time, will actually generate new ideas and potentially critical innovations,

therefore, making the relay between standardisation and design much leaner.

## Designer and architect jobs across domains

In civil engineering, as this is a domain where humans have an experience since millennium, and therefore a specific set of considerations for anthropology, ethics, laws and technology, designers and architects have rather well codified job descriptions with full curricula that are not only licensed but deliver diploma which not only gives the right to the architect to do his job, but comes too with responsibilities and liabilities.

If a bridge falls down, both from a legal and an insurance perspective, the process will inevitably lead to the question of whether or not the architect is responsible (liable) or not. His/her responsibility is engaged.

Interestingly enough in IT and ICT we observe many differences, at this stage:

* IT and ICT are domains that are much younger by orders of magnitude than civil engineering
* The role/job of an architect is extremely recent and was mostly hidden in the wordings ‘software engineer’, etc.
* The role/job and covers many subtypes:
	+ Software architect
	+ System architect
	+ Solution architect
	+ Etc.
* For a long time there were no codification and even trainings or certification for this job until TOGAF arrived in 1995 and yet, even today, like anything, it has limits
* There are no liabilities attached to any architect. An architect making a mistake at design level has absolutely no risk even if (lived stories) it could incur enormous costs and liabilities for the ‘customer’ and for the ‘provider’ of the architecture.

# Gap Analysis

Such a proposed approach is, in other field part of what is called Theory of Design. This is an area which is likely much better defined outside of IT and ICT domains but which is difficult to track extensively in IT and ICT and which probably requires a lot more cycles to be fully agreed, adopted and mature. Again, this should not be any surprise given the relative youth, let alone high cadence evolution and revolution which is making even more difficult to stabilise a fully fledge knowledge.

At this stage and mindful that this is not by any mean exhaustive we identified a few areas that developed ideas in various levels

Firstly we will on purpose start from outside the IT and ICT and simply highlight that Theory of Design is developed since a long time in other areas. Architects and Designers studied on a long genealogy of design theoretician and randomly could point to [NOD] as an example of work in this area, highlighting principle of designs.

As a matter of fact, [NOD] is the main source of inspiration of the proposed much more lightweight approach to Theory of Design in this contribution on the premise that there should be little if any difference between designing say a bridge vs designing IT and ICT technology and services.

Yet incrementally other IT and ICT professionals started to put words on things and when quality became a strong and hype requirement in the 90s it participated to a number of parties considering design quality criteria.

A simple research on Wikipedia shows that the in the late 1980s the US Department of Defense developed the Technical Architecture Framework for Information Management (TAFIM) which The Open Group developed into an extensive enterprise architecture framework and released The Open Group Architecture Framework (TOGAF 1.0) in 1995 which is now at version at version TOGAF 9.2 launched on 16 April 2018 (see [TOGAF]). One remarkable aspect is that TOGAF offers certification trainings and education curricula. Yet if focuses on Enterprise Architecture and so, like anything has a few limits.

As well, ISO developed a substantial amount of work on the topic in particular [ISO9126-1] and does a very good job at highlighting the architectural quality criteria and sub criteria in detail but again it focuses on Software Engineering not on an overall system.

Given the massive switch to softwarisation the above matter for our gap analysis, [LOSAVIO] offers a very good article regarding how to use the quality criteria to measure architectures. Yet it is a very rich model and perhaps a bit too rich for one who is looking for a lightweight approach which is our goal especially when the object of design are becoming hybrid objects including a system view, software, hardware component, human factor, etc. as well as new areas (see section 3) all together.

An example of a needed reconsideration is that among the criteria one which is particularly difficult to recognize, define, measure, qualify is flexibility. [KELLERER3] work made a significant radical approach to this problem and started to offer a really deep analysis on How to Measure Network Flexibility? [KELLERER1], [KELLERER2] down to the mathematical aspect of it. This fundamental work allows to decoy unqualified statements of the type “my design is more flexible than yours”

Should we be able to agree on design principles and criteria, we yet need to find a way to aggregate choices in heavy multi-criteria choice problems (see [MCDM]) with specific constraints on the aggregation operator (e.g. do we allow veto right of say performance vs flexibility) as well as considering inherent relationships between the criteria (e.g. a very feature rich design may affect its future manageability).

This is in the arcanes of this last design step that some significant discoveries can happen. Indeed measuring architectures help:

* Compare architectures
* Optimize architectures
* Categorize architectures by fit, by term (architectures for short, mid or long term)
* Migration paths between architectures including reversibility or irreversibility of decisions

And in the above, while analysing why certain results are as they are, sometimes, allow to reveal some hidden abstraction layers and generate innovation.

As well, Symantec Corporation recognizes too that some study groups are likely practicing this already in one form or another as some documents, in particular in SG15 hint to that conclusion but this would require a much deeper interview of a number of study groups especially SG15, SG13 and SG2.

The conclusion is that a lightweight approach to architecture standardization with reasonable design principles and best practices

* for the purpose of standardisation in the context of the ITU,
* and considering the systems that need to be designed in the context of the ICT and OTTs or better worded the Digital Service Providers

doesn’t seem to exist at least as a global agreed standard and practice.

The author welcomes contributions on this gap analysis.

# New developments for consideration

Assuming that we could define a core set of design principles inspired from what we learnt in the past, we cannot either ignore the future challenges that designers will face or are probably already facing. For example

* Is my design sustainable from the perspective of skills in the long term and its related hiring, education and capacity building aspects?
* Is my design sustainable from the perspective of the highly regarded United Nations Sustainable Development Goals (SDG)?

A few examples:

* Some systems will have extremely long life cycles. When engineers and technicians will need to run, maintain, adapt, develop those services, it is all good to propose a certain design but if the design doesn’t take into account the need to have a good availability of resources in a long term AND in a given geography with all the potential constraints of this geography (various reasons could lead to shortage of resources), a mistake at this level of design could have significant consequences on the viability of the service delivered itself.
* When the designer omits considering important goals such as the SDGs, the service can have dramatic effects on the energy required to run (think about crypto mining), toxic components in systems, etc. As expressed by Japan in ITU-T TSAG C53, it would be desirable to have an understanding of ITU-T recommendations against the SDGs. Whilst this is very difficult to execute a posteriori, would a pre-defined non mandatory design criteria on SDGs help not only identify recommendations pertaining to SDGs but as well would the design itself result in a better technical outcome? The answers are probably yes.

# Proposition

This contribution proposes to define a lightweight approach to architecture standardisation as a framework to propose contributors and editors the possibility to systematically improve the

* quality outcome of recommendations vs design quality criteria
* harmonisation of the outcome recommendations
* composability of the outcome recommendations
* speed of execution by factorizing potential common texts and templates
* innovation by discovering new abstraction layer revealing potential interesting gaps
* participation to the reinforcement of an effective excellence center

# References

[LOSAVIO] F.Losavio, L.Chirinos, A.Matteo, N.Lévy, A.Ramdane-Chefir. ISO quality standards for measuring architectures. The journal of Systems and Software. 13th April 2003. <https://www.researchgate.net/profile/Francisca_Losavio/publication/220629983_Designing_Quality_Architecture_Incorporating_ISO_Standards_into_the_Unified_Process/links/5779ff9f08aead7ba076473f/Designing-Quality-Architecture-Incorporating-ISO-Standards-into-the-Unified-Process.pdf>

[ISO9126-1] Software engineering – Product quality

[TOGAG] The Open Group Architecture Forum (TOGAF). <https://www.opengroup.org/togaf>

[KELLERER1] Kellerer, Wolfgang; Basta, Arsany; Babarczi, Peter; Blenk, Andreas; He, Mu; Klugel, Markus; Alba, Alberto Martinez. How to Measure Network Flexibility? A Proposal for Evaluating Softwarized Networks. IEEE Communications Magazine, 2018 (Volume: 56, Issue 10, OCTOBER 2018). DOI: <https://clicktime.symantec.com/3L2DVeVrG3FmLXM1BHzNjdb7Vc?u=http%3A%2F%2Fdoi.org%2F10.1109%2FMCOM.2018.1700601>

[KELLERER2] Presentation at ETSI NFV Standardization meeting in May 2019. [https://mediatum.ub.tum.de/node?id=1487546](https://clicktime.symantec.com/37DwNgwiZmysZtrAy1rEdQu7Vc?u=https%3A%2F%2Fmediatum.ub.tum.de%2Fnode%3Fid%3D1487546)

[KELLERER3] [www.networkflexibility.org](https://clicktime.symantec.com/3Uo8F8tEV5zje5AjFLmRoSN7Vc?u=http%3A%2F%2Fwww.networkflexibility.org)

[NOD] David Pye. The nature of design. 1964. SBN 289 36845 6

[MCDM] Multi-criteria decision-making (MCDM): <https://en.wikipedia.org/wiki/Multiple-criteria_decision_analysis>

# Annex 1 - A.1 justification for proposed draft new Recommendation X.tod

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| **Question:** | Q2/17 | **Proposed new ITU-T Recommendation** | Geneva, August 27-September 05, 2019 |
| **Reference and title:** | ITU-T X.tod " Architecture Standardization: Design Principles and Best Practices " |
| **Base text:** | COM16-C.nnn | **Timing:** | 2020-12 |
| **Editor(s):** | Arnaud Taddei Arnaud\_Taddei@symantec.com | **Approval process:** | AAP |
| **Scope** (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability): |
| This scope of this recommendation is the definition of a lightweight, pragmatic and proven set of design principles and criteria and how to apply them to architectural recommendations, how to evaluate if the architecture is optimal, how to compare architectures in order to have an upfront check if architectural recommendations will fulfill their objectives on the overall lifecycle of any product or service being standardized. |
| **Summary** (provides a brief overview of the purpose and contents of the Recommendation, thus permitting readers to judge its usefulness for their work): |
| Symantec Corporation clear mission statement at the ITU is to help the community to increase the number of recommendations to be ‘at product specification level’. As the number of recommendations moving in this direction is increasing, it showed too, a need to increase the excellence standard of the team on architecture and design principles and criteria. Indeed, any aspect which is underlooked at standardization level may have significant implications of the lifecycle of a product or a service and therefore we want to maximize the chances of adoption by equipping editors with a tool to validate upfront that their recommendations will meet the production class level of a real product or service at recommendation level.This recommendation purpose is to equip the community with a tool to accompany recommendations that are at architecture level either vision, general or detailed architecture. It will define a number of methodological aspects borrowed from the more general theory of design which is lightweight, pragmatic and proven. Once these principles and criteria will be established it will describe ways to use them and some best practices. |
| **Relations to ITU-T Recommendations or to other standards** (approved or under development): |
| None |
| **Liaisons with other study groups or with other standards bodies:** |
| Under investigation |
| **Supporting members that are committing to contributing actively to the work item:** |
| Symantec Corporation |

# Annex 2 – Proposed initial baseline text

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Architectures refactoring

Annex – Flexibility Criteria Advanced Considerations

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