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Framework of Building Engineering Standards with International Recognition

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Abstract-In this scientific article, reader is exploring the first-rate framework of building engineering standards with feature of international recognition if needed. This article shows clear and easy steps for creating and writing standards. Specialist who creates and writes standards will find what he is looking for in this article on how to plan, build, develop, re-engineer standards. This article is a guideline that makes sure all written standards are according to international way of building standards.

Keywords- *engineering standards, departmental procedures, process re-engineering, international standards*

I. INTRODUCTION

Building and writing engineering standards based on scientific experiment costs effort and time, consequently, more human and financial resources to complete the building project. Standards is the first sign of quality assurance applications. The American Society of Mechanical Engineers (ASME) defines standard as a set of technical definitions and guidelines [1]. In this article, the word "standards" includes codes, processes, procedures, manuals and technical specifications. In most companies and organizations, standards are part of quality engineering issues. Where quality engineering is defined as the set of operational, managerial, and engineering activities that a company uses to ensure that the quality characteristics of a product are at the nominal or required levels [2].

Many national and international organizations are dedicated to create and develop standards in general and engineering standards, such as, Institute of Electrical and Electronics Engineers (IEEE), National Society of Professional Engineers (NSPE) in United States of America and Saudi Council of Engineers (SCE) in Saudi Arabia. Most of the International organizations that create and develop standards write their own guide for the process of developing and creating standards such as European Telecommunications Standards Institute (ETSI) that wrote a Guide to Writing World Class Standards [3].

II. FIRST STAGE: INITIAL PLANNING FOR CREATING STANDARDS

To create engineering remarkable standards, planning is an inevitable stage before start creating those standards. Planning must set up on clear ideas and decisions. Moreover, those engineering standards should be applicable and perfected to the application purpose. Planning stage has three main steps:

A. First step: Creating a central single unit to be specialized in placing, updating, and publishing the standards:

Many organization are fine with having the mission of placing, updating, and publishing their standards to be handled by their own quality assurance department or a specialized unit under the quality assurance department named as "Standards Division" or "Quality Control" where that's mostly is the best technique, due to all have to do with quality standards in its all forms. The quality assurance handles the work of team providing that is experienced and distinguished to establish and update all standards.

B. Second step: Creating a general proposal for any new standards or developing the existing standards:

The best-practiced way to get excellent and well-studied standards is to begin with making the proposal, studying it well, and activating it when needed; that can accelerate building the standards in a much vast and time-consuming operation without having a stressful timeline. Due to visual planning and not implementing it on realistic environment, gives it a sense of flexibility in updating or modifying it. The initiative planning goes through all concerned departments to conceder all given opinions before publishing those standards and working by them. Therefore, this step covers making new standards or updating existing standards in the bellow core points:

1) Core point (I): Numbering and naming the standards with a unique and non-repeatable number for each standard:

The primary goal of documenting the standards is to have easy, yet, quick reference to go to, and that is a common thing to happened, most likely in legal matters. All mentioned standards have to be numbered and named carefully and not repeatedly used, for clarity caution, and to give them more specifications incase the wanted standards are under the same headline and have similar purposes.

2) Core point (II): Determining the user of the standards:

It is very important to determine the user of the standards to return to him when needed. In some cases, the user is more than one person, for example, when using the construction standards the user is clearly one of the mentioned parties in the construction contract. Specifying all mentioned parties of any

contract is very useful when it comes to communicating within a clear line. The common solid ground to go to when disagreeing or disputing between parties, is the put standards where the solutions are taken from. Therefore, the responsibility is fallen according to the standards, as well.

3) Core point (III): Specifying the person with given authority to the update the standards:

When referring to any standards, there must be a person or department mentioned with the authority to modify those standards, that could have many reasons to happen. For example, when a flaw found in some standards, or not applicable in some situation, the concerned parties are obligated to return to the person with the authority to point out that incident and suggest a modification to be put in the standards, if he sees the necessity to do so. When failing to mention a person or department with such authority, the result can be one of two cases:

a) Either, Losing valuable time and effort, therefore money, if no standards are made exactly on time, and took much more time that it needs to be to decide.

b) Or, having conflicted standards when each party changes the standards by their own.

4) Core point (IV): Dating the standards with start and end dates:

The dates to start or end any standards have to put by the standards' designer to avoid any conflicts when working by more than one standard at a time. Many standards can be published before their dates and can have serious financial impact and nonfinancial, on the other hand, the work becomes more accurate and punctual when the start and end dates are made to ensure the users with its updates every once in a while. Some manufacturers are obligated to have written dates or durations (annually, half-annually, quarterly, or monthly) for these standards to guarantee the functionality and accuracy of keeping steady pace with changes around it, especially the rapidly changing technological standards. Dating the standards periodically ensures the enrolment of all upcoming proposals from the retro feeding and updates on the current situation, and correcting the possible mistakes and mishap, if found, in these standards.

5) Core point (V): Referencing the legal clauses and which standard material have been quoted from:

It is very important to reference the laws of which are used, especially when the standards are mandatory implemented. An example of the mandatory implemented standards is the Executive Regulations for Universities which is a division of the general Official Regulation for Education, when mentioning the reference of any material and standards, it shows us the benefits of making excellent structured references to determine the given authorities and implementation of the standards to all concerned parties.

6) Core point (VI): Identifying the types of these standards:

There are many ways to identify any standards, by each way we identify and choose the intended standard to implement. In this core point we list some of these ways by their types:

a) Either optional or essential:

All identified and referenced standards show the importance in its legality to be implemented, and that is mostly found in its essentiality, regardless how essential they vary. As for the optional standards, it is found in the improvement and effects productivity or even unifying the efforts to accelerate the communication and comprehension of the users. Furthermore, by naturally the government standards, especially safety and security standards are the most important standards, as well as maintaining the intellectual rights.

b) Either onetime use standard operational standards:

A onetime use standard is made to be used in a single operation, and this type is most likely used in consulting projects when creating or establishing a new service; those are manly formed as authenticated requirements in contracts between different parties. On the other hand, the operational standards are more common to be made and used several times and developed periodically more than once such as the process task guide.

c) Either internal within an organization or external with other organizations or persons outside an organization:

Various examples such as, manufacturer engineering standards, are the most common kind of standards which set and developed by professional and specialized external departments. Those standards are used in internal procedures and policies after modifying and detailing them according to the needs of the user; either a person or a division, those standards are often mandatory standards because of having the project owner as the authority owner, too. External standards is a kind of standards which originations make for those outside an organization for their users or contractors, not their staff, and this kind is more optional rather than mandatory; unless the legislator is the authority owner on the user, in this case it has more an internal image more than it is as an external.

7) Core point (VII): Connecting the standards within before beginning putting them:

Drawing the first draft plan for all standards inside an organization is extremely important; more importantly is connecting and crossing the common grounds of these standards. Neglecting the draft plan exposes major standard conflicts, which shows in reducing safety, security, health standards, also shown in productivity standards, where the extremely worst conflict is a law conflict in standards. To maintain the legality of any standards in an organization begins with making the draft plan to connect the standards with each other, that also is time consuming and safes efforts and money, in some cases human lives. There are two kinds of connecting and crossing between a group of standards from a time view:

a) Connecting between the standards before putting them.

b) Connecting between the standards when introducing new standards.

8) Core point (VIII): Fixed template or form for writing standards:

A fixed template can be made to facilitate and make it easy to do any wanted standards, where the reader and user both can reach the requested information very easily, not to mention the more a user reads them, the more he gets used to the form of those standards. Regardless the shape of the form or template, the template has its own basic standards to include the above mentioned core points.

C. Third step: standards verification and validation:

After building and developing initiative planning for standards, this step must take place to ensure the quality of standards in its primary form according to the following indicators, as shown in Table I;

TABLE I. VERIFICATION AND VALIDATION: MAIN INDICATORS

	Indicator	Question	Percentage
1	Accuracy	Are these standards accurate?	…. %
2	Simplicity	Are these standards easy to comprehend?	…. %
3	Verification	Have the standards been checked for functionality?	…. %
4	Requirements	Do all standards cover the needed requirements?	…. %
5	Updates	Have the standards been updated and checked periodically?	…. %
Total Score			100%

According to the five indicators shown in Table I, the percentage for each indicator is given, that concludes to a 100% overall total score. It is also possible to add more details to any indicator, for example, we can divide the indicator "Simplicity" into subsidiary indicators, as shown below in Table II;

TABLE II. VERIFICATION AND VALIDATION: SUB-INDICATORS

	Sub-Indicator		Question	Percentage
1	Accuracy		Are these standards accurate?	…. %
2	Simplicity		Are these standards easy to comprehend?	…. %
	A	Steps	Are the standards put in a serial order according steps (flowchart)?	…. %
	B	Phrases	Are the phrases familiar and known to common people?	…. %
	C	Writings	Are the standards written clearly and readable to all parties?	…. %
3	Verification		Have the standards been checked for functionality?	…. %
4	Requirements		Do all standards cover the needed requirements?	…. %
5	Updates		Have the standards been updated and checked periodically?	…. %
Total Score				100%

As such, we can add details and elaborate each major indicator to subsidiary indicators, which can be divided even with more details and more accurately. We can leave the organization to handle their own subsidiary indicators to evaluate the standards with more accuracy and more factual to their environment.

III. SECOND STAGE: ACTUAL BUILDING OF STANDARDS:

In this stage actual practice of standards' building, is taking place, where the stage includes three steps:

A. First step: Documenting the standards by writing:

Standard as defined by International Organization for Standardization is a *document* that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose [4]. Quality in a general sense is documentation base and implementation of all documented operations, procedures, and standards of administrative, engineering, and health matters for an organization. Documenting the standards include the bellow:

1- Administrative procedures.

2- Internal standards in operational procedures.

3- Awareness and educational guidelines.

4- Manufacturing and commercial standards.

5- All other general standards such as, safety, security, and health standards, et cetera.

All of those standards are not considerable and taken in matter unless they have been documented and published on books, booklets, brochures, leaflets, etc. Even more uses are technological ways to publish like electronic files, internal web network, and maybe bulletins inside an organization. Surely, all the mentioned ways of publishing depend on the stakeholders in using those standards.

B. Second step: Lingual audit and inspection of the written standards before publishing:

Auditing and inspecting the lingual writing is the most important legal step in standards' publishing. Neglecting the auditing or not doing it at all can result intentional and unintentional mistakes due to flaws in sentences' building, which could lead to improvisation by the reader in more than a way of conclusion; that could sometimes result catastrophic mistakes. More of which, that would show unprofessionalism in the standards even if no mistakes resulted when implementing.

C. Third step: Legal authorization to publish and implement the standards:

All that is mentioned previously is not legally recognized standards unless has been approved to be published to work by, and there are three kinds of approvals:

1) First: approving the structure of the standards.
2) Second: approving the publishing of the standards.

3) Third: approving the implementation of the standards.

All three kinds of approvals are necessary and mandatory when those standards are initiated internally within an organization. Standards that are initiated and made from external organizations or even international, they are usually not mandatory on an organization, unless the initiative of the standards is an authority holder with a higher authority on the organization like the local government; that makes it very mandatory to approve and publish the standards to work by official and accredited standards.

IV. THIRD STAGE: IMPLEMENTATION OF THE STANDARDS:

This stage begins after the building of the structure and approving to publish and implement the standards. What is considered as official standards is publishing them to the stakeholders or beneficiaries of these standards and implementing them. After that comes implementing the standards on the ground and work by them, as the field visits happen by the users and beneficiaries to inspect the implementation of the standards correctly. Actual implementation comes in four steps:

A. First step: Publishing the standards to the stakeholders:

This step is the first step of the actual implementation for the standards, and by moment the standards are published, it becomes legal and ready to implement by to the given dates for the standards, and there are many ways to publish standards such as:

- Books, booklets, or guidelines.
- On the official web network of the organization.
- Awareness tablets visible for all users of the standards.
- Official letter addressed to all users of the standards.
- Official documented Email addressed to all users of the standards.
- Minutes of an official meeting published to the authority holder includes the standards.
- Published bulletin in all media.

The publishing can be in the known and most familiar way to circulate any new standards, to be sent to as many recipients as possible, where it is mandatory to make sure that all the users have received the published standards, and of course, there are more preferred ways than others according to which kind the standards are. For example, manufactories' safety standards are best published on awareness tablets put on the hall ways of the factory to make sure all staff have seen and read them, which can be as well as ways of reminders of safety in the industrial environment.

B. Second step: Training on how to implement the standards:

Mostly this step does not apply except if the standards are new, technological, technical, and new international standards. As for the administrative they do not need training on, for example, new standards and criteria for promotions, unlike technological and industrial standards when a new electronic equipment for an airplane comes, the user who is a factory technician surly needs training on the new equipment.

C. Third step: Implementing the officially published standards:

After publishing the standards and training on them, comes the step of actual implementation of the standards and that's the real goal behind making and documenting these standards. By default comes to mind that these standards must be implemented, and that not always correct, there are compatibilities to implement the standards after building them, such as:

1) Starting date to implement the standards:

By going back to core point (IV); dating the standards with start and end dates, as one of the most important points to give a limitation of applying the standards for many reasons, a part of which is releasing and publishing the standards before the time set for implementation. Therefore, it is necessary to look at the dates before implementing for usages they are made for.

2) Standards' implementation purpose:

Implementation here means the validation of those standards and implementing them when they are needed, some standards for example may not apply for years like safety evacuation standards when a natural disaster happens for an organization, where these standards may not apply at all for other organizations due to being unnecessary and not having any natural disasters.

D. Fourth step: Ensuring the implementation of the standards and field auditing visits to check applying the standards:

In the fourth step is the actual implementation of the standards on the field for staff who handle working by those standards, and often the working staff are under the quality assurance managing department. As for the field visits they have to be scheduled ahead for the using teams of the standards, and they can have unscheduled visits as known in the audit department as aperiodic or casual visits. As of the external standards either local or international standards, there can be three kinds of field visits to ensure the implementation of the external standards:

1) Unscheduled, day to day, supervisor visits as an internal field visits to the department using these standards.

2) Internal audit for the standards from quality assurance department.

3) External audit for the standards from authority holder organization.

Mostly, in this step, the organization obtains recognition on domestic and international organizations to implement those standards and may fail in obtaining the recognition in case it does not deliver to the level of the existing documented standards.

V. Fourth Stage: Updating, Continuous Reviewing and Developing Standards:

The stage of developing and updating never ends or enough to do in the beginning of standards' building. It is a continuous work while building and after that, where it is called in the engineering field as process re-engineering; it is the most important step to re-engineer the administrative operation including administrative procedures and policies to increase the productivity in an organization. At this stage, it is a feedback and reimporting the following:

- Suggestions.
- Flaws and mistakes during implementation stage.
- Comments and notes of the internal audit field visits.
- Instructions and higher management directions.
- Technological and environmental changes inside and outside an organization.
- Indicators when checking performance and productivity.

VI. Conclusion

A systematic approach to create and develop standards needs a clear framework to help as a guidance. Each recognized national and international organizations that are developing such standards has its own internal standards to create technical and engineering standards. This article shows a systematic approach to create and develop engineering standards. The approach grantee the sustainability and durability of such standards. The suggested framework is easy to read and apply since it uses steps within stages to build and develop engineering standards.

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