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Configuration Management and PLM

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Abstract

This paper draws attention to the benefits of Applying Configuration Management in PLM to achieve better quality control of engineering product in Aerospace and Automotive sectors and reduce the cost and instance of Engineering design errors if applied in the Initiation stages of a project. Configuration Management is a multi-Industry disciple that achieves reduced manufacturing errors and greater efficiency in engineering and manufacturing processes.

1. Introduction

The Configuration Management within the realm of Product Lifecycle Management is an engineering practice that entails assigning functional and physical attributes representing the design and operational information of the product in several disciplines like Aerospace, Automotive, Retail, Apparel, Biotechnology etc. to control the quality of the product as it progress from Initiation to Execution and Maturity phases through its Lifecycle.

The Product ultimately goes through several iterations of configuration processes like effectivities assignment and the logical operations on the product effectivity using the basic concepts of Logical OR, AND etc. operations to result in different permutations and combinations of the product effectivity that ultimately result in a better quality product.

Configuration Management is usually confused with IT network configuration and is a completely different subject. Engineering Configuration Management is becoming increasingly popular with Engineering and Manufacturing processes and is nothing but the mere assigning of effectivities with specific Range and Domains to the engineering product with the help of the respective PLM tool in use by the OEM or its Tier 1 and Tier 2 Suppliers to control the different phases of the product right from Initiation to Execution to Maturity in its Lifecycle.

Configuration Management is a tedious task and more and more Industries are coming to see its uses versus the cost overhead in achieving configuration management and coming to use it to achieve a superior product root class (PRC).

2. History of Configuration Management

The discipline of Configuration Management was conceived when United States DOD (Department of Defense) in the 1950'S started utilizing the concept on its hardware materials. Later on the Department of Defense (DOD) started developing its Military Standards for configuration management that started being followed by most OEMs in today's day and age like Boeing etc. as their bible.

The MIL-STD-480:Configuration Control: Engineering Changes, Deviations and Waivers was published by the DOD on 12 April, 1978[2].The MIL-STD-480 was initially devised for the use of all government agencies and its contractors and sub-contractors to submit engineering changes and delineated the processes pertaining to engineering changes and configuration control[3].

The MIL-STD-481A: Configuration Control: Engineering Changes, Deviations and Waivers (18 October, 1972) [S/S BY MIL-STD-973 talks about how to submit Engineering Change Proposals (ECP) using the form 1693 and form 1694 for Engineering Deviations and Waivers [4].

The MIL-STD-973: Configuration Management (17 APR 1992) [S/S BY EIA-649].The MIL-STD-1973 defines the Configuration Management policies to be followed by all government organizations and contractors as well as sub-contractors [5]. This was treated as a bible providing the details of different configuration management protocols that are to be applied as and when required to engineering data in software or hardware as per the requirements of a specific project. The Items in the project to which the Configuration Management Policies are applied is defined as a Configuration Item or a CI [5].

The MIL standards were initially developed to be applied to government projects that are wholly or partially developed using government funds but are

now commonly used and enforced by several OEMs and their Tier 1 and Tier2 Suppliers [5].

The MIL Standards 480's were consolidated into a Military Handbook called the MIL-HDBK-61, It was the Configuration Management Guidance Handbook (30 SEP 1997) [6]. This handbook serves as a Bible for the Configuration Management Policy Enforcers and Professionals from Government and Non-governmental Organizations in today's day and age to enforce the different configuration management policies for better logistics and Operational support and performance [6].

This Configuration Management Handbook serves as a handy piece of document that helps in the planning activities of the CM along with the performance and quality control through the different phases of the product lifecycle [6].This document was endorsed later by the Standards Developing Organizations (SDO) assigning it all the more industry use trustworthiness and reducing the technical standards which were highly specific only to the military use [1].

In 1998 the American National Standards Institute more commonly known as ANSI developed the latest configuration management standard called the ANSI-EIA-649-A Standard which was nothing but the national consensus standard for configuration management [7].

This ANSI standard defines that a product or military weapon or any other entity that needs to be supported through its entire lifecycle be applied with robust configuration management policies in order to stay at the top-of- line in its efficiency and quality in the application environment [7]. This piece of document also gives the different Configuration Management Functions and Fundamentals for different type of products complex and non-complex in nature. It however professes that a consistency be maintained in the product requirements, product information and its configuration through the lifecycle of the product in a project [7]. Not every Configuration Management Principle is applicable to each type of product in every lifecycle phase of the product [7].

More recent endeavours in Configuration Management philosophies have been integrated in bodies like ISO 9000, Information Technology Infrastructure Library (ITIL), and Product Lifecycle Management etc. [1]

The Specific Principles and Models that have come up with Configuration Management to name a few like Capability Maturity Model Integration (CMMI)[8].

Configuration Management usually crosses paths with Change Management and both play an essential role hand- in hand bringing about configuration control, quality control, minimizing engineering and manufacturing design errors and conformance to products requirements as laid out by project guidelines [1].

3. Operations of Configuration Management

There are different Dynamics that play a significant role in operations of Configuration Management in different industries.

3.1 4F Principle of Configuration Management

Configuration Management works on the principle of 4 F's: They are the principles of Form, Fit, Function and Fee [8].

Form defines how a product conforms to the product requirements as laid out by the project needs [8]. The form so a Product also defines how a product shapes up and ends up looking like through the different phases of a project lifecycle [8]. Fit defines how a product interfaces within a project environment and with adjoining application environment [8]. Function defines what are the different functions performed by a product or what is the purpose served by a product in an overall realm of a project and its goals [8]. Fee represents the charge for carrying out the configuration management of the product.

3.2 Baseline Configuration

Baseline Configuration is defined as the configuration of a product at the start of a project and is the default configuration of the project during initiation and when no other product changes are carried out yet. This is the starting point of a product and serves as the checkpoint of start of all configuration management activities. The baseline configuration is maintained through up to the point Engineering Changes start getting introduced during the execution phase. Modifications introduced during the execution phase then add to the baseline configuration through logical AND or OR operations.

3.3 Bill of Material

A bill of Material is defined as the List of Parts and or Products in an Engineering Project. More commonly it is called an Engineering Bill of Material or an EBOM. The Engineering Bill or Material also carries other information like Quantity of the Part or Product, Name of the Part or Product, Material of the Part or Product, Mass of the Part or Product, Number of the Part or Product and Position or place holder of the Part or Product in the Engineering Product Structure.

The Parts or Products that are ordered for Manufacturing after the engineering lifecycle compose the Manufacturing Bill of Material or the MBOM. Different PLM tools are used by OEMs and Tier 1 and Tier 2 to create and execute the EBOMs and MBOMs. Bill of Material often also carries the Configuration Management Information as well better known as Effectivities.

3.4 Five Phases of Configuration Management

The different phases of the Configuration Management (CM) Policy as outlined in the Handbook of CM: MIL-HDBK-61A [5] and ANSI-EIA-649[7] are summarized as follows: A pictorial representation of these phases of CM are also presented in Fig.1 [1] [5] [7].

Configuration Planning and Management: Configuration Management Planning and Management phase of the project lifecycle entails planning for people, resources and technology available for the project. The planning phase of the CM involves documenting this planning and managing phase of the training and administrative resources of the project and laying out the guidelines for the team to follow for the remaining lifecycle.

Configuration Identification (CI): Configuration Items are defined as the components or products or subsystem components that constitute actual physical entities that are designated for carrying the baseline configuration of the product in the project. CIs go through changes in their configuration through the entire project lifecycle. Reporting and Tracking of such configuration changes happens through the medium of these CIs.

Configuration Control: Configuration Control is defined as the process of evaluating the changes brought about during the lifecycle of the project and the process of bringing about changes in a control way to the project or the product. Documentation in hardware and software leading to controlling the configuration of the product is also a part of this phase.

Configuration Status Accounting: Is defined as the phase of the project where the reporting and tracking of configuration status of the product happens and this phase serves as the means of catching the errors during the execution phases and non-conformities to the product requirements.

Configuration Verification and Audit: This phase entails the review of all major Configuration Items (CIs) for the compliance to product requirements and conformance to the project guidelines as laid out during the design phase of the lifecycle. The Audit phase highlights the errors and corrective actions as suggested in the audit report. The Audit and Verification phase works hand in hand with the Quality departments to conform to the product quality.

4. Configuration Management and Change Management

Configuration Management and Change Management works symbiotically for the enhancement of project requirements and product development [9].

It's a well-known fact that 33% of the product lifecycle time is wasted in unknown and wasteful procedures like waiting for decisions, unnecessary work, or waiting for decisions regarding change as was found by Mckinsey and Company [9].

In order to overcome these wasteful factors during Product Lifecycle Change Management and configuration Management need to implement in a collaborated way. Global and Multiple changes resulting due to widespread development lifecycle in terms of geographical locations and resource definition of the project- handling change correctly becomes all the more imperative to the goals of the project [9].

An ECN is known as an Engineering Change Notice that formalizes or authorizes a Change Request (CR) [8]. Once the Impacts Assessment of a change is carried out and the analysis of the influence and consequence of this change is done at the different levels of a project, the change is justified and approved or disapproved to be implemented. This results in the issuance of a change notice and subsequent issuance of a change order. A change order further authorizes the work needed to bring about this change in the project. Once the change is implemented and the work is done to carry out this change, configuration errors are analysed due this new change that has been brought about. Configuration Status Accounting [5] [7] provides a tracking and report of the configuration changes and any errors thus induced due to this change.

Configuration Control is again carried out to carry out the impact of this change within the realm of the Configuration Management policies. Therefore a handoff between change management and configuration management is crucial for successful project lifecycle management and project implementation.

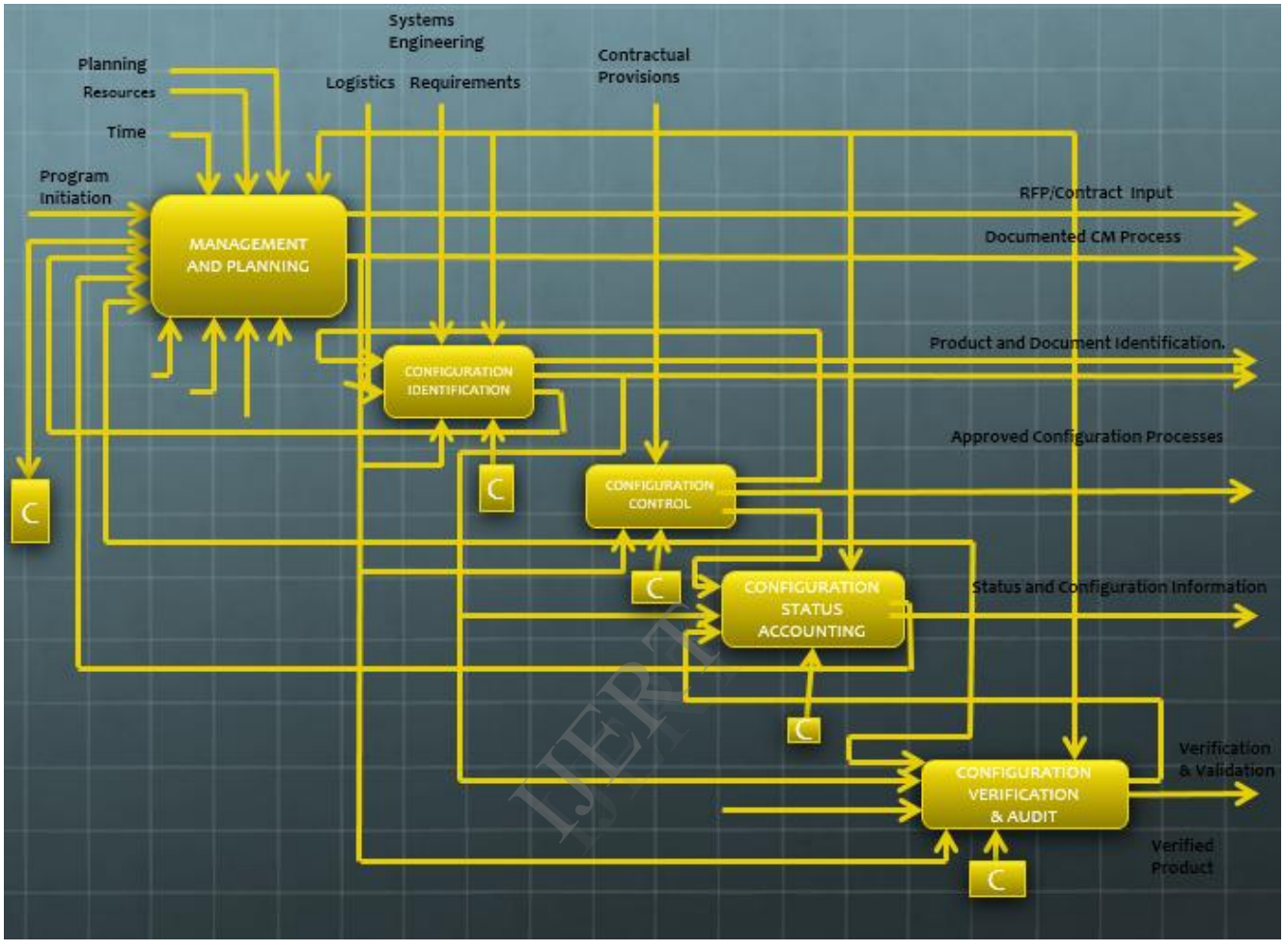

Fig.1 Different phases of Configuration Management [1]

5. Configuration Management and it's Scope

Standardization of systems and collection of requirements to establish an optimum Configuration Methodology that can be applied globally to any industry and just Configuration Management Intensive Industries like Aerospace is the future objective of CM [10][11]. It was found in 1987 that in aerospace industry alone the 39% of engineering data and 38% of manufacturing data is derived from standards [11]. Therefore the objective of Future CM is to establish an optimum CM policy that maximizes product output [11].

Successful Implementation of a top notch PLM solution entails the use of configuration management to an as-defined design process. Customization of CM to the meet and exceed the project requirements is a huge necessity of the future as project systems become global and very complex [12]. All projects have a common goal of reducing costs, saving time and minimizing errors and increasing the output of a project. Therefore the ultimate goal of a CM policy for most organizations have to meet these basic criteria for future development of CM [12].

6. References

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