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Barriers to effective configuration management application in a project context: An empirical investigation

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Abstract

Configuration management (CM) is not a new set of ideas, what it does represent is an effective way for project managers to use a formalized methodology in order that they can manage status and changes to it throughout the lifecycle. This research sets out to identify and prioritize the obstacles in the effective implementation of the CM practices, categorize these obstacles into more manageable groups of factors, and analyse the effects of multiple factors on the identification and rating of these barriers. Nineteen barriers are finalized and prioritized on the basis of their criticality and as a result three groups (managerial and organizational barriers, implementation barriers, and planning and process barriers) are extracted with the help of factor analysis. This study will help both configuration management and project management professionals to plan better and avoid the impacts of these key obstacles from much earlier in the definition phase.
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Keywords: Configuration management; Project management; Process improvement; Barriers; Aerospace and defence industries

1. Introduction

This paper investigates the obstacles to configuration management (CM) success in both the aerospace and defence industries, from a project management (PM) perspective. Configuration management is a management activity that manages the definition of a product, system or process from its earliest definition all the way through the lifecycle. In many cases, this is also required to be managed post disposal, in cases where access to data or documentation may be required for regulatory purposes. CM helps project professionals ensure that products and systems meet their defined functional and physical requirements and that any changes to these requirements are tightly controlled, carefully identified, and accurately recorded (Samaras, 1988). With clear rewards in terms of reducing product development time, minimizing through life cost, and enhancing overall product quality, CM is an essential part of the project delivery strategy. However, CM initiatives have been undermined and implemented in a haphazard way even in the presence of a sound structured methodology and sufficiently detailed requirements standards (Burgess et al., 2005). CM is based on sound business principles to establish product configurations, identify and manage changes to them through life, account for all incorporated/approved changes, and maintain the integrity of the configuration by validating and verifying compliance wherever required. Turner (1997) very eloquently puts this into a PM perspective as thus 'CM is not a radical discovery that revolutionizes the way the facility is developed and maintained. It is a set of good working practices for coping with uncertainty and change and gaining commitment of the projects participants as the design evolves'.

CM was first formally introduced by the US Department of Defence in the 1950/60's where its need was instigated through lack of data uniformity and change control issues in the race for a successful missile launch in the 1950's (Samaras, 1988). In the 1990s, CM was increasingly evident in more commercially oriented sectors to extend this concept and help them with

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through life management of product and system status. During this period the International Organization of Standardization issued their first guideline on CM in the form of ISO-10007 in 1994 with a major reflection being the inclusion of CM in the requirements based aerospace standards such as AS-9100. CM has remained one of the most critical process areas throughout the process maturity models developed by the Software Engineering Institute. CM is not limited in scope to just the aerospace & defence industries and extends to other sectors for example nuclear, conventional power generation, petrochemical, construction, and shipbuilding (Fowler, 1992; Gonzalez and Zaalouk, 1997) and has played a major part in business process improvements across the board (Gonzalez and Zaalouk, 1997).

CM is considered, by many, to be an integral element of the project management (PM) function which is a barrier to effective application is perhaps in itself. Several studies have identified that the CM process extends beyond the project, across engineering, support and disposal. Use of a common process is critical in ensuring conformance. Effective management of a project requires consistent and repeatable processes and methodologies to manage the constraints of scope, time, cost and quality, and to ensure project success. The PM professional requires CM to actively support the project direction and infrastructure (PMI, 2007). CM is a through life activity, which invariably extends beyond the traditional project lifecycle, and is encapsulated in a variety of engineering, project management and manufacturing management methods (Burgess et al., 2003). It is an on-going and repetitive activity to establish and maintain integrity of an evolving product/system throughout the lifecycle, whether it be at product, asset, system or project level, while PM is specifically concentrated on the definition and execution of the lifecycle at a project level. CM is an integral part of the system engineering function (Team, 2006; Sage and Rouse, 2009) whereas PM, quality management, engineering management, and logistics management are principal stakeholders in the ownership of the CM process (Kidd and Burgess, 2007).

The academic literature in the field of configuration management is unexpectedly and extremely limited with no formal study to date on the barriers to configuration management success. Several studies for example Burgess et al. (2003), Burgess et al. (2005), Huang and Mak (1999), Fowler (1996), have addressed several of the issues but have specific limitations on their own, namely in terms of their focus, and their scope of the discipline. The majority of studies focus purely on change management, and not CM in general. On the other hand extensive studies in allied professional activities such as quality management (Bhat and Rajashekhar, 2009; Sebastianelli and Tamimi, 2003), knowledge management (Riege, 2005; Sun and Scott, 2006), and project management (Atkinson et al., 2006) show the importance of research in the understanding of barriers. Studies on the topic highlight the core issues which facilitate the development of a road-map towards maturity of a process (Niazi et al., 2005; Yeo and Ren, 2008). This current research will not only help in organizational enhancement of the configuration function but also facilitate the exploration of ways to avoid obstacles and devise frameworks to establish excellence in CM practices for project management.

Configuration management is not practised to its full potential and is perceived in a similar way to that of quality management in Western organizations prior to its increased level of awareness in the 1980's (Burgess et al., 2005). Indeed, there is a common path for the development in that quality rose from a culture of quality control, through assurance and then on to management. CM, similarly, is very much entrenched in a culture of control/assurance. Burgess et al. (2005) further confirmed that achieving a highly performing CM system is not simple and needs further study to investigate the obstacles involved in implementing high-grade CM systems. To further investigate that very issue, this research is designed with the aim of highlighting the main barriers in the effective implementation of the CM process in both aerospace and defence industries. This study identify barriers associated with managing configuration management application, prioritize them with the help of differential statistics, categorize them into more manageable groups of factors through factor analysis, and analyse the effects of multiple factors e.g. academic education, gender differences, CM experience and types of organization on the perception of CM practitioners in the process of application and finally rating these factors through the application of inferential statistics.

With in-depth interviews and questionnaire surveys, nineteen (19) barriers were finalized and prioritized on the basis of their mean values which are grouped into three groups namely 'managerial and organizational barriers', 'planning and process barriers', and 'implementation barriers'. Significance is found in the CM practitioner's perceptions based on the typology of organizations in which they work.

2. Literature on barriers to CM implementation

CM barriers refer to those potential actions, phenomenon, or influences which impede and prevent effective implementation of the process in achieving its objectives. Detailed searches of peer reviewed journals and practitioner literature highlights that research based study on the topic is unexpectedly and extremely scare in comparison with other allied processes such as quality management and knowledge management, and no formal study is found with the aim to explore barriers to CM success. However, allied studies in the areas of quality management (e.g. Bhat and Rajashekhar, 2009; Sebastianelli and Tamimi, 2003), knowledge management (e.g. Riege, 2005; Sun and Scott, 2006), project management (e.g. Atkinson et al., 2006), and business process management (e.g. Da-Silva et al., 2012) provided a great deal of scope in this area of study.

Burgess et al. (2003), Huang and Mak (1999), and Burgess et al. (2005) could be considered the most influential studies to date which have supported the need for this research in many aspects but have specific limitations on their own. Instead of targeting CM as a holistic and generic process, these studies have targeted specific elements of CM execution. For example the study of Burgess et al. (2003) is related primarily to configuration status accounting while that of Huang and Mak (1999) deals with configuration change control and hence can't be considered a representative view of the CM process as a

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