

COMPUTER AIDED COMPREHENSIVE DESIGN FOR SIX SIGMA (DFSS) AND AXIOMATIC DESIGN (AD):

COMPUTER AIDED PERFORMANCE EXCELLENCE (CAPE)

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Abstract: The purpose of this paper is to outline the place of computer aid in development and design. Computer aid will be discussed as it applies specifically to Design for Six Sigma and Axiomatic Design. The integration of various methodologies in a comprehensive format will be described as will the possibility of computer aid to augment and support this integration.

Key words: Axiomatic Design (AD), Computer Aided, Computer Aided Performance Excellence (CAPE), Design for Six Sigma (DFSS), DMAIC, Integration, Lean, Quality Function Deployment (QFD), Six Sigma, Theory of Constraints (TOC), Theory of Inventive Problem Solving (TRIZ)

1. INTRODUCTION

As the number of methodologies that provide benefit increases, it becomes difficult at best to control their proper integration and utilization. The advent of advances in existing methods is causing a revitalization of many systems that appeared to be mature to the point of assimilation and disappearance. The revitalization is causing the number of complementary and competing systems to increase causing significant complexity in their

utilization, integration, and management. This provides an excellent opportunity for the application of computer aid to resolve these three issues.

2. METHODOLOGIES

Six Sigma has pervaded corporate society as the lead method for reducing the number of defects in a system. Lean is the method for the elimination of waste in a system. Lean also provides just-in-time strategies and a method for level loading. Quality Function Deployment provides a method for capturing, structuring, and the flow-down of the voice of the customer through the entire developmental process. Axiomatic Design has yielded a set of axioms to structure and govern the design process (attempting to apply more science to what has been considered an art). Design for Six Sigma is the method for creating a new product or process. The Theory of Inventive Problem Solving is the structured application of scientific and heuristic observations to problem solving (tactically) and the generation of concepts and their respective evolution (strategically). Theory of Constraints provides a means of identifying the barrier constraining the entire system and the application of techniques to remove the barrier allowing the system to evolve to the next constraint. Each of these methods has a complex structure and algorithms delineating the steps and application parameters necessary for their application. Even within each single method, there are “dialects”. This causes considerable consternation and confusion among potential users. Sometimes the complementary nature of these methods (and others omitted for simplicity) is hidden by particular features that compete. These issues provide the fertile ground in which a homogenous poly-system may be created in which the use of a computer aided structure may resolve all difficulties (of course creating a new set).

3. INTEGRATION AND EVOLUTION

These aforementioned methodologies are each an incomplete but valid perspective of Total Performance Excellence. As the needs of a corporation are considered from the development of a concept from mind-to-market, a list of competencies is created. If the capabilities of the aforementioned methods are mapped to this need assessment, you will find the fact that each method must be used in order to augment and support each corporate need. The fact that each method competes for a portion of a finite set of resources means that the most powerful piece(s) of each method must be combined to

form a hybrid structure. This hybrid structure’s complex heterogeneous nature would be supported by the development of a computer program that automated and provided a meta-structure to the integrated meta-method. The complexity of the new method would be mitigated as well as the logistical flow through each method and their respective tools through product / process development. A partial set of those skills necessary is represented in Figure 1.

Category Matrix

	Basic			Intermediate	Advanced			
R & D	Trial and Error	Derivative Development	Incremental Development	Closed Innovation	Open Innovation	Disruptive Technologies	Structured Innovation	
Design	Design by Specification	GD & T	Tolerance Analysis	Robust Design (DOE)	DFSS (DMADV)			Enterprise Evolution
Process Improvement	Quality System	SPC	TQM (PDCA)	Capability	Robust Manufacturing (DOE)	Six Sigma (DMAIC)		Drive to Six Sigma
Lean Principles	Virtual Factory and 5S	Elimination of Muda	DFX	Takt Time	Load Leveling	Demand Flow Technology		
Process Management	Establish Processes	Independent Divisional Models		Reduce Interdependencies	Enterprise Process Management			Fundamental
Strategic Planning	Vision	Goals and Objectives	Management by Objective	Balanced Scorecard	Hoshin			

Figure 1. Total Performance Improvement Model (TPIM) indicating the evolution of necessary skills from the fundamental to enterprise evolution. Computer Aided Performance Excellence (CAPE) would provide a structure containing the methods and tools to support all of these functions.

As Six Sigma is the evolution and integration of Deming’s work, Juran’s work, Fischer’s work, Shewhart’s work, and Feigenbaum’s work (not exhaustive) so to shall Total Performance Improvement be the integration of TRIZ, DFSS, TOC, Lean, and the other useful methodologies. Also, as MINITAB and Six Sigma project tracking software complement Six Sigma so to will CAPE complement Performance Excellence.

4. CONCLUSION

An excellent opportunity exists for the software development community to introduce Computer Aided Performance Excellence to society. This product should contain a meta-methodology that governs the entire

developmental process from mind-to-market. This product would (at a minimum):

1. automate voice-of-the-customer (VOC) capture,
2. assist the application of QFD and preservation critical-to-customer requirement flow-down,
3. assist the application of TRIZ to resolve contradictions identified by QFD,
4. assist the application of Axiomatic Design to the design process,
5. integrate existing DMAIC and DMADV (DFSS) tools and processes,
6. integrate TOC and Lean in product and process maturation, and
7. involve TRIZ for the resolution of any secondary problems.

CAPE will revolutionize the Performance Excellence industry and help to reduce excellence to a ubiquitous core competency for the evolving organization.

5. REFERENCES

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