

## **Implementing DTC QFD and DFX** **In product development**

### **Abstract**

There are two main customers in product development process. The first is the external customer who dictates the project performance, time table and price. The second is the internal customer, the organization that performs the development, which supplies the resources and dictates the product cost. Usually the product development team focuses mainly to fulfill the external customer performance requirements, while the product cost is derived from the design. This leads to high final product cost, which lower the profit and sometimes even creates losses. But we have to understand that product cost dose not determined in the manufacturing or the production, 90% of the cost drivers are determined during the development process. Therefore, this is the place where we have to look for, when striving to cut down costs. It must be a mechanism within the organization that places the product costs at the same level of importance as the other product requirement.

### **Design to Cost, (DTC)**

The traditional definition of Design to Cost, (DTC), is a managerial concept that established rigorous cost goals during development life cycle. While in reality, DTC is also an engineering-oriented concept that attempts to solve a problem: within a given budget and performance requirements, what product can be designed? It emphasizes meeting specific cost targets at various stages in a product's development life cycle. DTC deals with product cost, (recurring cost), and not with the development cost. Since DTC is only a managerial technique, we have to add specific tools that enable us to reduce cost whenever there is deviation from the target cost.

### **Cost as an Independent Variable (CAIV)**

CAIV, (Cost as an Independent Variable), deals with costs from the total ownership point of view. Given a fixed budget, how much performance can be provided within a minimal acceptable risk. It focuses on cost/performance tradeoffs which lead to an affordable product. This objective is only possible if we focus on a best-value balance among cost, performance, with the same intensity that we once devoted to performance alone. The project team must focus on "best customer value" related requirements, and eliminate non-value added requirements to drive costs down. Cost must be treated as a primary requirement that may only be traded for performance or other technical attributes, if the customer determines that doing so will provide overall best value and affordable product.

### **Best customer value (QFD)**

The main parameters that determine product costs are the requirements. But before digging into detailed requirements, and making tradeoff between cost and performance, we have to know what would bring the best value to the customer.

The best customer value is defined as:

- Solving problems
- Exploiting Opportunities
- The product should look good
- The Customer should feel good

Customer's needs derive from the best customer value, and the requirements derived from those needs. Therefore we should deeply understand those need and best value before challenging customer requirements.

### **Design for Manufacturing, Assembly, Testability, Integration (DFX)**

The DFX (Design For: Manufacturing, Assembly, Testability, Integration..), or as it popularly calls DFMA methodology, was developed by Boothroyd Dewhurst Inc. in R.I. USA. The DFMA methodology leads to:

- Reduced parts count
- Reduced number of manufacturing operation
- Reduced tooling cost
- Reduced number of assembly processes and assembly mistakes
- Reduced maintainability activities
- Lower stocks
- Reduced overall cost

DFA, (Design for Assembly), is the commonly used methodology, and focused on reducing assembly time, The DFA is based on the following premises:

#### **When:**

- There is no relative movement between parts,
- There is no requirement for different materials,
- There is no need for disassemble of the part,

**Then:** that part is a candidate for elimination or combination with another part.

DFX generated a revolution in design practices, because it has great impact on the total manufacturing product cost. The DFX simplifies the product structure, reduces the number of parts, simplify the assembly and thereby reduces the total cost. DFX provides a systematic procedure for analyzing and quantifying proposed designs ideas from the point of view of manufacture, assembly, and testing.

On an everyday basis, the designer is challenged to justify the existence of each separate part and process. This leads to a simplification of the product structure by reducing part counts and assemblies complexity. The designer strives also to eliminate adjustments and orientation, eliminate fasteners, maximize part symmetry and ensure adequate access for assembly. This methodology is very effective in the concept and preliminary development phases, as well as detailed designs and test requirements.

### **Cost reduction workshop**

The Cost reduction workshop is a concentrate effort of selected team member that focuses to achieve a step function product cost reduction. By integrating DTC, CIVA, Best customer value and DFX tools into one workshop, we create a combined and integrated cost reduction methodology that takes the best from each managerial tool.

The workshop duration is usually one day and contains about 15 people. The participants come from all the disciplines that involved in product designing and manufacturing like: engineering, analysis, production, assembly, testing, inspection and others.

The cost reduction workshop contains three basic elements:

- Multidisciplinary team (Integrated Product Team)
- Facilitator who facilitates the workshop
- Relevant tools and methodologies

The workshop is a product design review process that involves a step-by-step assessment of requirements, architecture, manufacturing, purchasing and other cost driven issues. Each workshop contains the following phases:

- Documenting the current cost status, and the cost drivers
- Brainstorming for ideas, and identifying opportunities for cost reduction
- Selecting recommended ideas for cost reduction for dipper evaluation.

The brainstorming and the group dynamic create many cost reduction ideas. By comparing those idea to the real product cost estimate, provides a measurable tool for trade-off implementation decisions. The outcome result of

the workshop is a "to do list" of activities which lead to lower product cost, including responsibilities and time table. About a month after the workshop, there must be a follow up meeting to verify that the ideas has been implemented within the design and the target cost has been achieved.

It can be easy implemented within the organization, and can show cost reduction results in a short term. The workshop can be applied on each stage of the design, but the best benefit is at the concept design stage where at least 70% of the final product cost is determined. The workshop overcomes limitations of absolute design rules, and promotes creative solutions to the design challenges. It provides a quantitative tool that can place a dollar figure on various design proposals.

The workshop requires a culture change that brings manufacturing capability and cost into designers focus on the one hand, and makes the manufacturing and logistic organizations full partners in design concepts and responsibility.

### **Implementing cost reduction workshop during the development life cycle**

When trying to implement DTC, we must go beyond traditional definition and create organizational culture that guides designers to implement DTC as a major goal. DTC must be an overarching philosophy that permeates the entire development environment and dominates all major design decisions.

The DTC is implemented in the following development phases:

Proposal – This is the first time to builds the product cost model. This cost model is based on the customer requirement, the preliminary design and the resources needed, (hours & materials), to build the product. The product cost model is the basis for DTC implementation.

Product development kickoff – During the negotiation period, from proposal submission till time when the final agreement is signed, the requirement, the architecture and the prices are frequently changed. Therefore, after the tender has been won, even before the development kickoff, a new target cost has to be established. It must be based on new product price, and on the corporate Allocations & Profit policy. This is sometimes unsolved equation, balancing the old design, which was prepared for the original proposal, with a new target cost, which is usually less than the original cost. Even though this new target cost must set as addition requirement for the project manager, equally to the other performance or milestone requirements. It is important to emphasis this issue because usually when the project is initiated, the designers are not used to take the product cost as a main requirement, and tend to forget about cost parameter, while diving into fulfilling the performance requirements.

Preliminary design – In the beginning of the preliminary design, we must balance between requirements and target cost, and identifying the main Cost Drivers. If the cost target is not achieved, a cost reduction workshop has to be conducted, because in this design phase, the flexibility for changes is very high and the costs per change are very low. In those workshops we brainstorm creative techniques for cost reduction by challenging:

- Requirements
- Architecture
- Technology

During the workshop, we evaluate alternatives and concepts, and make the necessary changes that bring the cost down to the target cost. One of the outcomes of the preliminary design are:

- Cost module for the project
- Cost allocation to the sub systems which sum up to a desire target cost.

The PDR (preliminary design review), will not be accomplished until the team shows that the target cost can be achieved in the architecture and technology of the preliminary design.

Detail design – In the detail design we revise the components, parts, manufacturability and assembly process to meet target cost. The cost module must be in grate details to reflect the cost drivers down to the simplest parts or fasteners. If the target cost is not achieved, a cost reduction workshop is conducted. This workshop challenges the:

- Assembly Processes
- Handling and Orientation
- Location and Insertion
- Joining and Fastening
- Adjustment & Finishing
- Number of parts
- Standardization and Reuse
- Design for Manufacturability
- Reducing Costs with Early Supplier Involvement
- Purchasing Actions to Reduce Cost

The outcome of the workshop is set of ideas for cost reduction that the development team has to evaluate. Process reviews are held a month later, to validate the final design, and the final cost. An integrated part of the detail design cost module that contain brake down of the product costs, and sum up to the target cost.

### **Summary**

The target cost must be an independent design requirement with importance equal to or greater than performance. DTC focus must begin as early as possible in a program, for early cost driver identification, and maintain through the development life cycle. To meet customer affordability objectives, and the organization profit goal, affordability must be the primary driver in all design and development activities. The project manager must track and measure the current design cost status against its goals at periodic intervals. The cost reduction workshop must be user friendly and accessible to all the people that involve in the product development, down to the lowest levels. The workshop keeps cost and cost reduction in the forefront of product team activity. This is a proven methodology that can lower the product cost down to 30% of the product cost in the preliminary design phase, and down to 70% of the product cost in the detail design phase.