Function-Based Competitive Product Design Analysis

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Executive Summary
Competitive product teardowns are often done in an unstructured, reactionary way with very short term goals and objectives (i.e. in support of a current project). The information generated from such activities may generate some value for the project team but is lost for longer term, strategic applications. Function-Based Competitive Product Design Analysis integrates the use of Function Analysis, DFMA, and Customer Oriented Product Concepting with traditional competitive intelligence activities and was created to bring structure to teardown activities and to maximize the return on investment (near and long term) of these activities.

Background
In the early 1990's, many in Kodak were beginning to consider how Kodak would make the transition into the digital imaging space and, more specifically, how Kodak would need to operate to compete in that space. For many years, Kodak had active and very effective competitive intelligence activities but they were mainly focused on the film business' traditional competitors. With the transition to digital technologies, there was a whole new set of competitors ranging from small venture capital funded companies up through consumer electronic giants such as Sony and JVC. Digital photography and digital imaging was quickly becoming big business with relatively low barriers to entry.

As lines of business within Kodak started to develop transition plans, it quickly became apparent that information about competitors, their products and technologies was needed as input into strategic planning activities. Key business and investment decisions were being made without an understanding of the competitive landscape. In a "kneejerk" reaction, several different groups started buying and disassembling popular products to better understand how they were being designed and manufactured. In several instances no fewer than 4 redundant teardown events took place on the same products with very little "real" intelligence being developed due to poor application of analytical techniques and poor collaboration across functional organizations.

***Competitive Intelligence**: A systematic and ethical program for gathering, analyzing, and managing external information that can affect your company's plans, decisions, and operations.*
Strategic and Competitive
Intelligence Professionals (SCIP)

Value Proposition
Most people in product management and product development understand the **concept** of value proposition … the subjective assessment of satisfaction with a product as compared to the price paid to acquire that product. Very few know that there's a discipline dedicated to understanding, quantifying, and improving value … it's called Value Analysis / Value Engineering (VAVE). VAVE is built on a very simple yet powerful equation:

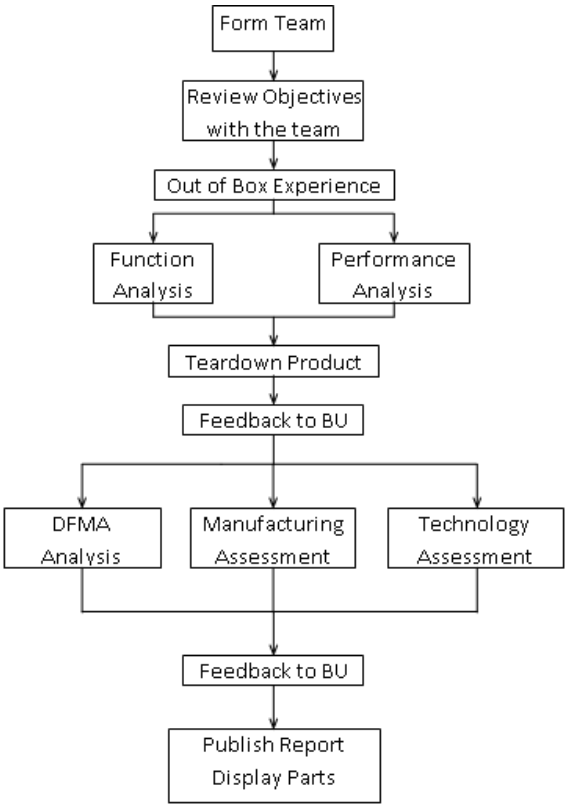
$$\text{Value} = \frac{\text{Function}}{\text{Cost}} = \frac{\text{Performance + Delivery}}{\text{Cost}}$$

At the system level, this equation describes how most purchasers of goods and services evaluate their options and make buying decisions. Through the application of analytical techniques collectively known as Voice of the Customer (VOC), business leaders can make decisions and trade-offs about the specifications of a new system to improve its market reception and business results.

Subsequently, at a more detailed level, this equation and VAVE analytical techniques can be used to guide the product development team in the decisions made designing the system and all of its components. Some of these analytical techniques apply very well in conducting competitive intelligence activities and are at the core of Function-Based Competitive Product Design Analysis.

The Analysis Process

The high level process is very logical … organize the team, collect the data, analyze the data, and publish/share the results. The challenge comes in the middle of the process with the details of collecting and analyzing the data. As with carpentry, "measure twice and cut once", it pays to prepare well and go slow. Typically, people involved (i.e. engineers) want to immediately remove the covers and "see what's under the hood". However, there is valuable information and data to be harvested throughout the analysis process, starting with the packaged product, and once you've "made the cut", it can be very hard to back up.

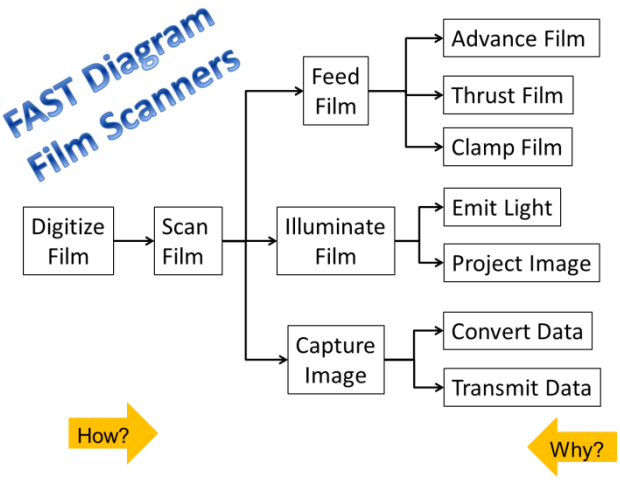


So, prior to removing the product from the package, the process starts with an Out Of Box Experience (OOBE) evaluation. This is an assessment of the package design and the ease with which the product is removed, set-up, and operated. Once operational, a performance assessment is completed to understand the product's capabilities and compare them to its specifications. Concurrent with this activity, Function Analysis (a VAVE technique) is completed to identify/verify the operational functions of the product.

Now the product can be disassembled but, again, it pays to go slow. By incorporating the use of Design for Manufacture and Assembly (DFMA®), important information about the product design can be harvested. The full teardown often takes several meetings as analytical assessments need to be performed at various stages of disassembly (i.e. optical subsystem evaluation, sensing and circuitry assessments, etc.). Eventually, at the part level, additional assessments are completed including part costing (using DFM Concurrent Costing), manufacturing capability and technology assessments. The results from all of these analyses are published in various kinds of reports and presentations (traditional and online).

Function Analysis

Within the VAVE discipline, there are very specific ways of defining functions, relating them to one another, and measuring the performance and delivery of those functions within any given system. Describing a product's operational functions and, subsequently, organizing data into those operational functions enables valuable insights across many competitive products including products from the same competitor within a product family.



Functions are defined using verb-noun pairs and organized into a FAST Diagram (function analysis system technique). From the FAST Diagram, operational functions become apparent that are useful for organizing competitive product information. In the Film Scanner example, Advance Film, Thrust Film, Clamp Film, Emit Light, Project Image, Convert Data, and Transmit Data are functions that all film scanners must perform. By functionally organizing data, one can see how different designs compare and how a specific company might be evolving their technological solution over time.

DFMA® Cost Analysis

Cost can be measured in many different ways (i.e. currency, time, effort, etc.) and at several points in the value stream. The typical approach is to estimate the cost to the final manufacturer of the product (i.e. unit manufacturing cost (UMC)). The use of DFMA® provides many advantages in the collection and analyses steps of the design analysis process:

- Slows down the disassembly process in order to capture DFA data providing more time for members of the team to capture observations reducing the risk of lost intelligence
- Provides objective assembly time and costs
- Provides objective part and tooling costs
- Enables functional grouping of UMC cost results
- Provides a relative assessment of design competency

In DFA, by changing how the structure chart is constructed (from assembly order to disassembly order), the disassembly process can be captured and the total assembly time estimated. Appropriate labor rate(s) can be defined to compute the assembly cost and the analysis results can be presented in tabular form and used for comparison against other products.

TECHNOLOGY	NO. OF UNIQUE PARTS	TOTAL USAGE
Sheet Metal	14	14
Plastic	26	26
Labels	5	5
Printed Circuit Board	6	6
Misc. Electrical Parts	6	9
Lens Manufacture	5	5
Total Custom Parts	**61**	**64**
Standard Hardware	4	43
Grand Total	**66**	**108**

Using the Pareto Principle, the "20% vital few" parts are then analyzed using DFM Concurrent Costing to generate a rough order of magnitude (ROM) estimate of the parts costs and tooling investment required. Typically the remaining parts are mostly commercially available items which can be estimated quickly based on direct purchasing experience of like parts. All of this data is integrated into the DFA model to generate an estimated UMC.

Combining the DFMA results with Function Analysis provides another perspective of the cost breakdown of the product and enables comparative analysis with other products. In DFA version 10, the Functional Grouping feature makes this extremely easy by assigning each part, subassembly, and operation to a pre-defined functional grouping. The software then allows you to present the results, by function, in a number of different ways.

FUNCTION	NX	NIKON
POSITION FILM	$5.84	$12.34
ILLUMINATE FILM	$16.03	$141.55
IMAGE FILM	$82.35	$153.39
SENSE IMAGE	$31.45	$232.28
DIGITIZE IMAGE		$50.00
SCAN TRANSPORT	$24.32	$147.53
FOCUS IMAGE	$7.96	$128.72
PROCESS IMAGE		$50.00
CONTROL SCANNER		$50.00
TRANSFER IMAGE	$40.25	$69.00
POWER	$30.29	$35.14
EMI CONTROL-REGULATORY	$3.86	$0.61
THERMAL		$2.25
CASE	$9.96	$26.92
SERVICE, ASSY, TEST		
ASSESSORY INTERFACE	$0.33	$0.67
SOFTWARE		$5.08
USER EDUCATION	$13.26	$5.00
SHIPPING-PACKING	$10.00	$9.30
	$275.90	$1,119.78

Function-Based Competitive Database

As is no doubt apparent by now, all of this data and all of the other information collected during the teardown process (i.e. pictures, videos, observations, technical reports, etc.) can and should be collected in a way that's easy to "mine" and present (the embodiment of intelligence). Organizing the data by function yields significant value as functions are typically consistent across the product category and, in some cases, across categories.

One such technique combines competitive intelligence with VOC and Voice of the Business (VOB) information as part of early portfolio planning and system design efforts. It's called Customer Oriented Product Concepting (COPC). The system is defined by its operational functions and, for each function the following information is collected:

- Customer weighted expectations (VOC)
- Competitive assessment against customer expectations
- Desired system capabilities (VOB)
- Relative importance for sales & product positioning (VOB)
- Weighted manufacturing/operational expectations (VOB)
- Potential known design solutions assessed against VOB and VOC expectations

Customer-Oriented Product Concepting

PRODUCT: VCR
TASK: Play Video on TV
DELIVERABLE: Electronic (TV) Image
BASIC FUNCTION: Display Electronic Image

COUNTRY: U.S. Only
MARKET: Video
SEGMENT: Home Entertainment
USER: Family
DECISION MAKER: Primary Income Producer

MARKET/CUSTOMER											MANUFACTURING/DESIGN							
	CUSTOMER REQUIREMENTS		COMPETITIVE ANALYSIS						PLANNING				TECHNOLOGIES (HOW TO)					
Operational Functions	Features	Importance	Current Us	OM1	OM2	OM3	Desired Us	Improve Ratio	Sales Point	Score / Percent Score	Mfg Criteria	Percent Weight	Tech 1 Mfg.	Tech 1 Cust.	Tech 2 Mfg.	Tech 2 Cust.	Tech 3 Mfg.	Tech 3 Cust.
Load Tape	Ease to Load	10	5	8	7	10	10	2.00	1.5	30.00 / 58.7	Cost	15	5	7	5	10	5	10
	Ease to Orient	10	9	9	9	8	9	1.00	1.2	12.00 / 23.5	Dev Time	10	3	9	5	9	5	10
	Instructions	8	7	8	8	8	8	1.14	1.0	9.12 / 17.8	Durability	15	5	5	5	6	5	9
										51.12 / 100.00	Time to Complete	5	1		5		4	
											Quality	20	5		4		4	
											Reliability	20	4		4		4	
											Maintainability	15	4		4		4	
												100	425	711	445	905	440	982
Transport Tape																		
Record Image																		
Playback Image																		
Rewind Tape																		
Remove Tape																		

Source: M. Larry Shillito

The competitive analysis ratings come from the performance assessment done as part of the teardown process. The technologies columns are subsystem designs representing both internal intellectual property and the output from competitive design analyses. All of teardown data (i.e. pictures, videos, technical reports, etc.) comes together to provide a spectrum of potential solutions and spur innovation of new potential solutions for each operational function. The product development team can assess the potential solutions by function and develop numerous system concept models "stitching" together solutions for each operational function. There might be a "fast to market" concept, a "lowest cost" concept, a "highest reliability" concept, and a "best overall" concept, each consisting of different functional design combinations.

A potential outcome of a COPC could be technology development projects to shore up competitive advantage with one or more key operational functions. In some cases, innovative new technologies could eliminate the need for certain operational functions leading to "game changing" product and technological solutions. The long term potential benefits of a robust competitive intelligence operation including function-based competitive design analysis are limitless.

Guiding Principles

Slow is fast … or another way to say it, "speed kills". As with any analytically intensive effort, good planning and meticulous, detailed effort is required lest you overlook potentially critical bits of data.

"Many hands make light work" … a company's intelligence, growth capability, and therefore its long term success, resides with the dedication, knowledge, and experience of its employees. Competitive intelligence should not be limited to a small group of individuals hidden behind closed doors. A diverse cross-functional group of people should be involved with each project and should have specific roles to play to ensure that the work is done quickly and effectively.

"A picture is worth 1000 words" … competitive design analysis should include many pictures and video in support of all the analytical results. Pictures aid in understanding the facts and the inferences. Especially in this digital age, you can never have too many images.

Don't wait to share … the analysis is never done, there are always new things to learn and study, and the report/presentation will never be perfect. Post whatever information you have as soon as you're able and be clear about its status (i.e. fact, inference, hypothesis, etc.).

Track utilization … collect and archive case studies of competitive intelligence utilization. Every corporate activity must be able to demonstrate a return on investment and the return on competitive intelligence activities can be difficult to quantify and you don't really know what you have until it's gone.

Constancy of Purpose … W. Edwards Deming coined the phrase in the 1950's in recognition of American management's seeming inability to stay focused. Dedication and persistence is needed to reap the long term gains of competitive product design analysis. Developing the behavioral "habits" associated with collecting, analyzing and utilizing competitive intelligence takes time. Stakeholders must be committed to it as a key tactic of future business growth.

Summary

Regardless of your industry, competitive pressures are a continual threat to meeting business objectives. Understanding the competitive landscape and, more importantly, utilizing that intelligence can be the difference between "meeting expectations" (or worse) and "beating expectations". This is especially

true in market segments that are technology driven where continual advancements in technological capabilities enable rapid introduction of new products and systems to tech hungry consumers. This tends to be a fast paced world and the natural reaction in such an environment is to “act first and ask questions later.” By slowing down and using methodical analytical methods in assessing the competitive threat, long term gains and decision making efficiencies can be realized that will certainly beat expectations.