



Best-Cost Best-Time Product Development

A White Paper for Senior Management

Optimize simultaneously in real time, product cost and time-to-market parameters during the product realization process.

An example shows a 54% reduction in product cost and a 67% reduction in product development time.

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July 10, 2005

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Introduction New product development is a leading driver of revenue, profit and market share growth for most companies. Driving forces are: 1. Increased competition (particularly from low-cost countries), 2. Goals to target new markets and create new revenue streams, 3. Customer demand for more innovative products, and 4. Pressures for product cost reduction. To optimize product development, the competing factors of cost and time need to be addressed simultaneously in the design and its execution. Cost includes product development and production. Time includes time required for product development and acquisition. Both need to be addressed in a real-time dynamic and changing environment and product design significantly affects both.

The Current (Old) Process minimizes both the magnitude of the problem and opportunity since it limits the number of choices which in turn results in only a few plans for easy (manual) evaluation.

The Problem to be solved to obtain an optimal cost and time solution for product development is the data. For manual approaches, the huge amount of data needs to be developed, plans generated and then evaluated and this is a deterring task. A simple product may have many components (usually defined in a bill of materials (BOM)), alternative components, component manufacturers (usually defined in an approved supplier list (ASL)) and component suppliers/distributors, each with a unique cost and availability (data). This involves thousands of combinations of components, suppliers, and manufacturers. Each set of component-manufacturer-supplier combinations results in a specific plan with its unique cost and time. More complex products have millions to billions of plan sets that can be generated and evaluated to achieve optimal cost time plans.

To add to the complexity and difficulty, both component cost and availability data change almost daily. This means that the optimal cost time plan will also change over time.

The Benefits and Competitive Advantage associated with correctly solving this problem in terms of product and development is huge.

The VED Tool Set used in this analysis utilizes a unique (proprietary patented) methodology that allows users to accurately estimate what they should be paying for global sourcing/outsourcing. It can identify and measure potential bottlenecks in the Design Chain/Supply Chain, enabling users to find their cause and ultimately their cure. It also provides performance measurement of the entire product development effort and individual elements such as design, purchasing and manufacturing. Our experience indicates as much as 50% savings in cost and time as illustrated in the following example of an actual product.

Application Example A current printed circuit board assembly (PCBA) was selected as the product development design to be analyzed for this test. This optimization analysis was performed on a simple assembly with ten components. The OEM's goal of lowest total price was the critical metric. A total of 485 alternative plans were automatically developed and evaluated by the VED

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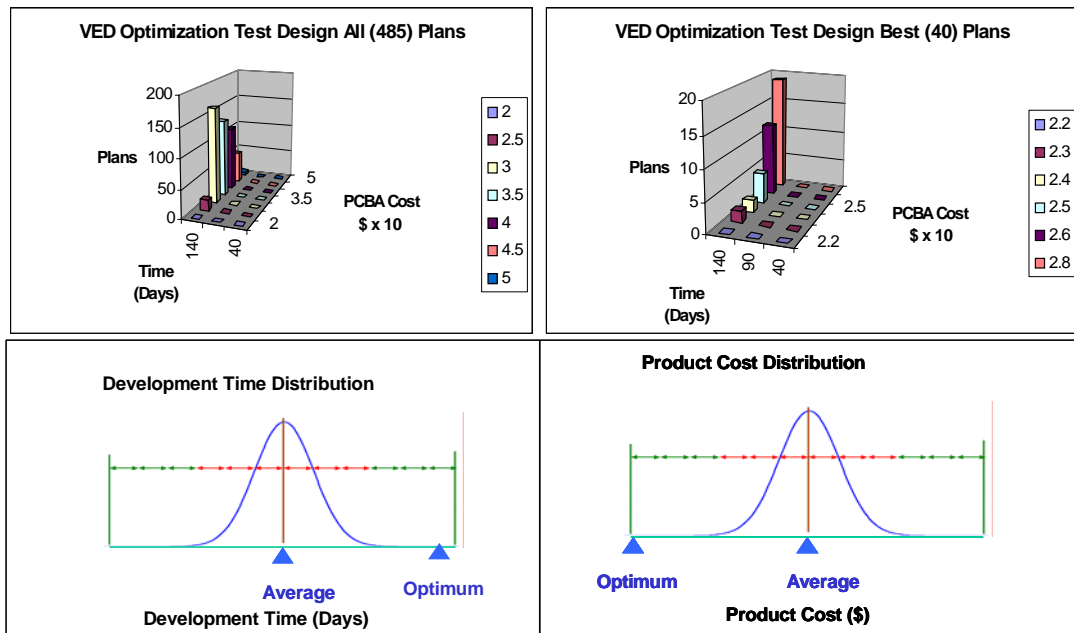
analysis. The software scales very well for much larger and more complex designs.

Input Data. Design Data required are the bill of materials (BOM), approved supplier list (ASL), printed Circuit board (PCB) description and quantity. These data are used with manufacturer's and distributor's data to obtain price and availability for components, PCB, and assembly. The databases, in most cases, can be mounted automatically to support automated tools.

Development of Plans. Plan validation, analysis and evaluation then determine best-cost best-time plans. The number of potential plans varies from thousands for simple products to billions for complex products. Without the benefit of the VED analysis this would require many years of effort.

The top panes of Figure 1 depict a set of product plan results in cost time blocks. Each block displays the number of plans within its time-cost block. The number of plans in each cost-time zone is shown on the vertical axis with cost increases to the right on the right axis and time increases to the left on the bottom axis. The legend on the right side is color coded to the cost of the product plans in each block. It should be noted that minimum-time/maximum-cost and minimum-cost/maximum-time are the norm. The top left pane displays all the plans. The top right pane displays only the 40 plans with the lowest costs including the two plans with the best cost which are in the lower corner block indicated by the smallest block. Achieving best cost/best time requires generating and evaluating a very large number of plans, a process that is now quickly accomplished in the VED tool set.

Figure 1



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The lower panes of figure 1 show the distribution (histogram) of plans for time in the left pane and for cost in the right pane. The majority of plans will be located at the mean or average value, while the best plans are located at the extreme (read six sigma (3.4 per million plans) or better) values. The charts are arranged to line up with the three dimensional cost time blocks in the upper panes. Along the time axis, shorter (better) times are to the right and along the cost axis, lower costs are to the left.

In addition to these results, the VED tool set analysis of the plans identifies changes in the plans that would further reduce cost and/or time. In this example two components were identified that had lead times of 112 days that in turn drove a total product cycle time of 147 days; three other components had lead times of 44 days. These component lead times also have a negative impact on cost due to the inability to take advantage of lower cost component alternatives and assembly sourcing options. The current manual and limited old process is limited to cost-time plans clustered about the average or mean cost and time plan value.

The Best Plan in terms of product cost was \$17.16. The median plan cost was \$32.29. The current purchase price of \$38.00 is 15% above the price of the median plan for this product, while 65% of the plans had a lower cost. Market pricing for the design was determined from component cost data that were obtained from major electronics component distributors. PCB and assembly costs were obtained from US suppliers and proprietary global models.

Impact using data from recent studies:

- Printed circuit board assembly (PCBA) cost is approximately 18% of an electronic company's revenue
- An electronic product designer supports \$10 million in revenue per year and on average develops ten PCBA designs per year.
- An average PCBA requires three iterations and nine months to produce a production ready PCBA design.

One PCBA designer affects approximately \$1.8 million in cost per year. Using the VED tools and services project average savings of 46% or \$830,000. In the above example 54% or \$970,000 in annual savings is projected.

A company with electronics revenues of \$100 million and similar PCBA designs, using VED tools and services would anticipate annual savings of \$9.7 million.

The results of this analysis project significant opportunities for improvement at all levels of product development. Accurately predicting cost and cycle time in all phases of development and product life cycle is necessary, critical, and difficult. The VED tool set enables users to gain a significant competitive advantage by measurement of performance in terms of product cost (\$) and time (days) throughout the product development process including Design Chain/Supply elements.

How It Works Ve-design offers the VED set of decision support tools and associated services that optimize simultaneously in real time, product cost and time-to-market parameters during the product realization process. Coupled with

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web-based visibility to component price and availability data, millions of design alternatives are identified. All the data must be and are considered to achieve optimal performance. Using the VE-design proprietary patented processes, each alternative is evaluated to determine product cost, material lead times, and manufacturing interval anticipated. The tools select the optimal alternatives that can provide differential advantage by achieving Six Sigma levels in cost and time performance. In actual client applications, the VED tools and services have demonstrated the ability to reduce product cost 54% while reducing cycle time 67% when compared to selections made in the conventional design process.

Even though originally developed to assist designers and manufacturing engineers in the product development process, the VED Analysis and Optimization tools and services are of benefit to individuals performing the following functions:

- **Management:** Verification tool confirms that the Project Team has selected the best design options. It also provides a tool for measuring improvements in the product development process.
- **Product Development:** The development of a Product Roadmap frames the cost and time interval boundaries when planning the expansion of a product portfolio
- **Design:** The intelligent design tool provides real time selection of best cost, time interval and alternatives.
- **Purchasing:** The tool provides baseline market conditions verifies supplier pricing in quotes and establishes market based prices for use in supplier negotiations
- **Manufacturing:** The tool provides process capability reference framework for driving continuous improvement to achieve lowest cost and shortest interval operation
- **Project Management** is provided with a change management tool and ability to identify alternatives to keep project cost and schedule on plan

Project Management Benefits The VED Analysis and Optimization tools and services provide benefits throughout all phases of the Product Realization Process by:

- Determining “best performance” cost and time interval targets at the Six Sigma (3.4 per million) or better level
- Assessing the cost and anticipated time interval of a product introduction at any stage of development
- Determining the projected actual cost and time interval for a given product design
- Measuring performance and effectiveness of the individual groups involved in product development activities in terms of cost and time.
- Measuring performance and effectiveness of the overall product development activity in terms of cost and time.
- Measuring performance relative to cost and time interval goals again at the Six Sigma (3.4 per million) or better level
- Identifying bottlenecks in a given product development plan

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Tool-Set Use How each of the VED clients (management, product development, design, purchasing, and manufacturing staffs) would use the VED is described individually. There is cooperative optimization because each client can use the tools to plan, measure and/or improve their own operation as well as demonstrate their performance in terms of an optimal target. The view and benefits depend upon who drives the issues while the company as a whole benefits from the optimized resultant product.

Management would use the tool to determine budget and project schedule from the business case developed for the project. To achieve the rate-of-return expected in the business case, product must hit the cost and time-to-market targets. Management would use results from the VDE analysis to determine if these targets are achievable or, if not, what alternatives are available to meet the expectations of the business case.

Product Development would use the tool for establishing and maintaining a Product Portfolio Roadmap, and a plan for continuously introducing new products or features. Results from the VED tool-set analysis provides insight into the commercial availability of emerging technologies or advanced manufacturing capabilities that will define product time-slots on the roadmap. The cost analysis provides insight into product architecture changes necessary to achieve target cost.

Design Management or Project Management would use the tool for maintaining the project on schedule and within budget. VED tool-set would be used to evaluate alternatives when unacceptable component lead-times delay product introduction or assess alternative manufacturing sites should leading-edge designs expand beyond the capabilities of previously selected manufacturing partners.

Designers: VDE tool-set serves as a supplement to CAD tools that provides selection of best design alternative from a vast number of design options

Purchasing would use the VDE tool-set to help document the market-based prices for materials or services procured to support the product introduction. It is an important source of information that supports contract negotiation with suppliers.

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