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Whirlpool Corporation has successfully utilized Boothroyd Dewhurst DFMA® software in various methods across functions for the past five years. This paper shows how the DFMA® tool was used by new business team to determine the validity of transferring commercially sourced products to products manufactured and assembled internally.

DFMA® Methodology,

Support for a Winning Whirlpool Business Case

Whirlpool Corporation

Whirlpool Corporation has grown from its origins as a Midwestern U.S. company to the major appliance industry's global leader. Today the company leads the $120 billion global home appliance industry with 2012 sales of more than $18 billion. Its products are sold in more than 130 countries around the world.

Founded on November 11, 1911, in Benton Harbor, Michigan, Whirlpool Corporation's time and labor-savings innovations have transformed home and family life during the last century. Driven by the belief that everyone needs a comfortable place to call home, the company is focused on improving lives one home, one family at a time.

This foundation sets the stage for the company's next century. Its employees are passionate about creating products that provide real, sustainable value to consumers.

Introduction

The new business team at Whirlpool, familiar with the Boothroyd and Dewhurst software capabilities, sought out the Design for Value team to facilitate a DFA workshop. The goal of the new business team was to present a successful business case showing the advantage of transitioning externally sourced product to internally manufactured and assembled product. The goal of the workshop was to produce product costs, generated by DFA® software, to justify this transition. The target cost for each product was 15% below current Purchase Order pricing.

This paper addresses the Boothroyd Dewhurst Design for Assembly® methodology as used to capture, organize and evaluate a baseline structure for assembly and subsequently improvement alternatives resulting in increased value to our consumers. Contained in this paper are the outputs and results for the High Volume Baseline product which had the biggest impact on the business case and the high level results for all four product lines.

Scope

The scope of the workshop and follow up work was to build DFA® product structures for four products including all fabricated and purchased components as well as packaging. Each product structure would provide a cost rollup. Product structures were built utilizing current manufacturing and process

capabilities with relatively minor capital investments. An additional output would be redesign of products and processes based on suggestions for redesign from the DFA® software.

The Workshop

A cross-functional team was assembled for this workshop which was facilitated, at the proposed manufacturing facility, to tear down the products in scope and build the DFA® baseline structure in real time. This cross-functional team included business leads, lead product engineers, engineering managers, packaging engineers, procurement representatives as well as manufacturing and process engineers.

The DFA® software provided the team a structured approached to capturing all components and processes for an assembly with a relatively unknown value stream. Beginning with a packaged unit in the form the end user would receive upon purchase, the tear down of the high volume baseline model was performed in reverse order. Each component was measured, photographed and recorded in the software. As each component was recorded its value was discussed and a determination was made if there was an opportunity for elimination or reduction in cost. These were captured in the Notes section in the software.

The High Volume Baseline model was completed in four hours. The final number of components was 72, with a final product cost of 24% under the current purchase order price and 11% under the target cost for the business case. This procedure was completed for three different units over the course of a one day workshop.

The Analysis

The Product Worksheet was exported for cost analysis. Each line item created in DFA was labeled with a module name and module costs were evaluated based on the consumer's value of the module and the cost of that module per Figure 1 below.

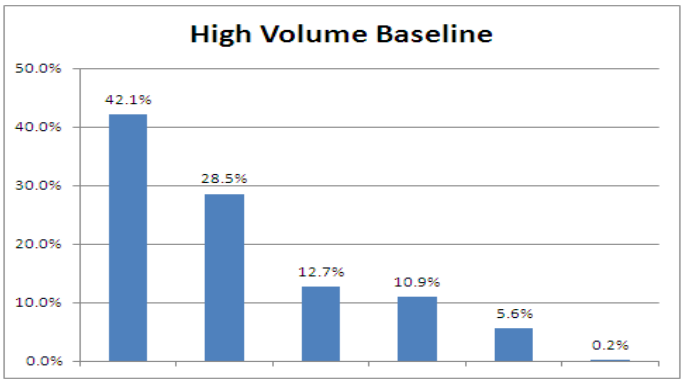


Figure 1

Each cost in the Product Worksheet was labeled with a maturity level, Make (M), for an internal cost, Estimate (E), as estimated by engineering, Quote (Q) and PO, purchase order per Figure 2 below. This cost maturity analysis allowed the business team to determine the level of risk involved in using the cost rollup in the final business case.

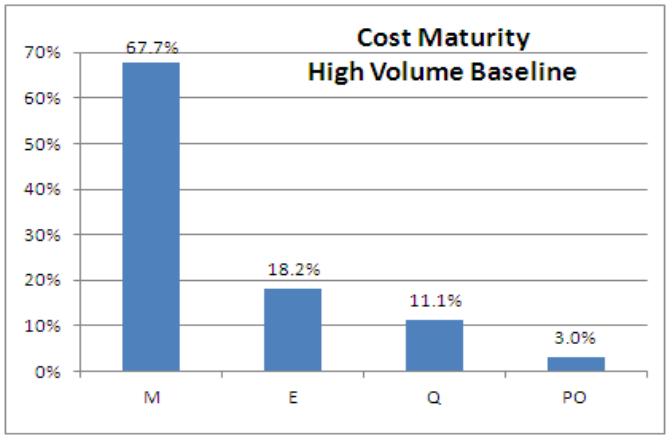
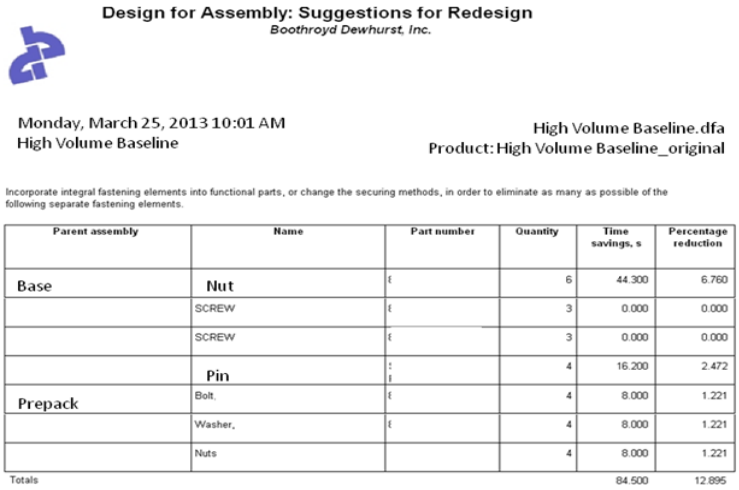


Figure 2

Next Steps

To further enhance the business case, an improvement plan was put together post-workshop to show the impact further DFA enhancements could render. The DFA software was utilized to show the opportunities for elimination on non-essential components, such as fasteners and connectors per Figure 3 below. Fasteners used as temporary supports, to be thrown away by the consumer, (See Part Name, Pin in Figure 3 below) were recommended for elimination. These fasteners had no value to the end user and redesign of the components needing the support was suggested to incorporate this function. This resulted in the elimination of 4 parts. Similarly, a mounting component (not referenced in

Figure) and its corresponding hardware, see Parent Assembly, Prepack in Figure 3 below, were suggested for elimination and redesign of the features into the mating structures. This redesign alone would result in the elimination of 13 parts, 12 of the 13 parts included the bolts, washers and nuts and one mounting component.



Design for Assembly: Suggestions for Redesign
Boothroyd Dewhurst, Inc.

Monday, March 25, 2013 10:01 AM
High Volume Baseline

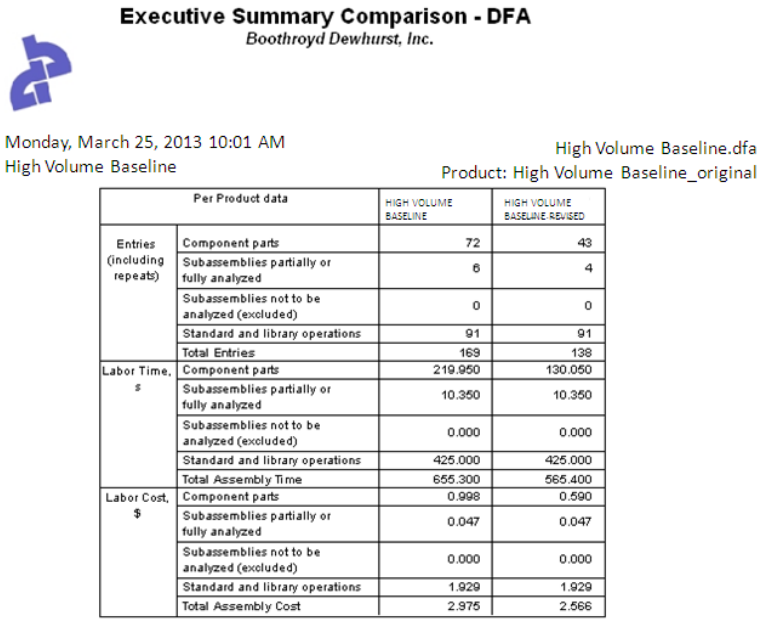
High Volume Baseline.dfa
Product: High Volume Baseline_original

Incorporate integral fastening elements into functional parts, or change the securing methods, in order to eliminate as many as possible of the following separate fastening elements.

Parent assembly	Name	Part number	Quantity	Time savings, s	Percentage reduction
Base	Nut		6	44.300	6.760
	SCREW		3	0.000	0.000
	SCREW		3	0.000	0.000
	Pin		4	16.200	2.472
Prepack	Bolt,		4	8.000	1.221
	Washer,		4	8.000	1.221
	Nuts		4	8.000	1.221
Totals				84.500	12.895

Figure 3

The overall suggestions for redesign of the High Volume Baseline resulted in a 5% savings opportunity in material and labor cost over the product roll up cost generated. The total number of entries was reduced by 31. This proposition would eliminate 29 components from the baseline model, see Figure 4 below.



Executive Summary Comparison - DFA
Boothroyd Dewhurst, Inc.

Monday, March 25, 2013 10:01 AM
High Volume Baseline

High Volume Baseline.dfa
Product: High Volume Baseline_original

Per Product data		HIGH VOLUME BASELINE	HIGH VOLUME BASELINE REVISED
Entries (including repeats)	Component parts	72	43
	Subassemblies partially or fully analyzed	6	4
	Subassemblies not to be analyzed (excluded)	0	0
	Standard and library operations	91	91
	Total Entries	169	138
Labor Time, s	Component parts	219.950	130.050
	Subassemblies partially or fully analyzed	10.350	10.350
	Subassemblies not to be analyzed (excluded)	0.000	0.000
	Standard and library operations	425.000	425.000
	Total Assembly Time	655.300	565.400
Labor Cost, $	Component parts	0.998	0.590
	Subassemblies partially or fully analyzed	0.047	0.047
	Subassemblies not to be analyzed (excluded)	0.000	0.000
	Standard and library operations	1.929	1.929
	Total Assembly Cost	2.975	2.566

Figure 4

Conclusion

The Design for Assembly software made it possible to develop a representative model of the components, as well as manufacturing and assembly processes including tooling. Additionally, sub-assembly and final assembly labor outputs in an easy and efficient manner gave the business team feedback needed to build the business case. In each of the four product lines evaluated, the cost rollup exceeded the target cost on baseline costing alone. Proposed Design for Assembly improvement plans generated an additional 5-15% savings (per product line) opportunity for the project.

Not to be overlooked, an added benefit of this structured process is that it provided clarity to the Bill of Materials. Using a methodical teardown evaluation and recording each step in the DFA® software, confirmed or updated components, quantities, measurements and materials to current state.

Without the use of the software and methodology, the schedule would have been longer, the resources greater, the risk higher and savings opportunities smaller. In conclusion, the information achieved through utilization of DFA® software is credited as a fundamental part of the success of the business case.