



Case Story

The Company

Whirlpool Corporation is the world's leading manufacturer and marketer of major home appliances, with annual sales of more than \$19 billion (USD), more than 73,000 employees and 72 manufacturing and technology research centers around the world.

The Competition

Whirlpool is the leader in the appliance industry, but competitors include Sweden-based Electrolux, US-based GE Consumer & Industrial and LG Electronics based in South Korea.

The Products

Whirlpool offers appliances for the laundry room—such as washing machines and dryers, for the whole home—such as air conditioners and water purifiers, and for the kitchen—such as ovens, dishwashers and microwave ovens.



Figure 1: Whirlpool® microwave oven

Countertop Microwave Ovens (MWOs):

- are global, high-volume products
- are highly standardized with zero or very little configuration
- are extremely material cost-sensitive because of fierce competition
- model lines have a lifetime of one to two years

The Challenge

New Requirements-New Type of Product

Compared with countertop MWOs (outlined above), a built-in MWO presents several new design challenges—among these, cooling. Countertop MWOs have a free supply of air all around, but a built-in needs air circulated with the aid of a fan. A traditional countertop MWO uses microwave power and, in some cases, an extra grill element. The new built-in MWO platform was designed to offer two new cooking modes; forced convection and crisp.

Additionally, the requirement was to reduce costs by 60%.

Reducing Volumes while Increasing Variance

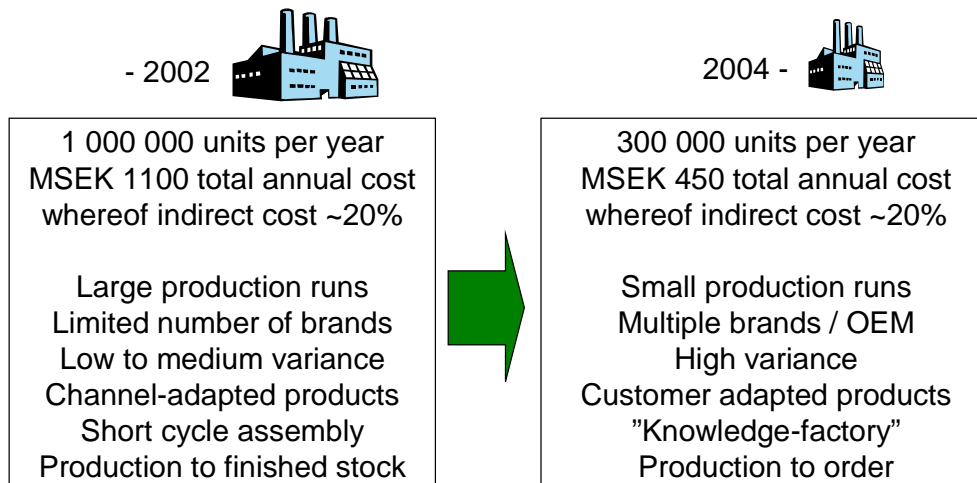


Figure 2 – The challenge

How Modular Management Helped Conducting a ValueMap™ Study

To determine where the manufacturing facility needed to make its reductions, Modular Management's ValueMap™ method and tools were used. A team interviewed representatives of all cost centers in the factory and its Research and Development facility.

Opera Project Plan

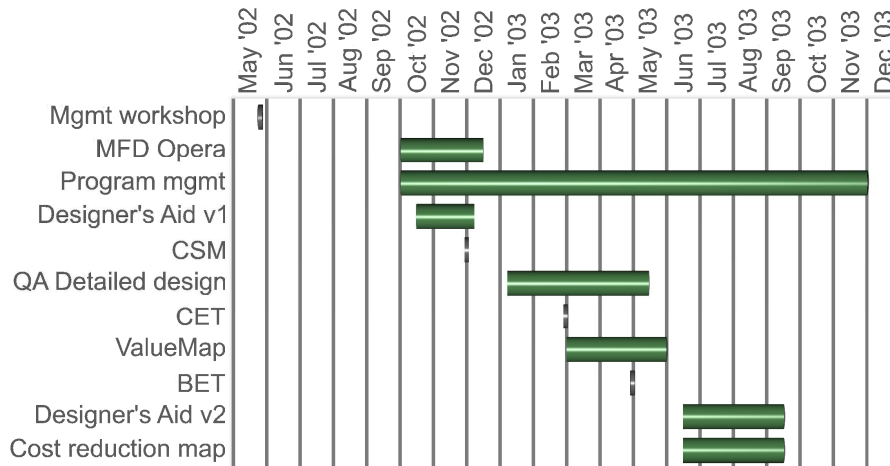


Figure 3 - Gantt-chart of Opera project, with key milestones and “tollgates”

Modularity in a platform project

At the core of Modular Management’s method is the MFD™ (Modular Function Deployment) process. The five major steps of the process are shown below:

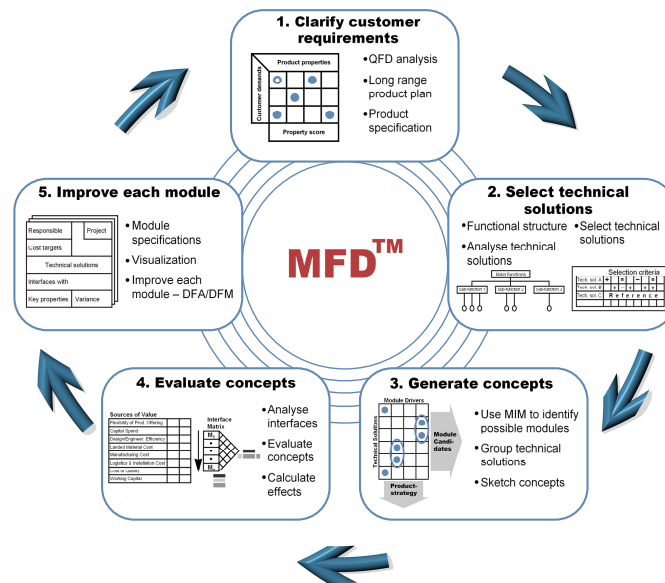


Figure 4 – The five step Modular Function Deployment method

A module specification captures key data about the module and its variant. The Opera team produced 40 module specifications, one for each module. The module specifications listed the following key points:

- Name of module
- Responsible for requirements
- Responsible for execution
- Main function
- Included technical solutions
- Module drivers (e.g. strategic justification)
- Key properties and associated target values
- Development plans, if any
- Main interfaces to other modules
- List of module variants
- Target cost by module variant
- Sketch
- Revision history

Concept Selections

During the course of the Opera project, the team was confronted with a number of important concept selections. A concept selection not only considers customer value and material cost, it also considers complexity—as illustrated below. Note the total cost optimum is where the sum of direct material cost and complexity cost has its minimum.

Complexity vs Material Cost—the tradeoff

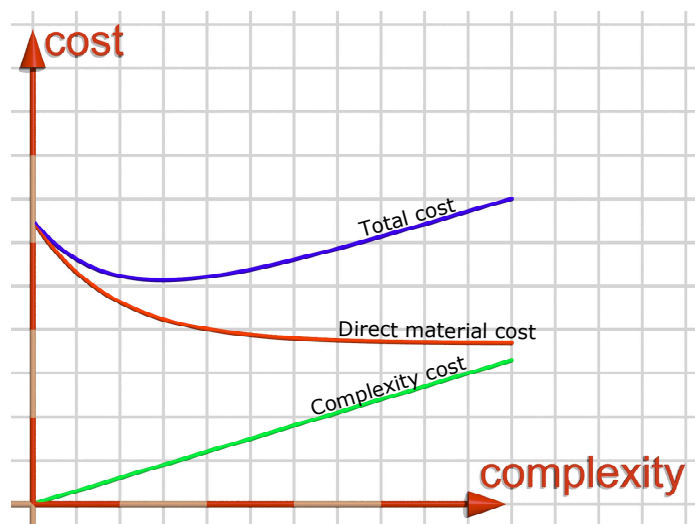


Figure 6- Material cost vs complexity

Results

As the Opera project is ongoing, Whirlpool has not yet publicly released the results.

Modularity in Action

Flexible Control Panel

Variations in styling was a very clear goal in the Opera project. The platform needed to handle a huge variation and impose as few constraints as possible.

In a traditional MWO, knobs and buttons are placed directly on the Printed Circuit Board (PCB) in one of a number of reserved positions. If a knob needs to be in an unanticipated location, a completely new PCB must be created. Additionally, each unique configuration requires a unique panel with a specific set of holes. Each of these panels requires a unique tool. Therefore, the traditional design has very limited flexibility due to:

- Each knob/display configuration requires a unique panel
- Knobs, buttons and displays can only be placed in predefined locations as relocating will require a new PCB

In the Opera project, a modular approach was taken. First, panels had pre-defined surfaces so knobs could be placed in any location. Making these holes did not require tools, but were drilled with a laser to produce smooth edges. Second, buttons and knobs were placed directly in the PCBs so all buttons, displays and knobs could communicate with the PCB via a standardized interface—a cable with a connector. All mechanical knobs were replaced with electronic knobs. This improved their lifetime and addressed known quality issues. Because of increased purchasing volumes, the price of electronic knobs was reduced to that close to the old mechanical knobs.

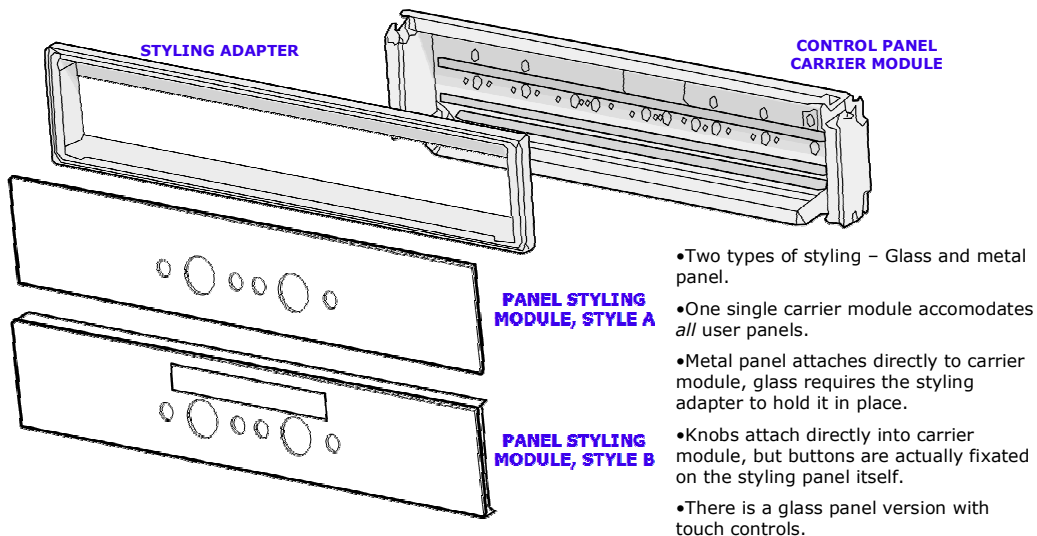


Figure 7- Control Panel carrier module enables free knob placement

As a result, the Opera team designed several panel styles, as illustrated below.



Figure 8- Several early renderings of panel styles

The illustration below shows just a small selection of European Opera variants. There are approximately 200 active Opera variants.



Figure 9- Sample of Opera SKUs

Why Whirlpool Corporation's Opera Project was so successful

- Built-in MWOs lend themselves to modularity better than countertop MWOs. On a countertop MWO, the entire product is exposed to the consumer. On a built-in MWO, the consumer only sees the door and control panel.
- “It is clear we could not have reached the results we achieved without Modular Management,” said Jorma Mäkilä, Whirlpool employee and owner of the Opera platform. “I believe we saved a full year of development time and we launched the first Opera products well ahead of schedule. The key consultant from Modular Management held weekly Quality Assurance meetings with all design engineers to make sure nobody took off on their own track or broke any interfaces. The truth is, his work was extremely important in the project.”
- “The mindset of modularity allows us to predict the impact of any request for change much more quickly than before. This saves time and energy. In our old, non-modular designs, when someone asked us for a styling or performance change, we had to review the entire design. Now we can easily see which modules are impacted and provide a response much more quickly than before,” Mäkilä said.
- “The Opera product was divided into 40 modules which allowed for concurrent engineering,” said Mäkilä.
- Mäkilä also said modularity allowed the team to work with drawings and Bills of Materials more efficiently than before.

Expected Lifetime of the Opera Product Line

“When I retire, I expect I will still be working with Opera products,” said Conny Gustafsson, Whirlpool employee and Opera product architecture specialist. “The Opera platform will be different than it was in 2003, it’s like our body—the cells are replaced gradually. We don’t have to throw the platform out and start from scratch like we had to do with countertop platforms. A countertop model would have a lifetime of one to two years. Opera evolves.”

About Modular Management

Modular Management (MM) is based in Sweden with U.S. headquarters in Bloomington, Minnesota. MM helps companies define, create and implement modular platforms.

Modular Management has developed its own complete methodology to define modular product structures, called *Modular Function Deployment*, or MFD™. MFD™ is supported by software for creating and maintaining modularised product platforms and financial tools for calculating complexity costs and estimating modularisation potential. The company was formed in 1995 and today works with some of the largest international companies, in industries ranging from manufacturing to services.

For more information, please contact us at the address below or visit us at www.modular.se.

Acknowledgements

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