

# Transforming the Laundry Process

BY PAM NYBERG & JOY KEMPIC

Thoughtful user-centered design produced a resource-efficient, easy-to-use front-loading washer and dryer with passionate customer advocates and marketplace success.

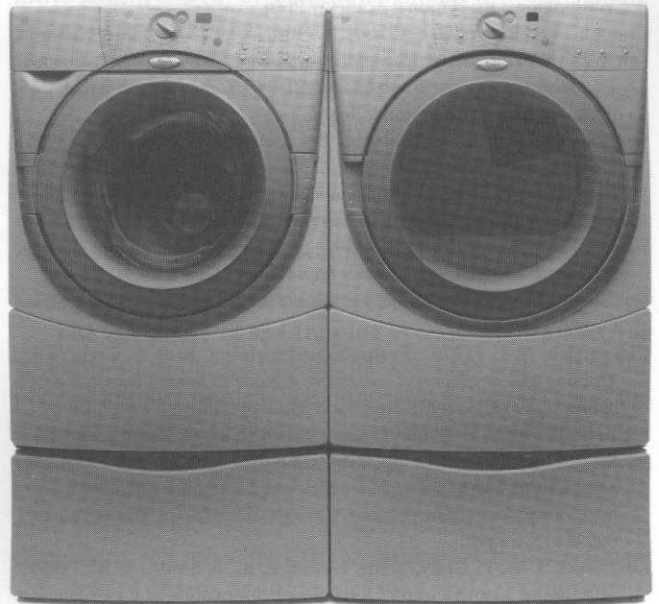
*The products featured in this article won the 2004 HFES Product Design Technical Group's User-Centered Consumer Product Design Award. Each year, we invite the developer of the winning product to submit a brief article describing the work that contributed to the product's success. As with all submissions to Ergonomics in Design, these articles undergo full peer review.*  
— Editor

**I**MAGINE THAT YOU'VE JUST BOUGHT A NEW WASHER AND DRYER. While using them, you're overcome with such enthusiasm that you invite the neighbors over to show them your new purchases. During their visit, you proclaim that you *love* doing laundry now, and you describe these appliances as your "little mechanical buddies" or members of your family. To properly complement your new washer and dryer, you redesign your laundry area so the appliances become focal points in the room. And you confess to others that your new laundry pair makes you feel happy, like a better person, less stressed, prouder of your children, loved and appreciated, and accomplished.

This scenario sounds extremely unlikely, especially given the seemingly mundane source of your excitement. But feelings and experiences like these have been shared by a surprising number of people who purchased the Whirlpool® Duet® Fabric Care System, a front-loading washer and dryer with optional pedestals and user-friendly electronic controls.

In addition to creating a passionate user base, this laundry pair has generated sales far in excess of Whirlpool's expectations, and it is being used as an internal corporate benchmark. The Duet® Fabric Care System has also transformed the front-loading washer industry and has won numerous design and engineering awards.

This article chronicles the Duet® Fabric Care System's user-centered design development, the ensuing results, and keys to this project's ultimate success.



Duet® Fabric Care System.

## Project Background

Europeans have been doing laundry in front-loading washers for decades, but until recently, use of these appliances in the United States was limited to laundromats. By 1999, Maytag and Frigidaire were selling their versions of these washing machines in stores, effectively marketing the water- and energy-saving advantages provided by this style of washer. Home use of front-loading washing machines began to grow in the United States.

Because Whirlpool Europe already manufactured front-loading washers, Whirlpool U.S.A. decided to leverage this knowledge and develop a front-loading washing machine designed primarily for the North American market. A multinational project team was assembled that included representatives from marketing, design, user experience, and engineering.

At the time, most competitive front-loading washers and dryers weren't designed with physical ergonomics or differentiated design in mind. Having identified those two areas as opportunity gaps, the team strove to develop a visually compelling, user-friendly front-loading washer with best-in-class cleaning performance and a matching dryer. Because of the technology involved and the user benefits to be incorporated, the appliance and its matching dryer counterpart were to be positioned at the high end of the market.

Even though Whirlpool Europe had experience manufacturing this style of washer, the U.S. project team still faced some daunting challenges:

1. It had been roughly 40 years since we'd produced a front-loading washer for the U.S. market, so we had little existing knowledge of North American user and buyer requirements for this configuration.
2. We were charged with meeting an aggressive two-year development time frame. This was further complicated by the fact that our core team members were located in different countries (the United States, Germany, and Italy).
3. Because of manufacturing optimization, we would be manufacturing the washer in Germany while building the dryer in the United States. By producing these matching appliances on different continents, minor issues like matching colors and aligning engineering approaches became more difficult.

### User Group Characteristics

To focus our initial research efforts and to identify user issues that could be addressed with a front-loading washer platform and related wash technology, we referenced a piece of research previously conducted by Whirlpool called the "Laundry Quantitative Habits and Practices Study." This research was conducted several years prior to the project and was instrumental in shaping our initial list of user group needs and characteristics. The list of user needs and characteristics included the following:

- need to clean large loads of laundry
- are resource conscious
- are time starved and want a time-efficient laundry process
- are concerned about fabric care
- strive to clean delicate materials at home
- want to clean bulky items at home rather than going to a laundromat
- want/need ergonomically friendly appliances that are easy to use
- value distinctive, aesthetically appealing appliances.

The photo below illustrates a typical posture that users adopt when doing laundry. Given these extreme postures,



*Typical posture when doing laundry.*

one of our primary areas of focus for this project was to make the laundry process more ergonomically friendly.

### Development Process: In-Context Observational Research and User Interviews

Before beginning significant design activities, we needed to bridge our user-related knowledge gap and develop a common understanding of the U.S. front-loading washer market. To address these issues, we conducted in-context observational research and user interviews with current front-loading washer owners. We also visited retail environments and laundromats for additional inspiration.

Six U.S. cities were selected for research visits because of residents' varying perspectives on environmental conservation. Owners of Maytag and Frigidaire front-loading washers were specifically recruited for participation.

**At the time, most competitive front-loading washers and dryers weren't designed with physical ergonomics or differentiated design in mind.**

All team members were actively involved in the contextual research, which ensured a shared appreciation for user behaviors and priorities. We divided the team into two- to three-member groups for visits to each designated region. Because only one representative from the User Experience group was assigned to the project, we trained inexperienced team members in proper interviewing and note-taking techniques. As a group, we also assembled a comprehensive list of issues to investigate. By involving the entire team in the development of the discussion guide, we were confident that all relevant questions would be covered.

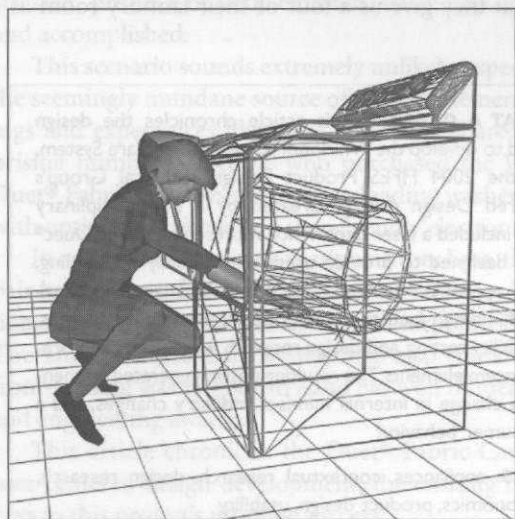
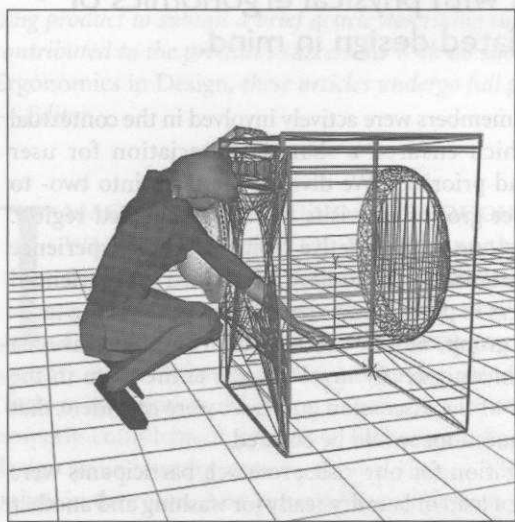
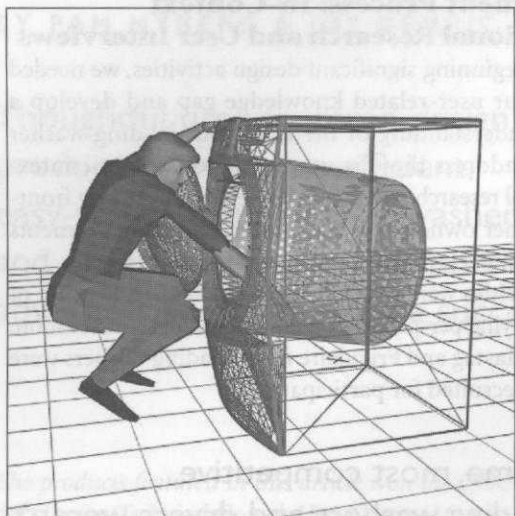
In preparation for our visits, research participants were asked to have a load of laundry ready for washing and another load waiting to be transferred to the dryer. Upon arrival, we requested that they give us a tour of their laundry room as

**FEATURE AT A GLANCE:** This article chronicles the design process used to develop the Whirlpool® Duet® Fabric Care System, winner of the 2004 HFES Product Design Technical Group's User-Centered Design Award. Created by a multidisciplinary team, which included a User Experience representative, the Duet® system was designed to provide users with visually compelling, user-friendly appliances with best-in-class performance. Contextual research, human factors evaluations, biomechanical analysis, iterative usability testing, and design research were used to inform and refine system elements. The resulting design generated tremendous sales, a change in internal mindset, industry changes, and a shift in consumer behavior.

**KEYWORDS:** appliances, contextual research, design research, physical ergonomics, product design, usability



Postures used to retrieve clothes from the Whirlpool washer (top) and two other front-loading washers using the modeling software Jack by UGS.



well as other relevant areas of the home. During the tour, they were asked to illustrate their laundry process in detail.

Following each user session, the research teams debriefed with each other, recording their findings on sticky notes for data synthesis purposes.

### Data Analysis and Synthesis

After conducting the user research sessions, we regrouped as a team, shared interview highlights, and posted our sticky note findings on the conference room walls. Then, using a technique called *affinity diagramming*, we silently sorted the sticky note insights into categories based on their similarity to one another. (By doing a silent sort, the process is considerably quicker.) After the insights had been grouped, we discussed each item within a category, edited as necessary, and then named each category to further focus its content.

### To establish initial human factors benchmarks, we conducted heuristic evaluations and cognitive walkthroughs of competitors' front-loading washers.

Based on this conversation, we identified user priorities, needs, and key technical issues for further investigation and development. Several unique opportunities included the following:

- optional pedestals with integrated storage, for improved appliance access and conveniently located, out-of-sight laundry product storage.
- oversized washer and dryer door windows to facilitate user understanding of cycle operation. As an additional benefit, some users, their children, and their pets enjoyed watching the appliances operate.

### Ergonomic/Anthropometric Evaluations

Early in this project, we felt that ease of use was a competitive advantage we could own. Because physical ergonomics plays such a critical role in ease of use, whenever possible, we tried to facilitate convenient usage by an especially wide range of people. Anthropometric limitations for individuals ranging from the 5th percentile female to the 95th percentile male were calculated to establish the following:

- overall appliance height – the units were optimized for side-by-side placement as opposed to placing the dryer on top of the washer
- door opening maximum and minimum heights and diameters
- optional pedestal height
- control heights, given the range of reach and visibility limits
- dispenser container height.

Because the pedestal would be optional, we wanted to ensure that our proposed washer design without the pedestal would be at least as ergonomically beneficial as competitors' appliances. To evaluate the Frigidaire, Maytag, and Whirlpool designs, we conducted a biomechanical evaluation using three-dimensional ergonomic modeling software. (See the illustration on page 18 for an example of the results.) Evaluated postures included loading and unloading the washer, reaching into the back corner of the drum for a lingering sock, and setting the controls.

The results revealed that our design did provide ergonomic benefits compared with competitive washers. As one example, user access was improved because of the larger washer door and angled washer drum.

To establish initial human factors benchmarks, we conducted heuristic evaluations and cognitive walkthroughs of competitors' front-loading washers. We also conducted a dispenser evaluation of European front loaders and consolidated previous dispenser research to highlight best-in-class designs and requirements.

### Control Logic and Layout

During development of the Duet® System's control logic, our goal was to ensure that novices and experts could successfully use the appliances without instruction.

When users select a cycle, control defaults are displayed that suggest the most optimal settings for that particular cycle. By providing these defaults, we enable less knowledgeable users to become more educated about appropriate cycle settings, and they can trust that their garments won't be damaged if recommended defaults are accepted.

Those individuals who feel comfortable making adjustments to cycle defaults have the ability to do so, within certain boundaries. We did block several settings, in combination with specific cycles, to prevent users from damaging their items. For example, we don't allow users to select a hot temperature after they've chosen the Wool cycle. (Hot water would most likely ruin the garment.) However, if they do choose to use hot water for their wool load, we force them to select a different cycle, indicating that we don't recommend this treatment for wool.

The control layouts were developed based on our existing laundry user interface strategy. We'd generated this strategy several years prior, after conducting extensive research on users' mental models. Functions are distinguished using size,

location, and color cues. For instance, the CONTROL ON and START buttons are green and PAUSE/CANCEL is red. In addition, we grouped controls based on frequency of use and function. The washer control panel is shown in the photo below.

**To further streamline the laundry process, we developed several washer and dryer cycles that run for similar lengths of time, eliminating the traditional dryer bottleneck.**

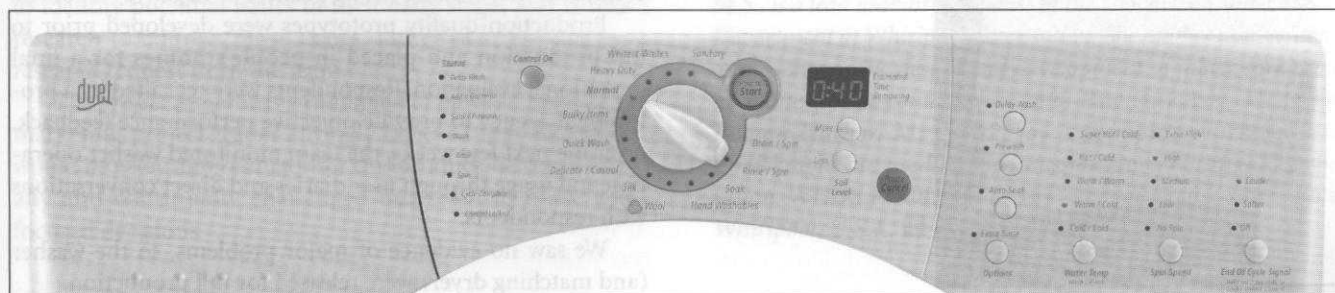
To address people's desire for a more efficient laundry process, we included several time-focused control functions. During operation, the current cycle stage (washing, rinsing, etc.) and remaining cycle time are displayed to provide users with more detailed feedback, letting them know when they should return to the washer or dryer. The ability to start the appliance with two button presses was also viewed as beneficial because many people use the same washer and dryer cycle for all loads.

To further streamline the laundry process, we developed several washer and dryer cycles that run for similar lengths of time, eliminating the traditional dryer bottleneck. Special cycles, such as Wool and Silk, were also included. These cycles give users the ability to clean fragile items at home, saving them money and the travel time necessary to transport those items to and from the dry cleaner.

### Iterative Usability Testing

As part of our product development process, we conducted iterative usability testing on prototypes at necessary junctures in the project. Three usability studies were run in our labs with external participants of varying statures, ages, and levels of laundry experience. We investigated user interaction with all critical aspects of the washer and dryer including the following:

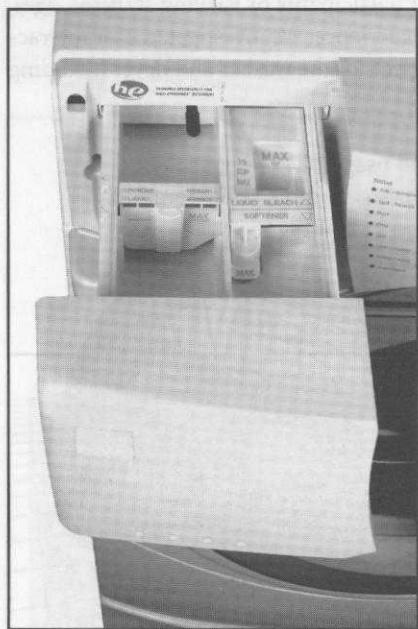
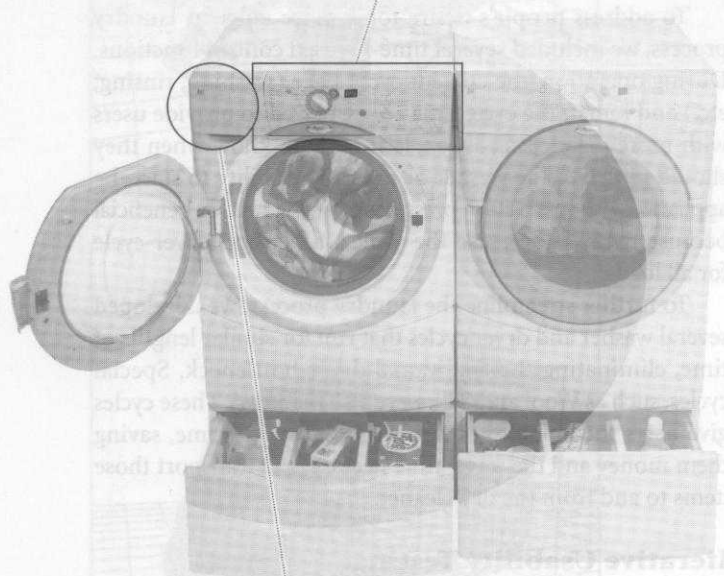
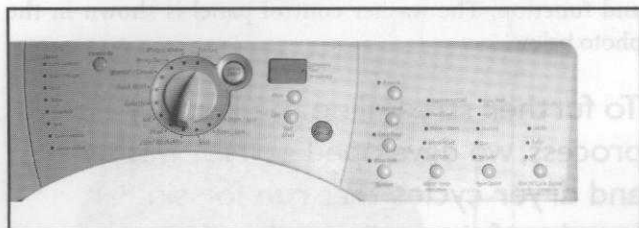
- dispenser access and usage
- control legibility, understanding, and operation
- pedestal drawer access and usage
- door opening/closing
- drum loading/unloading



The washer control panel.



Components investigated during usability testing: control panel (top), dispenser drawer (bottom).



During each study, we conducted in-depth explorations of the controls. In the first session, we used low-fidelity prototypes to generate feedback and insights. Touch-screen computer simulations were tested with users during the second session. For the third study, we used high-fidelity prototypes to delve more deeply into users' desired tactile experience. The photos at left show some of the components that we tested in the usability sessions.

**In addition to creating a passionate user base, this laundry pair has generated sales far in excess of Whirlpool's expectations.**

Even though individuals with disabilities weren't recruited for these studies, we were confident that our design direction would provide a more optimal interaction experience for specific audiences than competitors' models could. Those in wheelchairs as well as those with back problems could more easily access Duet® washer and dryer drums because of the oversized door openings, angled washer drum, and raised drum heights when pedestals were used.

Based on previous internal research conducted with arthritis sufferers and individuals afflicted with decreased hand strength, we knew that these audiences could more easily operate electronic controls, in contrast to the electromechanical controls provided on competitive appliances, because of the reduced forces required for control activation.

### Quantitative Design Research

While we addressed user interaction and engineering issues, the designers created several potential aesthetic looks for the laundry pair. These different executions were then evaluated in a quantitative design research study to determine the appropriate appearance for the Duet® Fabric Care System. The study was conducted in one Midwest and one West Coast city by an independent research firm. These researchers showed prospective customers our proposed design mock-ups and had respondents compare them with competitors' front-loading washers.

Our intentions with this research were to learn (a) which, if any, of our concepts, was more appealing than those of competitors; (b) which model best reflected the Whirlpool brand attributes; and (c) which design pushed target consumers' comfort zones, evoking strong positive or negative responses.

Production-quality prototypes were developed prior to full production and placed in people's homes for a final operational evaluation. Respondents were recruited by a professional agency to provide objective performance feedback. Over the next few weeks, the team monitored washer operation and usage through user diaries and direct conversations with respondents.

We saw no evidence of major problems, so the washer (and matching dryer) were released for full production.

## Impact Within and Outside Whirlpool Corporation

Because of the popularity of the products, Whirlpool initially struggled to meet demand. Five years after the laundry pair was released to market, it's been selling far beyond projections and has helped make Whirlpool the world's leading manufacturer of front-loading washers.

Surprisingly, the Duet® system has also motivated a change in traditional washer/dryer purchase behavior. Typically, people replace an appliance when it stops functioning. However, in this case, buyers have been replacing their washer and dryer at the same time.

Internally, the Duet® Fabric Care System is viewed as a corporate benchmark because of its level of innovation and performance within an aggressive time frame, its financial returns, and its ability to emotionally engage purchasers, motivating them to become vocal advocates for the laundry pair. The project has also demonstrated to the company that innovative engineering and user-centered design are necessary to develop a great product. In addition, the Duet® pair has raised the perceived importance and impact of design within the organization.

After the Duet® system had been in stores for some time, various competitors started introducing stands that raised their front-loading laundry pairs off the floor. Apparently, our optional pedestal had alerted them to users' need for improved access to front-loading appliances. As such, we accept some credit for initiating a positive shift in the industry, to users' benefit.

### Keys to Project Success

The following elements proved to be the most important contributors to this project's success:

*The entire team was involved in structuring, conducting, and analyzing the contextual research.* Actively participating together in the research gave our team a shared perspective. This unified view resulted in a high level of team member agreement when facing decisions about project direction and areas of focus.

*A User Experience representative was included on the core team.* Participating in core team meetings helped us anticipate when research would be needed. With this knowledge, we could plan studies so they wouldn't delay team progress. Research was conducted on a just-in-time basis, and results were provided in a timely fashion. In addition, we were able to identify potential issues in their early stages and conduct research to address those issues, rather than waiting for a research request from the team.

*The project leader was a champion of the user.* Because the marketing project leader strongly believed that ease of use would be a key differentiator for this product, he was a strong ally and continually challenged our team to make user-focused decisions.

*Frequent communication and colocation were encouraged.* Because core team members resided on different continents, good communication was critical to project success. Project team teleconferences were held weekly, sidebar teleconferences were conducted as needed, and face-to-face meetings were held at critical junctures. When individuals were working closely on particular tasks, they were colocated for the sake of efficiency.


*The team made timely, fact-based decisions.* Rather than relying on people's opinions for direction, we required team members to support their approaches with facts or proof of past experience.

*No corners were cut, despite our aggressive schedule.* Despite our short development time frame, we refused to bypass important steps in the process. Past experience demonstrated that skipping steps could result in increasingly more complex or more costly problems later in the process. We were thankful that the team was aligned with this philosophy.

The Duet® Fabric Care System has enjoyed wide recognition, including the following:

- 2004 HFES User-Centered Product Design Award
- 2004, 2003, 2002 *Consumer Reports* rated performance as Exceptional
- 2003 IDEA (Business Week) Gold Award Winner
- 2003 I.D. Magazine Design Distinction Award (Consumer Products Category)
- 2002 Appliance Manufacturer Excellence in Design Award (Best Overall, Majors Category Winner)
- 2002 *Popular Mechanics* Design and Engineering Award
- Write-ups in *The Wall St. Journal*, *Harvard Business Review*, *The New York Times*, and *Fast Company*.

As human factors/ergonomics professionals, we were exceptionally fortunate to work on the Duet® Fabric Care System project. Not only did it exceed our team's greatest expectations, but it also positively influenced Whirlpool, the appliance industry, and the lives of owners.

*Pam Nyberg, M.S., is a physical ergonomist and educator with a passion for design and user research. She's been applying user-centered design practices for more than 13 years on consumer products, consumer electronics, industrial equipment, strategies, and packaging and will complete a master of design degree at IIT's Institute of Design in December. Joy Kempic, M.S., is a lead usability specialist in the Global Consumer Design Department at Whirlpool Corporation. She applies user-centered approaches to the design and development of fabric care products. She can be contacted at 1800 Paw Paw Ave., MD 6008, Benton Harbor, MI 49022, joy\_k\_kempic@whirlpool.com. Photographs are used with permission from Whirlpool Corporation. WHIRLPOOL and DUET are registered trademarks of Whirlpool, U.S.A. *