

Power to the people:

making DIY tools easier for all



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inclusive design~
providing tools for
the design community
to address the needs of
the whole population

i~design case studies

This is one of a series of inclusive design case studies published as part of the i~design research programme. These case studies document inclusive design collaborations between the Helen Hamlyn Centre (HHC) and industry and voluntary sector partners, under the Helen Hamlyn Research Associates programme. They also document the results of the DBA 'Inclusive Design Challenge', a design competition co-ordinated by the Helen Hamlyn Centre and the Design Business Association (DBA).

i~design is a multi-centre collaborative research programme funded by the Engineering and Physical Sciences Research Council (EPSRC). The purpose is to foster the adoption of inclusive design by business decision makers and professional designers, in particular by presenting the business case, developing tools and techniques, and building a network of researchers around the projects.

i~design partners

- **The Royal College of Art Helen Hamlyn Centre**, is a centre for inclusive design, with extensive contacts in industry and the design professions.
- **The Engineering Design Centre** at the University of Cambridge has a strong reputation in the improvement of design process and development of design methodologies to address specific issues.
- **Applied Computing** at the University of Dundee develops information technology systems to support older and disabled people.
- **The HCI Group** at the University of York has a long history of inter-disciplinary research in the area of user centred design arising from collaboration between the departments of Psychology and Computer Science.
- **The Design Council** inspires and enables the basic use of design by business, education and government to improve prosperity and well-being.

Power to the people:

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Abstract

DIY is a popular activity among those of retirement age, but domestic power tools are designed without taking into account the physical impairments resulting from the ageing process. Through a close partnership with the UK's largest home improvement retailer B&Q and a user-centred research centre, the Helen Hamlyn Centre (HHC), the design consultant Matthew White was able to develop a series of easy-to-use DIY power tools. With intensive input from older users, four new or improved power tools were developed. The prototypes received positive feedback from both users and the industry partner. The cordless screwdriver and the palm-sized sander – two of the new designs – were taken to market. This case study demonstrates that retailers can drive consumer product development from within and a study of older users can help generate viable inclusive solutions.

Keywords

Do It Yourself (DIY), older consumers, power tools, inclusive design, user-centred design, retailers, user testing

Project period

October 2000 - October 2001

Overview

Research undertaken at the Henley Centre for Forecasting indicates that older people (age 50-70) are enjoying a combination of rising income and more free time (Figure 1). Understanding how they fill this time is an important indicator of new market opportunity. DIY is among the top ten leisure activities for the post retirement sector but this activity tends to decline with age (Table 1). A special analysis of data from the Centre's Leisure Tracking Survey 1996, segmenting the 50-75 population into five-year age band groups, revealed significant trends across the 50+ population and in particular in comparison with the under 50s. According to White [1], contributing factors include the physical demands of DIY tools and the increasing impairments related to the ageing process. *Which*, a magazine [2] offering impartial advice and information on mainstream

consumer products and services, also reported problems regarding the ease of use of DIY power-tools from jigsaws to cordless screwdrivers.

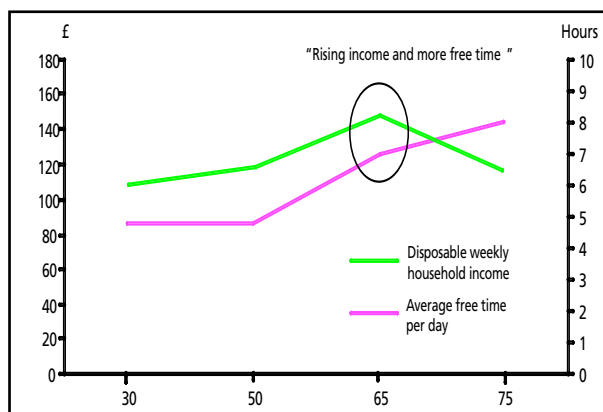


Figure 1. Disposable weekly household income, average daily free time by age (source: Henley Centre for Forecasting's Leisure Tracking Survey, Family Expenditure Survey)

Age group	Under 50	50-54	55-59	60-64	65-69	70-74	75+
Order of DIY among top leisure activities	7th	5th	6th	7th	8th	8th	9th

Table 1. DIY as a popular leisure activity for older people in the UK (source: Henley Centre for Forecasting's Leisure Tracking Survey 1996)

Good practice case studies in tool design were identified, from Swedish design consultancy Ergonomi, in the form of extensive user research leading to new designs for cutlery, and hand tools, in particular for Sandvik [3]; and Helen Hamlyn Research Associate Bryn Griffiths's study of product features and forms that aid older users in understanding and operating domestic equipment such as vacuum cleaners [4]. However, an audit of currently available power tools that are essential to many basic home improvement tasks, revealed that these were overwhelmingly designed for physically strong users, with no attention paid to the growing market of older people.

B&Q, Europe's largest home improvement retailer, planned to develop own brand age-friendly power tools, as an extension of its diversity programme into new product development. Previously the company had focused on making its stores accessible to disabled and older customers and on employing older workers. It had never used design at a strategic level, preferring to buy in products from Asian manufacturers and sell on price advantage. This new development was realised through participation as an industry partner in the HHRC Research Associate Programme. Matthew White, a graduate of the MA course in Industrial Design Engineering of the Royal College of Art became a Research Associate of the HHRC, and a steering group was established, comprising a senior buyer and Marketing Depart-

ment personnel from B&Q, along with a professor of inclusive design from the HHRC.

As is customary in the HHRC Research Associates Programme, the one-year project was divided into four stages:

Stage 1: Explore (October-December)

Stage 2: Focus (January- March)

Stage 3: Develop (April-June)

Stage 4: Deliver (July-September)

Methods

During the 'explore' stage, meetings were set up with various departments of B&Q in order to get a picture of their understanding of the project and its placement within B&Q's strategy. These included showrooms, the 'Hardware' Department, Marketing Department, Communications Department, and Diversity and Sustainability Division (see details of this Division from [5]). Table 2 shows the activities involved in the exploratory phase. Three different timescales of user testing were used throughout the project (Table 3).

After the exploratory research, the project focussed on DIY power tools. A major buyer of power tools for B&Q became closely involved with the project. The Hardware Department also helped further narrow the focus to encompass cordless drills, sanders, jigsaws and cordless screwdrivers. A core relationship was thus built between the designer, the buyer, and the Hardware Department.

Activities	Aims
Store visits and product audit.	To understand B&Q from the viewpoint of both its customers and store staff. To try out products in store and photograph them to produce a record – this was used to highlight key areas where user-centred design was lacking.
In-store interviews.	To ascertain why customers were there, what they thought of B&Q and their age and background.
Analysing marketing data (competitor evaluation).	To obtain general knowledge of the nature and size of the B&Q customer base and the attitudes of customers to B&Q and its business.
Desk research (library and Internet search).	To find relevant user study methodologies. To obtain information about new innovations and products from brand leaders.

Table 2. Activities involved at the 'explore' stage

Activities	Aims
Focus group and observation: (during the concept creation stage): four women and one man ranging from seventy to ninety years of age. (Figure 3)	To identify areas most in need of careful design.
Short-term tests: (during the project concept selection and initial development phase): trying out different makes of tools and asking about comfort, ease of performing operations etc.	To create, confirm and reject ideas.
Long-term testing: offering tools to nine users and asking them to keep a diary on how they used the tools.	To identify problems and difficulties of using the tools in detail.

Table 3: User testing during the process

Results and design outcomes

From the exploratory study, the Research Associate found that manufacturers tended to apply the same standards to mass-market non-professional tools as for professional tools, on the assumption that the user has the same strength, skill and needs as a professional practitioner. As a consequence, non-professional tools tend to be too heavy, too complex and too big for many potential users, especially women and older people. Specifically, DIY power tools were identified as the best area for design consideration and development.

A brief report, 'Improve: a report documenting methods for product usability improvements', was made based upon a product audit for B&Q power tool buyers and own brand manufacturers (Figure 2). It listed six key aspects that affect the ease of use of power tools, namely:

- **Colour:** consideration to be given to its effectiveness in aiding the operation of a device.
- **Form:** consideration of its size and shape to enhance function, human fit and clarity of designed use.
- **Placement:** the 'logic' and balance achieved by feature positioning.
- **Force:** minimisation of user effort to perform product functions.
- **Feedback:** clarity of information as to the intended function of features, how they are to be used and if the required operation has been effectively completed.
- **Comfort:** how features aid comfortable operation.



Figure 2. Improve report cover



Figure 3. Focus group/ user study session



Figure 4. Cordless screwdriver – easy to grip (working prototype)



Figure 5. Cordless drill – reducing weight (working prototype)



Figure 6. Reciprocating saw – ergonomic rethink (3D model)



Figure 7. Palm-sized sander – hand strap innovation (3D model)

The brief report demonstrated how simple but careful consideration of all six aspects could greatly improve the design of any power tools. The product audit was subsequently combined with findings from long-term user tests to generate several product concepts, among which four were selected in conjunction with B&Q for development: a compact cordless screwdriver (Figure 4), a cordless drill with a weight-saving extension clip allowing the battery to be attached to a belt (Figure 5), an ergonomic reciprocating/jig saw (Figure 6) and a hand-strap palm sander (Figure 7).

Each concept addressed key ease-of-use factors, such as size, weight, configuration and semiotics, as described in the paragraphs that follow:

- The cordless screwdriver is one of the most popular power tools yet current products are long, unwieldy and difficult to grip and activate. A redesign made the shape easier to fit into the palm of the hand while its foreshortened design allowed it to be used in corners that were inaccessible to screwdrivers of conventional length (Figure 8). The tool is also automatically activated as soon as the screw bit locks into the screw head.
- Cordless drills are heavy to use due to their battery weight. By attaching the battery via a belt clip to the waist and connecting it to the drill with a short power cord, the freedom of cordless drills could be preserved whilst simultaneously relieving battery weight and allowing a range of tools to connect to a single battery.
- The reciprocating jigsaw has become a best-selling product but little attention has been paid to the ergonomics of holding the saw whilst applying force. By changing the angle of application and totally redesigning the handle and battery case, a unique new type of power saw was created (Figure 9).
- Conventional palm-sized sanders are generally uncomfortable to hold, as the user is expected to press and hold a sander against a surface to re-create a sanding motion while it vibrates gently. The tool can tend to slip sideways due to this motion leaving the user to grip, hold and steer simultaneously. The prototype was redesigned to 'cup' the hand (Figure 10) while a hand strap (Figure 11) eliminates the need to grip it firmly.

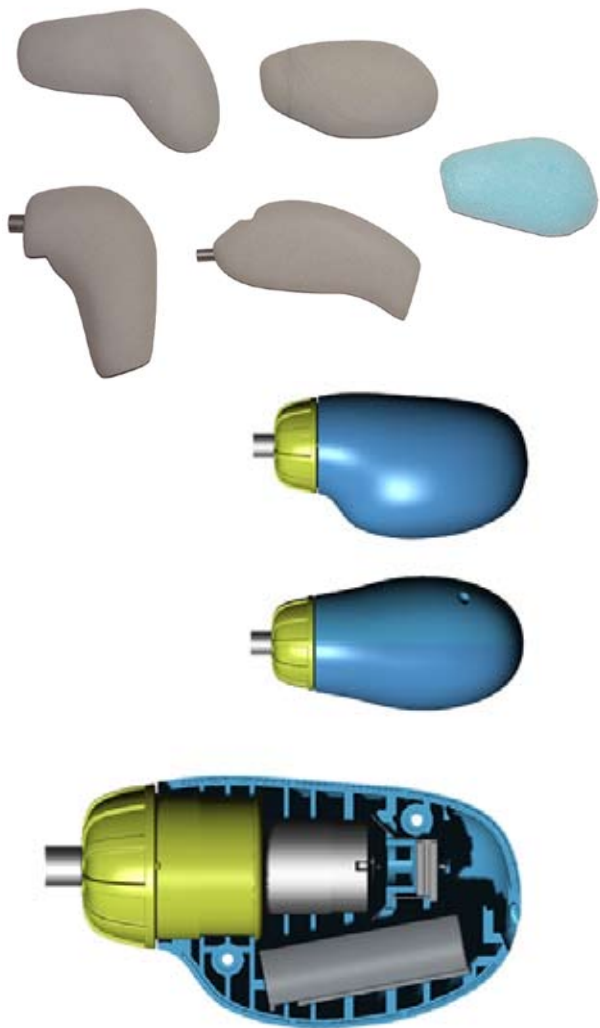


Figure 8. Gofer - foam models and CAD models



Figure 9. Reciprocating saw - foam models and CAD models

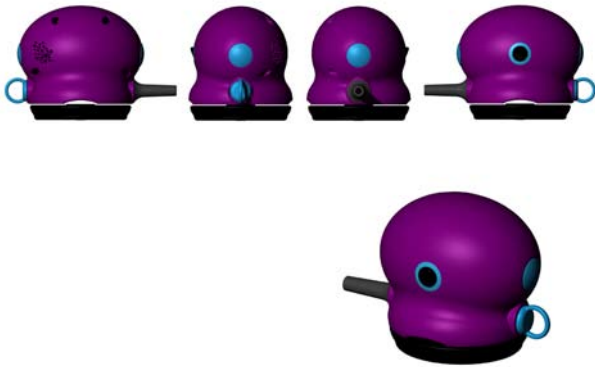


Figure 10. Sandbug - CAD models



Figure 11. Sandbug - First prototype

Development stage	Results
Concept design	Sketch work; CAD models; physical models and simple test rigs.
Embodiment design	Accurate foam models were produced to check the ergonomics; CAD layout models were used to check sizes and viability of assembly; final CAD models and rapid prototypes were made for user testing.

Table 4. Product development stages and results

All the design ideas were developed through ‘concept design’ and ‘embodiment design’ stages (Table 4), and IPR protection was secured in the form of patents on five key features.

Assessment

The buyers were impressed by the report content based on the product audit. They took the report to China for their supplier visits. The feedback from the suppliers about the report was positive, as it identified key usability features that could improve sales and increase customer preference.

All design concepts generated were reviewed against user needs, market compatibility and their

development potential. Table 5 summarises the evaluation results against user needs.

A key concern of the project was to ensure that the designs produced would be viable for production with existing suppliers. Accordingly, an investigation and assessment of the suppliers’ abilities and attitudes was undertaken. The feedback has been positive. B&Q evaluated the prototypes and chose two to take to market – the cordless screwdriver (Figure 12) and the palm-sized sander (Figure 13). Both products were made in China. Early reports suggest healthy sales for each line, reflecting consumer support for B&Q’s drive to make its own-label products more user-friendly.

Design concepts	Problem to address	User needs	User testing results
Cordless screwdriver	Current products available are not ergonomic and can be extremely long.	To make the device compact. To eliminate the switch.	The automation and size are beneficial, desirable and offer considerable advantages over current cordless screwdrivers.
Cordless drill	Users cannot pick up heavy tools. About a third of a drill’s weight is the battery alone.	Remove the battery and lighten the weight of tools by at least a third: using a retrofit device.	By relieving a third of the weight alone, the results were overwhelmingly positive.
Reciprocating saw	The current design demands the user to hold it in a position 90 degrees opposed to a natural grip with the other hand in a similar awkward placement; a difficult battery clipping system.	The ergonomics were to be changed to allow a natural strong two-handed grip. To design a better battery clipping method.	The hand positioning is comfort and the battery clipping method is potentially easy
Palm-sized sander	Noticeable vibration becomes uncomfortable after prolonged use.	Allow the user to exert the force required onto the sander without needing to rigidly grip it, by addition of a hand strap.	The sander is immediately attractive to consumers who feel it would make a good tool and a great gift.

Table 5. Evaluation against user needs



Figure 12. Gofer - final product (above) and exploded view (right)

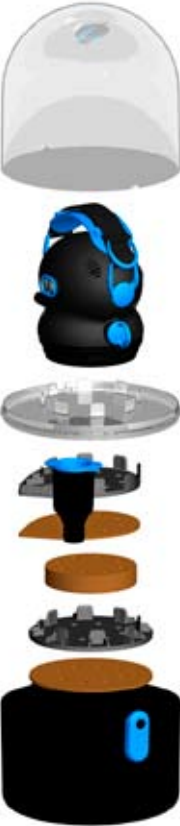


Figure 13. Sandbug - final product (above) and exploded view (right)

Discussion

The key to this project was the interpretation of the results gathered through user testing. Numerical evaluation using test rigs provided precise quantitative results, but the Research Associate found that conversational interviews provided equally important qualitative information on consumer attitudes and preferences. Observation of users performing tasks was also important. Many problems originated from users performing secondary tasks such as battery changing.

Focus groups did not prove fruitful as most did not indulge in DIY. The most useful time was spent passing cordless drills of various sizes around and asking participants to perform simple tasks. For the majority of users, the tools were far too heavy and the whole group failed to remove half the batteries of the drills tested. These experiences fed directly into the new designs.

Short-term user testing is quick and simple, enabling tools to be rapidly assessed for ergonomics, usability and appeal. Long-term user diaries were especially useful for the professional testers as they performed many tasks frequently.

The 'in-house' design approach had definite advantages. The expertise of B&Q fed invaluable information into the design process to merge

design objectives and user needs with commercial experience and requirements. Involving buyers as much as possible also proved invaluable to the success of the project.

Conclusions and future work

The main conclusions are as follows:

- Combining user testing methods and incorporating user needs and feedback into the design process can create a better product.
- Using design to meet the needs of older users has the potential to create products that are more appealing to all market sectors.
- Simple changes can make a significant difference.
- Retailers can drive change from within.

After the successful one-year Research Associate project, Matthew White was employed directly by B&Q as a design consultant. He then spent the next 12 months making his designs production-ready by refining components and producing engineering drawings. B&Q then worked with a second Helen Hamlyn Research Associate in the area of garden power tools, and developed company guidelines for inclusive design.

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Acknowledgements

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About the research partners

B&Q plc is Europe's largest DIY retailer and is part of the Kingfisher group. It operates 320 stores in the UK and is expanding rapidly into the Far East. B&Q has won many awards for its work on diversity and sustainable development. www.diy.com



About the Research Associate



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The Helen Hamlyn Centre was set up at the Royal College of Art in January 1999 to alert design and business to the far-reaching implications of a rapidly changing society. It works to advance a socially inclusive approach to design through practical research and projects with industry. Its Research Associates Programme teams new RCA graduates with industry partners.

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