
Preface

On October 2, 1995, a Special Interest Forum (SIF) was held in Taylor, Michigan on the topic of Accessible Plumbing Fixtures. Its purpose was to promote innovation in plumbing fixture design that would make kitchens and bathrooms more accessible and usable by a diverse population, including people with disabilities. This report is based on the presentations made during the Forum. It captures the main points raised by the presenters and elaborates on many of the issues.

The SIF was organized by the Association of Safe and Accessible Products. It was hosted by the Masco Corporation of Taylor, Michigan. Funding was provided by The Center for Inclusive Design & Environmental Access, (IDEA Center), State University of New York at Buffalo as part of a grant from the U. S. Department of Housing and Urban Development entitled *Fair Housing Means Universal Design*.

Introduction

Since the Industrial Revolution, the inevitable march of progress has been a universal theme in our culture. This “march” has often taken the form of reducing the burden of work, increasing speed and efficiency, as well as applying new technologies to meet basic human needs. History shows that technological progress has often moved hand in hand with social progress. Feminists in the late 1800’s and early 1900’s sought to apply technology to aid their social agenda. They promoted new work methods and technologies in order to reducing the burden of work on women in the home, improving the quality of their lives (Hayden, 1981)(Fig. 1).

Advances in technology in the home products industry have extended far beyond what people could have imagined in the

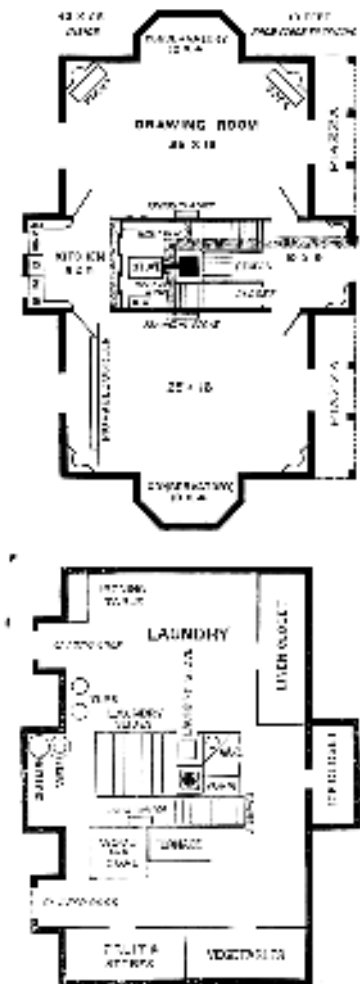


Fig. 1 Feminist Housing
(Beecher & Stowe, 1991)

late 19th century. Domestic tasks such as cooking, washing, bathing, etc. are far easier than they ever were. For example, electric power, which we take for granted, has greatly facilitated such tasks as washing dishes, doing laundry, and bathing.

However, the design of plumbing fixtures and equipment, particularly bathing products such as tubs, has not kept pace with the “march” of progress. Despite technologies such as running hot water and plastic, the design of the bathtub has remained basically unchanged from the first known bathtub used by the Minoans in 1700 BC (Wright, 1960) (Fig. 2). Showers, developed for medicinal purposes in the early 1800s, also remain essentially the same. While it can be argued that these forms and systems meet the design challenges and that these solutions are “time tested,” it is apparent that the times and challenges are changing.



Fig. 2 Early 20th century bathroom

As we approach the end of the 20th century, the civil rights movement has evolved to recognize the rights of people with functional limitations. People with disabilities, elderly people with some loss of physical function and many other people who fall outside the “norms” of society are now included in the phrase *all the people*. Advances in medical technology, and the aging of our society are making functional limitations increasingly relevant to plumbing fixture design. Product designers, architects, engineers and builders must establish new design goals to meet the challenges of a changing society.

Government has not been unresponsive to these social changes. Civil rights laws such as the Americans with Disabilities Act and the Fair Housing Amendments of 1988 acknowledge the need for our built environment to respond. These laws reflect the fact that traditional design practices resulted in discriminatory environments and that new practices must be put into effect to accommodate social trends.

Participants at the Forum expressed concern over a variety of issues related to improving accessible design in the plumbing fixture industry. Restrictive codes, marketing challenges and identifying design issues were some important concerns of industry. A desire for improved communication between industry and government also was evident. No one doubts that accessible products can be designed and manufactured. Rather, the industry is concerned about the viability of change in a market with deep traditions. As one attendee stated, “Is America ready to pay for accessibility?” The plumbing fixture industry cannot afford to

ignore accessibility issues in our rapidly changing society. Thus, the most critical issue may be how can the industry adapt in an economically viable manner.

Our objective for both the Forum and this report is to stimulate and support innovation in plumbing fixture design. We will outline reasons for the need to make plumbing fixtures more accessible and typical features of accessible fixtures. Examples of accessible products and several corporate programs will be presented. We will analyze the barriers to innovation and present some strategies for universal design of plumbing fixtures. We will conclude with a summary of the state of the art in this area and some recommendations for improving the pace of innovation.

Bathing: The Challenge of an Aging Society

The aging of our society is perhaps the most important social trend fueling the interest in accessible design. The aging of the American population will not halt, even if political opposition slows down the disability rights movement. One of the ways that products can be evaluated for accessibility to all is to determine how well they serve the needs of older people. Current research findings seem to indicate that the state of the art in plumbing fixture design falls somewhat short of the ideal, particularly in bathing fixtures.

According to a 1984 survey, approximately 35% of people over 65 need assistance in order to perform bathing activities. Approximately 21% need assistance in performing meal preparation in the kitchen. Considering that 12% (Fig. 3) of the current US population is over 65, these are significant numbers (NCHS, 1984). Approximately 17% of that number will be over 85, and generally will require some sort of adaptation to maintain independence (Gibbs, 1988). Accidents among people 65 and older account for 22% of all deaths and 18% of all injuries in bathing.

A research study at the IDEA Center (Mullick, 1993) identified difficulties encountered by older people in the bathroom and how the environment supports or hinders their activities. Forty people participated in the study; 20 of them were able to bathe independently. The remaining 20 included 6 people who needed assistance in bathing and 14 who provided assistance to dependent bathers. Through personal interviews and observation of bathing activities, a general picture emerged of the problems that older people have in the tub or shower.

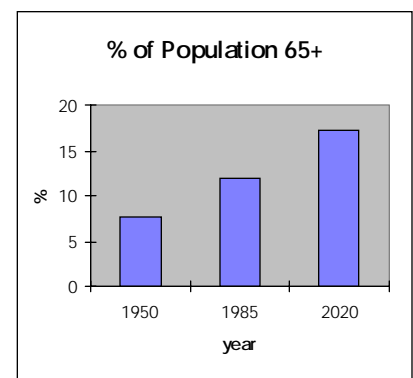


Fig. 3 Percentage of Population over 65 (NCHS, 1984)

The area in and around the tub or shower is often confining, making movement difficult. This is particularly true when both a bather and caregiver are present. It is also an unforgiving environment: the combination of protruding edges, slippery surfaces and poor illumination can lead to serious injury. Furthermore, conventional fixture and interior designs result in difficulties reaching and grasping controls, maintaining balance, adjusting water temperature, and safely storing accessories in reachable locations.

Currently independent bathers who have some loss of function are put at risk of accident and injury by design. This can lead to greater dependence in the future. Bathers who have a greater loss of function, or who are somewhat dependent to begin with, are forced into greater dependence by this “handicapping” environment. These problems are not limited to the bathroom. Hard slippery surfaces, as well as controls that are difficult to grasp and adjust, are issues of concern for kitchen environments as well.

An environment that is safe and accessible must be designed so that it matches the capabilities of the people using it. Our environments are generally designed for the capabilities of able bodied young and middle aged adults. Adults who are elderly or have a disability, as well as children, people of short stature and others who do not meet the “norm,” are handicapped by these environments. Not only is this a discriminatory and stigmatizing condition, but a dangerous one as well. Handicapping environments may force people to act outside the range of performance we would consider safe to perform many daily tasks.

Mullick’s research found that current bathing environments:

- are difficult to maintain balance in,
- are slippery and hazardous,
- are difficult to enter and exit, as well as being difficult to help others do these tasks,
- have controls positioned so that they are difficult to reach, especially from outside the tub or shower,
- make it difficult to adjust water temperature,
- are generally poorly illuminated,
- are inadequately heated,
- do not have effective storage systems,
- are too inflexible to individual user needs (i.e. tub or stall size, grab bar positions).

The research illustrates the importance of designing for a broad range of user abilities. Not everyone has the same capabilities

to use bathtubs and showers, nor do abilities stay the same over time. Aging is inevitable and often results in functional limitations. How can manufacturers create products that will result in accessible and safe environments for a wide variety of users with many different abilities? One way is to adopt the philosophy of universal design.

Toward Universal Design: Rethinking Traditional Approaches

Four federal laws require accessibility to plumbing fixtures in housing. Three of them, the Architectural Barriers Act, Section 504 of the Rehab Act of 1977-78 and the ADA apply only to housing that is built with public funds or that is operated by public programs. The third, the Fair Housing Act Amendments passed in 1988, applies to all newly constructed multifamily housing, including privately financed construction and housing built for sale as well as for rent. Whereas the regulations for the first three laws require only a small number of accessible units in each project, the Fair Housing Accessibility Guidelines require all dwelling units in elevator equipped buildings and, generally speaking, all ground floor apartments in walk-ups to be accessible. Although the Fair Housing requirements are not as extensive as other accessibility regulations, they apply to a much wider range of dwelling units.

Advances in medical technology have contributed to two demographic changes in our society. People are living longer over the natural course of aging, and are therefore encountering a greater number of disabling conditions throughout their lifetime. Furthermore, survival rates for previously fatal injuries and diseases are now much higher, but chronic disabling conditions often result. Social trends are also changing the demographics of people with disabilities. The independent living movement encourages people with disabilities to live as independently as possible, often moving from institutional settings to residential ones. De-institutionalization is also being encouraged by government agencies seeking to save money as well as to improve the quality of life of former institutional residents. All these demographic changes mean that there are more people with functional limitations in the housing market than ever before.

The regulatory and social changes go hand in hand. Regulations can be seen as a direct response to social change. They can play the role of catalyst for change in a physical environment that

has not kept up with the changes in society. Regulations have limitations however, particularly as a tool for designers. They tend to steer designers into thinking about problems to be solved or rules that must be followed rather than in terms of opportunities for good design and challenges to be met. Today, a trend is developing in product design to meet the challenge of a greater number of people with disabilities and other functional limitations. This trend is called *universal design*.

Universal design seeks to provide solutions that are safe and accessible for all people regardless of their abilities. It recognizes the need to acknowledge differences between people of varied ages, sexes and functional abilities and to design in such a way that all people can use the same or similar products. This is not at all the same as previous concepts of accessible or barrier free design, where problems were often solved by applying “band-aid” solutions, or by designing “special” products for children, the elderly and people with disabilities. The old approach resulted in special product lines for “niche” markets, a costly and inefficient strategy. Universal design seeks to accommodate the traditional niche markets while designing for everyone.

Disability advocates refer to the concept of TAB, or the *Temporarily Able Bodied*. Using this perspective, universal design acknowledges that everyone at some point experiences a change in their functional abilities, whether from aging, injury or illness. Universal design principles recognize that there is no “them,” only “us.” Universal design will become the new norm when all products acknowledge this change in attitude.

John Salmen proposes that universal design includes a number of different attributes (Steinfeld, 1995):

- Choice in method of use which can be provided by adjustability, alternative methods or redundant systems,
- Inclusion and respect for diversity,
- A search for meaningfulness (e.g. added value) in the design,
- Rejection of the idea that “one size fits all,”
- Properties of accessibility are invisible (e.g. inherent to the design),
- An emphasis on the process of design as opposed to product.

Proponents of universal design accept the limitation that it may be impossible to accommodate each and every person on Earth. Furthermore, it may be impossible to fit the needs of everyone with only a single product. The evolutionary process of seeking universal design is more important than reaching the ideal at any one point in time. This way of thinking will promote creative

solutions to pressing problems in an inclusive and thus more efficient way, reducing the environmental discrimination that has taken place in the past. Perhaps a better term to describe this idea would be “universal designing.”

Mary Jo Peterson, a Kitchen and Bath Designer with many years experience designing accessible and universal environments, offers a view of how universal design could be achieved in kitchen and bathroom plumbing products. This view involves a break with tradition in plumbing fixture design and installation.

Peterson observes that traditional kitchens and baths have come to have a certain consistency to their design, in part as a result of standardized products and partly due to the expectations of the modern consumer. Breaking with the conventions can help to make a kitchen more usable for everyone. An example of this approach is the inclusion of multiple counter heights that can better support different abilities, preferences and tasks (Fig. 4). Certain kitchen tasks, such as peeling a large quantity of vegetables, may be more comfortably and easily performed sitting down. Others, such as pouring a glass of juice may be best performed standing at a high counter. Rather than relying on a single compromise height, counters at multiple heights to handle different types of tasks can be provided. These alternatives benefit all users, not just people with disabilities.

Multiple counter heights have added “spin-off” benefits. A higher counter top allows a dishwasher to be installed higher, making it easier to reach the contents without bending. This is important not only for those with disabilities, but for older people, or anyone with a back problem. Sometimes alternative heights are needed at the same workcenter. Kitchen sinks with flexible plumbing can be built into adjustable height countertops to accommodate a wide range of users. These adjustable countertops are currently in small scale production, but could become standard cabinetry features in the future.

Fixture layout is also an important issue in universal design. Sinks that are installed near ranges make it possible to fill pots already on the burner with a spray wand, rather than carrying a filled pot across the room (Fig. 5). To maintain the traditional “work triangle,” a bar sink with a flexible spray can be installed near the stove. While accessible design has a focus on basic access, universal design is concerned with a broader range of design issues. For example, Peterson designs kitchens with contrasting colors on sink and faucet controls and around sink



Fig. 4 Multiple counter heights enhance accessibility in the kitchen (photo by MJ Peterson)



Fig. 5 Locating the sink and range close together allows pots to be filled on the range (photo by MJ Peterson)



Fig. 6 Contrasting colors help those with visual impairments (photo by MJ Peterson)



Fig. 7 Wall hung toilets offer advantages to accessibility and hygiene (photo by MJ Peterson)



Fig. 8 Height adjustable toilets enhance flexibility for all (photo from Linido USA)

bowls rather than chrome or colors that match the countertop because they help everyone, especially people with poor vision (Fig. 6).

Bathroom fixtures can also benefit from a break with tradition. Wall mounted toilets can be placed at any height, in order to best accommodate the needs of the specific users. Wall mounting has the added advantage of making the toilet area easier to clean (Fig. 7). Adjustable toilets are available and will eventually be economical (Fig. 8). Sinks with offset drains at the rear of the bowl can help alleviate the problem of where to put plumbing when knee space for wheelchairs is desired. Built-in shrouds for plumbing are also a useful fixture on wall mounted sinks meant to be usable while seated (Fig. 9). Bidet seats for toilets can be useful to help people who have difficulty with reach maintain independence in using the toilet. Bathtubs with soft surfaces enhance safety and comfort for everyone. Implementing universal design often incorporates slight breaks with tradition and rethinking the solutions to age old problems.

The expectations of consumers have been strongly influenced by tradition in this market. Everyone has an image of what a kitchen or bathroom should look like, as they have been exposed to basically the same design for the last 40 years. While there is a strong incentive to follow tradition in plumbing fixture design, the market is ripe for innovation. Consumers may be looking for features that will add value to their investment. No one wants to spend money on the same kitchen and bath their parents or grandparents had. By providing new and innovative universal features, as well as informing the public about them, the plumbing fixture industry can take a lead role in educating consumers about what can be done to make kitchens and baths safer and more usable by all. General Electric Appliance has given us an example of education for innovation. Working with several other companies, GE created a model kitchen to display their own products, as well as innovative approaches to cabinetry and fixture design. They produced a video tape called *Real Life Design*, which is essentially about universal design. By informing the public about issues of aging and how specific problems can be solved by universal design, GE is educating consumers about the features they will want in kitchens and baths in the years to come. They are taking a lead role in promoting universal design as a desirable feature in any kitchen.

The Role of Regulations

A review of regulations is useful to better understand the difference between accessible and universal design. It highlights the limited scope of accessibility regulations; they simply do not address the full range of consumer needs. It also identifies how design to regulations alone will not lead to products that are desirable to the broader population. Finally it can reveal the nature of the industry's frustration with the regulatory process. The regulations insure civil rights, but they are only a point of departure, not a comprehensive solution.

There are three major codes and regulations that apply to the design of accessible plumbing fixtures and accessories: the CABO/ANSI A117.1 Standard which is referenced by many building codes, the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Fair Housing Accessibility Guidelines (FHAG). The FHAG is the most general, but it has the broadest scope, since all new multifamily housing units on ground floors and those served by elevators must comply. The code requires usable kitchens and bathrooms and gives some general guidelines for clearances at fixtures and positions for grab bar reinforcing.

The ADAAG has much more specific requirements for plumbing fixtures, though its scope is somewhat different. While it applies to all commercial and other public construction, it is applicable only to residential construction that is publicly funded. The guidelines that pertain to plumbing fixtures include very specific prescriptions for the inclusion and placement of grab bars, accessible controls, clearances around fixtures, as well as fixture size and placement. The ADAAG is currently being reviewed and revised, including the section related to plumbing fixtures.

The CABO/ANSI A117.1 standard is not a code, but rather a consensus standard formulated by representatives of industry, government and consumers. The technical provisions of both the ADAAG and the FHAG are based on this standard. It has very specific requirements for plumbing fixtures. However, the standard is also currently under revision, which has implications for changes in the plumbing fixture industry. To date, the proposed changes include the following:

Space Allowances and Reach Range

- Clear definition of knee and toe space clearances
- Clarification on how clearances are measured



Fig 9. Sinks with built in shrouds reduce the risk of injury from hot pipes (photo by MJ Peterson)

- Reduction of the side reach upper limit to 48 in.
- An exception to the 48 in. reach limit for forces < 3 lbs. (54 in. allowed)

Mirrors

- Bottom edge of mirror at 40 in. max. (it is now 38 in.)
- Deletion of the full length mirror requirements

Water Closets

- Centerline of water closet relaxed to 16-18 in. from wall
- Clearances around water closet reduced to same as toilet stall
- Seat height range extended to 15 - 19 in.

Lavatories and Sinks

- Rim height on counter mounted lavatories limited to 1/2 in.
- Only one compartment of multiple bowl sinks needs to comply

Bathtubs

- Clear floor area in front of the entire length of the tub
- Drain stoppers and diverter valves now covered
- Deletion of rim height limit (17-19 in.)

Shower Stalls

- Transfer stall size changed to 34 in min. x 38 in. max.
- Roll-in stall size changed to 36 in. min. x 48 in. min.
- Rectangular seats allowed in addition to “L” shaped seats
- Thermal shock prevention to 110 degrees required
- Controls to be located above grab bar

Grab Bars

- Alternative 2 in. diameter max. for non-circular sections now allowed

Another important change in the CABO/ANSI A117.1 standard is the revision of the section on dwelling units. There are now two optional sets of requirements. The “Type A” unit is relatively the same as existing requirements for residential bathrooms. Any adaptable features, such as those in the FHAG, are treated as exceptions. The “Type B” unit is almost identical to the standards set out in the FHAG, which calls for adaptable features but does not require full accessibility.

Several other proposed changes to the CABO/ANSI A117.1 Standard have, so far, been rejected by the committee. These

include the elimination of the requirement for the rear grab bar at the water closet, freeing the location of water closet from the wall, allowing pivoting bars as well as changes to the “Type B” unit concept. These proposed changes included designating “Type B” units as having a lower level of accessibility, or “ambulant accessible,” or creating a separate standard for “Type B” units.

Although there is an attempt to coordinate revisions to ADAAG with those to CABO/ANSI A117.1, at the present time it is unclear how much uniformity will be achieved. Although the “Type B” concept may bring CABO/ANSI and FHAG closer, currently there are significant differences between them. The FHAG has no latch side clearance requirement for doors, as well as no distance requirement from the wall for toilets. CABO/ANSI requires 18 inches in both cases. While CABO/ANSI requires the installation of grab bars in accessible units, FHAG only requires the reinforcing be placed for them. FHAG allows a parallel approach to the sink and lavatory, while CABO/ANSI requires that a front approach always be accommodated. Adaptable vanities are only allowed in the “Option B” FHAG bathroom, while CABO/ANSI A 117.1 will allow them in either. Furthermore, the FHAG requires only a 30x48 in. long clearance at tub or shower, while ANSI requires a 30x60 in. clearance.

Frustration seems to be the word the industry most often associates with accessibility codes and standards. The vast majority of manufacturers view accessible products as a desirable goal, but the codes and standards often do not make achieving that goal easy. The lack of consistency between the federal codes and standards, as well as the differences across states are major problems. The codes and standards also make it extremely difficult to create innovative and accessible products. Despite development avenues like third party testing and model code agency reviews, conflicts with federal or state codes almost always develop. Furthermore, there is a perception among those in the industry that they are moving toward greater accessibility and accommodation faster than the code agencies.

Communication seems to be at the heart of these concerns. Industry and government use different knowledge bases, which results in different recommendations. There also seems to be a general feeling that the current database of research knowledge is inaccurate; society and technology have changed to an extent that current codes and standards may no longer apply. Industry



Fig. 10 Pivoting bars offer a wide range of accessibility options (photo from Linido USA)



Fig. 11 The door on this tub eliminates the need to step over the rim (photo from Kohler Corp.)

feels that it has done a better job at keeping up with this trend, although the need for better research is acknowledged. Greater cooperation and communication with code officials is desired to redress the differences in perspectives. For example, pivoting wall mounted grab bars offer accessibility in a way that provides choices (Fig. 10). They can be mounted near toilets that are not adjacent to side walls, thus expanding design options. By installing one on either side, a person can use the bar they prefer, and swing the other out of the way. This is particularly important for people with paralysis on one side of their body. Pivoting bars are not accepted by the codes, despite the fact they offer greater accessibility options. Another example is side opening tubs like the Kohler Precedence (Fig. 11). This tub has a side door that opens to allow a person to walk into the tub without lifting their legs over the rim. While the product offers greater accessibility, the codes are not written to exploit the additional options that designs such as the Precedence provide.

While Federal laws help to alleviate some of the inconsistency in requirements across states that used to be more prevalent, they are not enough. More uniformity, either in national or even international standards would be a great help for manufacturers. Standards should allow greater flexibility to accommodate different types of accessible designs and improvements based on current research findings. In particular, industry representatives make the point that there are many products, like pivoting grab bars and side opening tubs, that benefit older people but do not meet current accessibility codes. A universal design approach should recognize the need to address issues of aging. Current regulations thus limit the achievement of universal design.

Regulations will always have gaps. These gaps are further complicated by inconsistencies and conflicts among the different codes and standards. Rather than advocating that the codes cover the all gaps, advocates of universal design seek more options and flexibility in regulations to leave room for good product design. A broader range of issues can be accommodated this way and better products result.

Corporate Strategies for Achieving Universal Design

Several plumbing fixture manufacturers are already exploring universal design. Two companies, Delta Faucet and Linido, have found that universal design makes a lot of sense.

In the early 1980's, Delta sought to position its products so that they would be compatible with upcoming laws pertaining to barrier free design. Not knowing how to accomplish this, they turned to an expert consultant, Ronald Mace. Mace suggested that plumbing fixture design for "the handicapped" was painfully inadequate. The best example was the "standard handicapped lavatory" design. These products were (and still are) very institutional and thus have a demeaning connotation. Furthermore, their features were unnecessarily wheelchair oriented and did not take into account the wide variety of disability types. The large paddle handles and gooseneck faucets were borrowed from surgical sinks. These medical features were rarely necessary to accommodate people with disabilities. The idea of a minimum number of "handicapped" fixtures was also a problem. Many codes at the time required 10% of all lavatory fixtures to be "handicapped accessible." Deciding where exactly these should go was a significant problem. Mace challenged Delta with the idea that all of its products should include accessible features. This could be done in an attractive and cost effective way. To Delta it made sense to pursue universal design.

Delta based its fixture line around the single lever faucet. Doing so provided accessibility features while not creating a "special" product. The same basic faucet could be equipped with a variety of handle types, finishes and luxury features. Anti-vandalism features were also available. Dual control faucets were available, as were a variety of interchangeable handles. Attractively designed and finished levers could replace standard knobs simply by unscrewing them. By adopting a systems approach and featuring a universally designed base product, Delta provided for general accessibility as well as allowing changes over time for aging in place. Rather than relying on codes to prescribe design features, Delta incorporated ergonomic designs that would inherently satisfy the code requirements (Fig. 12).

Linido, a company based in the Netherlands, has developed a line of bathing fixtures and accessories focusing on providing comfort, safety and aesthetics. They have built these products around a connection design called the ErgoGrip. This is a wall connection that can be used to support a variety of bars and products. It is made in such a way that the person gripping it can achieve a firm hold in a neutral position everywhere along the bar, including close to the wall. Linido has integrated this design into a variety of fixtures, including shower curtain bars,



Fig. 12 Delta's basic faucet has many universal features (photo by Delta Faucet)



Fig.13 Linido's fixtures all serve as safety devices (photo from Linido USA)



Fig. 14 Linido uses aesthetics to unite their products into a single family (photo from Linido USA)

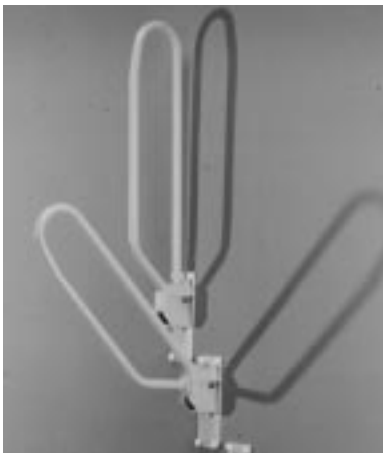


Fig. 15 Linido's pivoting grab bar offers choice and utility to a wide variety of users (photo from Linido USA)

mirror supports, towel bars, as well as traditional grab bars. All of these devices are capable of bearing loads, thus greater safety in a potentially hazardous environment is achieved (Fig. 13).

Linido has also focused on integrating different features into single products, in order to enhance safety, improve usability and use space more efficiently. Toilet paper holders that hang off grab bars and adjustable shower sprays that use the grab rail for support are two examples of this strategy. Furthermore, accessories such as soap dishes, toothbrush holders, shelves, and toilet brushes incorporate the same aesthetic as the safety items, creating an attractive environment as well as reducing the institutional look of most safety oriented accessories. All of Linido's products incorporate a variety of colors and design options. This further broadens their appeal (Fig. 14).

Perhaps the most versatile product that Linido makes is their pivoting grab bar. This bar can be mounted to the wall or on stanchions bolted to the floor. Pivoting bars offer additional accessibility options, particularly in bathrooms used by people with different disabilities. Rather than being limited to a single fixed bar on the side wall, two pivoting bars can be installed on either side of a toilet. Thus, one can be swung out of the way while the other is used to transfer, depending on the preference and limitations of the user. Bars installed in this way also do not limit the toilet to a position near a side wall.

The Linido bar also offers some options when installed near a tub. Locked in the up position, it can aid a person getting in and out of the tub. It can then be swung down to assist in sitting and standing. As with all their products, the pivoting bar is available in attractive colors. It can support up to 250 lbs. on the end of the bar when installed to manufacturers specifications (Fig. 15).

Linido has also ventured into automation as a means to achieve greater accessibility. The company manufactures height adjustable toilets and sinks, both made to match the aesthetics of their line of bathroom accessories. These items are currently very expensive, and generally are sold only in the European market. The ideas behind them, however, have a growing appeal to an American market seeking greater accessibility and usability (Fig. 16).

Both Delta and Linido have created product lines that provide variety and choice to the consumer through the use of integrated systems. Rather than creating special accessibility products, they

have implemented product lines that provide accessibility, safety, and aesthetics for everyone. This universal design strategy positions these companies to satisfy the needs of a changing society in a competitive and cost effective manner.

Example Products

Delta and Linido are only two of many companies currently offering products that are approaching universal design. Many of these companies have not consciously developed these products with a universal design attitude, though they have become more universal in their attempt to meet the needs of a broad market.

The Aqua Bath company has added a molded shower stall unit to its product line called the “Remodeler” (Fig. 17). It is designed to replace an existing tub or shower unit with a minimum of new construction, and includes accessibility features such as a low threshold and a molded seat at wheelchair height. A non-skid texture is also added to prevent slipping. It is primarily designed to accommodate those who use wheelchairs, however the seat can also help older people and others who might have poor balance or low stamina. The size of the unit is the same as a tub. As a person ages or if they have a disabling accident, this unit could replace their existing bath tub. Aqua Bath also manufactures more traditional molded shower units. Using standard templates, they can manufacture many custom shower designs from the same basic parts. This process allows them to accommodate individual user needs without significant cost increases.

Aqua Glass manufactures a line of molded bathing units. There are many different shower and bath types to meet different commercial and residential applications, as well as different needs (Fig. 18). This company has organized its manufacturing process in order to facilitate easy transition from manufacturing one product to another. All of its products can be made using the same system of molds and other machinery. This flexible manufacturing approach provides the capability to maintain a diverse product line without the high cost of custom machinery for each product. A standard gel coat, single molded design helps to prevent bacteria and mildew build up, and surfaces are textured to prevent slipping. All of the units offer stainless or finished grab bars options, accessible single handle lever controls, sprays with flexible hoses and low thresholds. Ramp accessories can be included or the units can be installed to be flush with the



Fig. 16 Automated, height adjustable sinks and toilets accommodate a broad range of user abilities (photo from Linido USA)

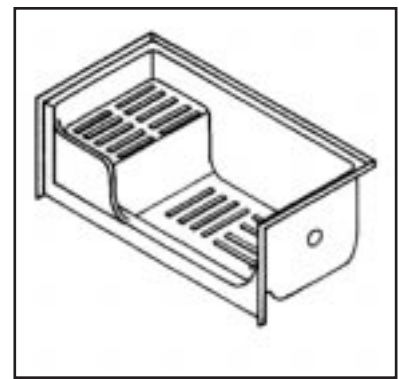


Fig. 17 Aqua Bath's Remodeler is designed to easily replace existing tubs (photo from Aquabath)



Fig 18 AquaGlass can manufacture a variety of customized shower units (photo from Aquaglass)



Fig 19. ICP's SoftTub enhances user safety (photo from ICP)



Fig. 20 Hewi manufactures adjustable grab bars and mirrors (photo from HEWI Inc.)



Fig. 21 Seachrome makes a variety of grab bar styles (photo from Seachrome Corp.)

finish floor. Different front panels can facilitate different installations, and molded or fold down seats are available. By maintaining a diverse product line that can be manufactured by the same equipment, individual user needs are met without significant custom design costs.

The International Cushioned Products company has a different approach to bathing unit design. They manufacture the Soft Bathtub, a bath tub with a soft foam lining covered by a flexible coating (Fig. 19). The surface is very durable, resisting most accidental puncture damage. Moreover, it is non porous, thus it is easy to clean and will not support the growth of bacteria. In fact, it has also been used widely to make safer and cleaner amusement park water slides. The polyurethane covered foam lining makes the tub safer by increasing slip resistance and protecting those who fall from serious impact injury. These are extremely valuable features for older people and people with disabilities. What others would consider relatively minor accidents can be severe problems for these groups.

Accessories in the bathroom can often make a major difference in accessibility. HEWI Inc. manufactures several items that increase bathroom accessibility. These include a pivoting grab bar that folds flat against the wall when not in use and an adjustable mirror that can accommodate people of different heights (Fig. 20). All of the HEWI products are coated with a nylon surface, which is non porous and thus easy to clean and resistant to the growth of bacteria. This surface comes in a variety of attractive colors, and makes the bars warm to touch.

The Seachrome Corporation manufactures grab bars as well as shower seats and other accessories. They focus on a more cost conscious market than companies like Linido or HEWI. The majority of Seachrome's business is supplying functional stainless steel grab bars and shower seats to meet accessibility codes. Recognizing the growing trend in combining function with aesthetics, the company has offered a solid brass bar and other decorative style products for high end residential and commercial applications (Fig. 21). Seachrome is also extremely active in the Original Equipment Manufacture (OEM) and private label markets, producing both standard and specially designed grab bars for other manufacturers.

Lubidet corporation takes a more high tech approach to plumbing accessories. They manufacture a product that fits onto an existing toilet, transforming it into a bidet without interfering with normal toilet functions (Fig. 22). The unit provides a warm water wash

and air dry at the touch of a button. It can be installed on either the right or left side of the toilet, and the activation button can be equipped with an extension for those with severe reach limitations. A bidet is advantageous for many people with disabilities and the elderly, or anyone with reach limitations. However, the appeal of the Lubidet is broader. Everyone can benefit from the added hygiene provided by a bidet, particularly those with incontinence, women who are menstruating, those with hemorrhoids or anyone who has had pelvic surgery or recently gone through childbirth. It can be easily moved to accommodate a change of residence, protecting the value of the investment over time.



Fig 22. The Lubidet enhances independence and comfort on the toilet.
(photo from Lubidet Corp.)

Yet another high tech approach to universal design in the bathroom is being pursued by Freedom Bath (Fig. 23). This company manufactures a bathing unit that includes several automated features. By activating a switch, one wall of the tub slides down, allowing a person with limited mobility or a wheelchair user to transfer to the molded seat without climbing over a tub rim. This feature also helps caregivers because it reduces the need for heavy lifting. Once inside, the door is raised and the tub filled. It fills and drains more rapidly than a standard tub, reducing the amount of time that a person must be exposed to cool air. The tub includes a whirlpool for therapy, and is priced competitively with other high end whirlpool or therapeutic tubs.



Fig. 23 The Freedom Bath provides easy access through automation
(photo from Freedom Bath Corp)

High technology approaches are also applicable to the kitchen. AD/AS uses a hydraulic mechanism in order to create a height adjustable sink that can be activated at the touch of a button (Fig. 24). Flexible plumbing connections, or connections mounted in sleeves with the traps below the adjustable section allow instant flexibility.



Fig. 24 AD/AS uses automation to provide instant flexibility
(photo from AD/AS)

The Challenges of Marketing

There are many benefits to universal design. One of the participating companies estimated that the safety features built into a \$1000 product could help to prevent hip injuries from falls and eliminate the health care cost associated with them, an average of \$12,000 (Associated Press, 1994). Yet marketing these products to an older population and those with disabilities is still a challenge. Consumer education is the stumbling block. Traditional marketing venues such as trade and home shows and direct mailing don't seem to be productive. The market simply isn't accessible through these avenues. Other forms of

advertising do little to educate prospective consumers about the benefits of accessibility products. Elderly consumers, in particular, are very reluctant to spend money on products they know little about. Added to this is a fear of fraud, making reliability and trust important concerns.

Aqua Bath has taken some innovative steps in marketing its Remodeler products to its primary consumer base, the elderly. By forming relationships with local senior centers, they were able to arrange field trips to their manufacturing facility. Once there, a group of seniors receives a tour of the facility, views the methods of manufacture and then participates in a focus group in which they are able to comment on the product as well hear how the Remodeler could alleviate their problems. This method establishes a rapport with the prospective client base and addresses their concerns in a no nonsense, non-sales oriented way. While it is unrealistic to expect visitors to travel long distances to view factory floors, the process could be replicated through the use of media such as video. The key concept is establishing a personal relationship with a consumer in a setting that is familiar and that establishes trust.

Direct marketing is not the only effective method. OEMs can offer another option for smaller companies making accessible products. Rather than creating their own cabinetry product line, AD/AS is attempting to market their adjustable sink product to larger cabinetry companies in order to incorporate it into existing product lines. By establishing relationships with larger companies who are better equipped to market their product, AD/AS can concentrate on manufacturing and improving their design. AD/AS is also establishing relationships with housing developers who wish to offer adjustable sinks as an accessibility feature in public housing. Finally, they are pursuing relationships with companies like Home Depot, who wish to offer their customers options for accessibility and usability in their kitchen and bath design departments. These strategies acknowledge that individual consumers are not the only targets of marketing efforts.

One of the greatest challenges is that many of these products are “ahead of the curve” when compared to conventional designs. Products such as the AD/AS adjustable sink units, ICP Soft Bathtub and the Freedom Bath are relatively high end products. While providing added safety and convenience, they are viewed as luxury items. The Lubidet faces a cultural challenge as well, since bidet use is not common in this country. As more and

more companies begin to adopt a universal design approach to products, these innovations will become more common and desirable. The current challenge is to introduce these new technologies in an affordable way in order to compete with conventional products.

Barriers to Innovation

Manufacturers and designers agree that there are many barriers to innovation in the area of universal design and perhaps in the design of plumbing fixtures in general. These include: restrictive codes, tradition, lack of a systems approach and indirect marketing.

Codes can limit innovation by specifying features too narrowly. Research demonstrates that different groups of people benefit from different features. Some requirements of accessibility codes and standards are based on the needs of wheelchair users. This limits the ability to accommodate a less severely disabled group more effectively. For example, most codes require a grab bar in a toilet stall or bathroom mounted on a wall that is 18 in. on center from the water closet. The bar must be mounted 33 in. to 36 in. high and extend 42 in. long parallel from the floor starting from a point 12 in. from the rear wall. This design is best for people who transfer from a wheelchair to a water closet. Some people use these bars to pull themselves up and maintain stability when doing a pivot transfer from chair to water closet or the reverse. Others use them to pull themselves across to the water closet from the chair. Recent research has demonstrated, however, that older ambulant people can most benefit from bars they can use to push off from when standing up from the water closet. To be most effective for them, these bars should be placed closer to the water closet and much lower than 33 in.

Pivoting or hinged bars mounted on back walls can be used to provide the option without conflict with the existing requirements because these bars can be moved out of the way when not needed. But code officials may reject such additions because they are viewed as obstructions to use of the toilet stall. A third type of bar, one that is mounted on a wall but extends up at a 45 degree angle to floor after about 30 in. of horizontal run is also preferred by the elderly to the standard horizontal bar. Such a bar should be usable for both wheelchair transfers and standing mounts and dismounts. The lack of a mechanism to add optional features

to a “one size fits all” design specified by code limits innovation. There are other examples of restrictive code requirements. These include the requirement for a circular profile on grab bars, the very specific dimensional constraints for knee clearances at lavatories, sinks and water fountains, dimensions of shower stalls and the requirements for the location of controls in bathtubs and showers. It is hoped that the revision of CABO/ANSI A117.1 and the ADAAG will address some of these restrictive requirements.

Tradition is another important constraint on innovation. Plumbing fixtures have been the same for so long that it is very difficult to imagine consumer acceptance for new features. Material is a case in point. The ICP Soft Bathtub often elicits an immediate emotional reaction. Many consumers believe that the soft surface will damage easily and be difficult to clean. Yet, the ICP material is used in water parks where it gets much more abuse than it would get in a residential bathroom and where hygiene is a serious management concern. Not all soft materials are created equal. The new technology used by ICP is actually superior to many other surfaces in both durability and maintainability. It resists accidental puncture very well and it is much easier to clean because it is non porous. A quick wipe of the surface can clean off dirt with relative ease. In comparison to a porcelain enamel or china surface, IPC’s material is superior yet they have to constantly overcome the weight of tradition by educating the consumer about the differences. Manufacturers using acrylic, fiberglass and other “new” material as well as those offering other new features like electronic controls, built in lighting and adjustability face the same resistance.

Most plumbing fixtures are designed as stand alone products. To fixture producers, system design is limited to standard interfaces for faucets and rough ins and color/style coordination. Manufacturers of accessories and fixtures do not work together to integrate their products. Accessory manufacturers, in particular, accept industry conventions as givens. Thus accessories like grab bars, shower seats and storage devices do not fit very well with the fixtures. Moreover, the fixture manufacturers have left the field of add-on customization or personalization to small manufacturers. The result is that good ideas for accessories are difficult to market and often have inherent flaws due to lack of modular coordination. Where there is integration, closed system designs are used that limit options

and flexibility. For example, grab bars and shower seats can be easily attached to tubs and shower stalls. In fact, many manufacturers of prefabricated shower stalls and tubs provide integrated bars. But these bars are usually installed in fixed locations limiting their adaptability to individual needs. They are often more decorative than useful for supporting transfers. A systems approach that would specify interfaces like those for connecting water supplies and drains could open up new avenues for partnerships between accessory and fixture producers.

One can imagine purchasing a tub/shower that has connections built in for inserting grab bars, storage devices or seats of different types. Several manufacturers could then produce optional products that the consumer could select to personalize their unit for their specific needs. A fixture manufacturer, acting as an OEM, could offer an array of options along with the unit. Such an integrated open systems approach would lead to safer, more usable products and provide marketing benefits for all involved. The open systems approach to design requires modular coordination, some industry standards on connection systems and communication among the various producers. No doubt other advantages for the industry as a whole would emerge from such activities.

Plumbing fixtures in new construction are not marketed directly to the consumer. Builders make decisions on which fixtures to include based on marketability and profit. Even when building custom homes, builders usually give consumers only a limited selection of options. It is doubtful that they give much consideration to the usability of the plumbing products they install. They are probably more focused on cost and aesthetics because few consumers will take a water closet or shower for a test drive before making a decision to buy a house or rent an apartment. Moreover, it is unlikely that plumbing fixtures alone will sway a sale one way or another.

When a product is marketed directly to consumers, on the other hand, the entire decision is in the consumer's hands and usability becomes a much more important priority in decision making. Good examples are the consumer electronics and computer industries. Indirect marketing therefore is a barrier to innovation in usability features because there is no mechanism for real consumer demand to influence the purchase decision in a significant way. This is particularly a problem in highly

competitive markets where the additional cost of an added feature will eat into the profit of the builder.

One way to overcome this barrier is to demonstrate to the builder the value of innovative products in creating a competitive edge. While this may not be too effective where competition is primarily based on price, it can be very useful in higher priced markets where value is the issue. In these markets, safety and accessibility will be perceived as a real plus, particularly if the age range of potential consumers is late middle aged and older. Builders must understand that one or two universal design features alone will not be as effective as a holistic approach. Thus, GE Appliance's Real Life Design campaign extends beyond the appliances that GE makes to the entire kitchen environment. GE recognizes that appliances are used in context. Every single convenience feature in a kitchen contributes to the usability of the kitchen as a whole. Once a builder decides to make a universally designed kitchen or bathroom, they should consider each and every feature in the room in relationship to that goal. After all, what good is a bathroom with an easy to use sink but a hard to use bathtub?

Strategies for Universal Design

This report has described many products that enhance accessibility and have universal features. From these products, as well as other sources, a list of strategies for designing universal plumbing fixtures and accessories has been developed.

- **Better ergonomic design**

Products should be designed with the physical needs of the users in mind, not just their functions. A good example is the depth of sink bowls. While a deep kitchen sink can accommodate a lot of water and many dishes, it is often the source of back problems. Reducing the depth of the bowl and expanding its width provides just as much functionality and increases comfort and ease of use.

- **Accommodate of a wider anthropometric range**

Too many products are designed with a “one size fits all” mentality. The same products and designs are used to accommodate children, their parents, as well as their grandparents. This is aggravated by codes that prescribe compromise conditions in order to accommodate a limited percentile range of sizes. Designing products that

are adjustable can increase their usability as well as satisfy codes. Allowing options in similar designs can also enhance usability. For example, sinks with drains toward the rear, rather than the center of the bowl can accommodate users who need to have knee space under the counter.

- **Use of a systems approach**

Products that are designed to be flexible and modular can also go a long way toward accommodating different users. Products using a systems approach can be changed over time in order to accommodate changing needs. Furthermore, components can be purchased incrementally, as finances allow. This approach also allows related products to work together. The toilet area could be seen not as a collection of discrete products, but rather a *toileting center*, with options for bars, different flushing mechanisms, toilet paper holders, etc.

- **Better surface treatment**

Kitchens, and especially bathrooms, are filled with hazardous surfaces. Products that incorporate non-slip surfaces, as well as surfaces that are less dangerous greatly increase safety. The ICP Soft Bathtub is an excellent example of such an innovation.

- **Integration of other building systems**

Products that incorporate such features as additional lighting, electrical connections and storage add functionality to a bathroom or kitchen. This also increases efficiency and saves space, adding value to the product.

- **Better space planning**

Innovative space planning can also be achieved through product design. Interchangeable positions for plumbing fixtures and the hardware to support this type of accommodation allows greater flexibility and accessibility. For example, a person who is disabled in an accident may find that his or her toilet cannot be approached from the open side. Relocating the fixture may be all that is needed to achieve independence. Radical space planning concepts, such as first floor room conversion kits to create bathrooms, or mobile “pods,” that can add a bathroom to the side of a house can also increase accessibility.

- **Provide a choice of attractive styles and range of prices**

This strategy will broaden a product's appeal and market, by addressing a range of individual preferences and choices. Product lines should offer a variety of colors, styles and materials. Different price points and levels of luxury also broaden a products appeal.

Conclusion

It is no longer necessary to perpetuate the design conventions of the past that do not meet current challenges as our society ages and becomes more inclusive of people with disabilities. Social pressures toward civil rights for all demand that we rethink concepts and break limiting traditions in all product design, including plumbing fixtures. Economics and practicality also indicate that a shift of focus is in order. Advances in technology and materials, as well as the better understanding of the needs of a diverse society, are charting the future path for the “march of progress.”

Our society is aging rapidly; every year a greater percentage of the population is over 65 and their needs are changing. Research has shown that conventional plumbing fixture design does not meet the needs of older people. Current designs are hazardous and difficult to use, increasing the risk of injury and “handicapping” older people with dependence. As more of the population experiences limitations in function, strategies must be developed for product design that meet the needs of a diverse population. Government has responded to these social changes by enacting laws to mandate minimum levels of accessibility, but the regulations are not enough. Rather than create special products to meet the needs of niche markets, a better approach is to incorporate universal design into main product lines.

A universal design philosophy seeks to provide products that are safe and easy to use by everyone, regardless of differences in ability or functional limitations. Rather than focusing on end products, universal design focuses on the process of design and how diverse needs can be met. Universal products not only provide accessibility, but are attractive, easy to use and offer safety features. These features are inherent, and thus “hidden” in the design that will be used by everyone. Mary Jo Peterson's example of a dishwasher installed under a higher counter illustrates this idea well. Not only is accessibility provided for people who use wheelchairs, but everyone benefits from not

having to bend as far to reach inside the appliance. The differences in counter height provide choices and accommodates different types of tasks. Through programs such as General Electric's Real Life Design, the industry can educate the consumer about what the future holds, and how universal products can benefit them today.

Many companies have already implemented a universal design approach. In order to position themselves to provide competitive products in the face of impending government regulations, companies like Delta adopted universal design. Rather than following convention and offering special products that met the minimum specifications of codes, such as the "wheelchair lavatory," they implemented product lines that offered accessibility, safety and aesthetics through a systems approach. These designs satisfied the codes, allowed the companies to implement accessibility in a cost effective way and offered consumers greater choice and value.

The grab bar is a perfect example of the way that regulations do not meet the full spectrum of consumer needs. In attempting to specify minimum standards to insure civil rights, industry perceives that government has become too rigid in its prescriptions. Product innovation often provides a greater level of accessibility than the codes, however the codes are difficult to change to allow use of these new products. The pivoting grab bar is an excellent example of this frustration. Furthermore, inconsistencies across state and federal codes also make it difficult for industry to bring innovative products to market. Greater communication between industry and government, as well as more flexibility in the regulations are needed to ease the frustrations of industry and aid the movement toward universal design.

Regulations are not the only challenges to innovation. Traditional marketing practices have been inadequate to bring accessibility products to consumers. New avenues, such as establishing direct relationships with consumer organizations, can provide the means to educate consumers about the value of universal products in an atmosphere that establishes trust. Marketing to OEMs and larger companies to incorporate innovative products into established lines may also be a way for smaller companies to overcome the marketing hurdle. The greatest challenges confront companies that are "ahead of the curve" and manufacture products that are not yet accepted. Eventually, universal design will become the convention for product designs.

How can manufacturers, government, and research and development groups plan to facilitate the development of universal design in the plumbing products industry? At the Forum, steps for an action agenda were discussed.

Changes in the regulatory process seem to be high on everyone's list of priorities. Implementation of less restrictive codes that will allow more innovation and flexibility based on consumer needs would ease the restrictions on industry and encourage better designs. Uniformity of regulations and codes across municipal and state boundaries would make it easier to deliver universal designs. In a growing global economy, uniformity across national boundaries is also a concern. Implementing national codes as well as acknowledging the importance of international standards such as ISO9000 seems to be an important future direction. Achieving uniformity requires efforts to educate government agencies about the universal design approach. Implementation of performance standards, rather than prescriptive and sometimes restrictive codes would clearly improve matters.

Another priority is developing a system of third party review and certification of products. This system could work closely with code agencies, industry, and consumers in order to educate both about current research and state of the art approaches. Access to and understanding of current research data seems to be a problem in the industry, as well as in government. Furthermore, government agencies do not have access to the technical information and expertise that is available to industry. A third party could act as liaison and impartial expert to facilitate the introduction of universal designs into the market. Coordination services could also be developed by associations such as ASAP, in order to facilitate interaction between component manufacturers and OEMs. Also, development of open system standards, so that products from diverse manufacturers could work together, would be of great assistance in the design of universal products.

These standards might be especially helpful across product family lines. Rehabilitation products could be made with plumbing fixture design in mind. For example, electric wheelchairs could be equipped with standard remote control devices that would allow the users to change adjustable sinks. A lower tech adaptation could be a transfer board that is integral to the chair,

and affixes to standard brackets built into a toilet. This would allow safer transfers for those who make use of transfer boards. By establishing open standards, products from very different families can work together, increasing usability for all.

Education of the public about the benefits of universally designed products is a high priority. Outreach programs centered at universities and other research centers can help in this task, but manufacturers can also provide effective education through their marketing efforts. Forming relationships with established national organizations such as the National Council on Aging can increase the exposure of companies making universal products. Associations with other companies who manufacture compatible products to create home show displays, consumer showrooms or displays in home improvement stores are other marketing strategies that can help educate consumers. These ideas can be carried into other media, such as print or video, in order to broaden a company's reach. In addition to focusing on sales, programs must educate consumers about the benefits that universal design can achieve.

Third party reimbursement is also an area of concern. It seems that those who would benefit the most from accessible products are often the least able to pay for them. Education and reform underway in the health care reimbursement system could impart benefits to address accessibility problems. Home modifications are far less expensive than home care services or nursing home care. Industry can also work more closely with third party payers to facilitate reimbursement and eliminate red tape. Making it easier for the end user to pay for and install devices will help to increase sales.

Innovation is occurring in a slow and incremental manner. But, there is an inevitable trend toward universal design. It simply makes sense in order to meet the demands of a changing market. An industry-wide commitment toward universal design could speed change, benefiting both consumers and producers. This commitment should focus on innovation through strategies such as better ergonomic design and technology transfer. Industry can help itself by taking a leadership role in working with government, researchers and consumers in order to meet the challenge.

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Companies:

Aqua Bath
Aqua Glass
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HEWI
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Seachrome
Upper Tubs

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