Universal Design: Comparative Costs for Implementation

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In our modern world minorities remain discriminated against and excluded through the structure and norms of our society. For example, implicit biases have been shown to negatively affect people of color when receiving medical care. People of color face more barriers to accessing healthcare, and when they do receive care, they are more dissatisfied with their experience than white people (US Department of Health and Human Services, 2003). There has been increasing focus on equitable design in technologies over recent years with diversity, equity, and inclusion (DEI) being emphasized throughout companies and universities around the world. Every year companies in the US spend around $8 billion on DEI efforts, according to research by the consulting firm McKinsey & Company (Ellingrud et al., 2023). DEI efforts focus on developing products and environments for all while recognizing that those from underrepresented groups, such as students with disabilities, have additional barriers to equity. Universal design is a concept that aims to address the issues highlighted by DEI. Traditional design practices often focus on the average user, which can leave out people with disabilities (Burgstahler, 2021). The universal design approach eliminates deficits in products and environments that make them inaccessible to some people in order to provide the same improved experience for all. My research will investigate the costs associated with universal design and universality in relation to comparative costs. I will detail the benefits, costs, and counter arguments of universal design as factors in its potential for future applications.

Discussion of Literature

Universal design is a methodology meant to include the maximum number of people possible, regardless of age, sex, disability, or other factors. While most products are designed to

be suitable for the average user, universally designed products are designed to be used by every possible person without the need for adaptation or modification. There are seven principles of universal design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach in use. Equitable use means that the design is usable and marketable to all users and avoids the segregation of any disabilities. Flexibility in use is the idea that the design is open to preferences from the user and can be used in different ways according to the user to accomplish the same goal. Simple and intuitive use is easy to understand and interpret regardless of level of education, experience, or language. Perceptible information means that the design communicates information to the user effectively through multiple means that ensures all users can understand. Tolerance for error in design accounts for mistakes and mitigates hazards by providing warnings and implementing fail safes. Low physical effort in design helps those less able bodied to experience the same product. Finally, size and space for approach in use means that the product can be seen, used, and handled regardless of body positioning or mobility (Centre for Excellence in Universal Design, n.d.).

Universal design has significant benefits to society as a whole. It greatly benefits individuals who experience challenges with common frameworks of our society such as web design or the physical design of public spaces. The adoption of universal design is especially important as our population continues to rise in average age. In 2022 National Census found the number of people over 80 years of age increased by 25% since the 2016 census (Centre for Excellence in Universal Design, n.d.). Along with an aging population comes an increase in the disabled and people with difficulties in mobility. In the 2022 national census the percentage of persons with disabilities was 22% up from 15% in the 2016 census (Centre for Excellence in

Universal Design, n.d.). While universal design conceptually benefits all people with or without disabilities, those with disabilities stand the most to gain as they currently experience difficulties with current systems. Thus, it is important to invest in universal design practices as the need for it in our population continuously increases.

Universal design principles can increase the quality and economic impact of goods and services. Universal design supports the production of goods that are differentiated from competitors' which could provide economic advantages. It fosters competitiveness that can breed innovative solutions. It does this through aiming to serve the maximum number of users, being more intuitively usable, and being better able to satisfy all users' needs. This provides competitive advantages such as increased market share due to the increase in number of potential users reached, greater differentiation of products and services, and greater customer loyalty. Additionally, companies that invest in universal design principles can gain a reputational advantage over competitors that do not make such investments (Verma, 2021). It may be in the best interest of companies to invest money and resources into universal design as it can provide several advantages over competitors that could provide them greater profits and growth in their industry. This can be viewed as an argument for universal design and should be weighed in the comparative costs of universal design that will be discussed.

Case Discussion

The cost of universal design can be evaluated through the design of sidewalks. Sidewalks are an integral part of our society and provide valuable connections between people and places. They allow people to socialize, events to happen, and public spaces to populate. When sidewalks are not accessible to the whole community, they exclude those that can not use them from the

community. The movement of people in shared spaces is vitally important to the social network of a community, and sidewalk accessibility acts as a barrier that allows or disallows certain parts of the population. Before adoption of accessibility in public spaces, the disability rights movement performed protests, drafted legislation, lobbied, and filed lawsuits in order to effect change (Mayerson, 2012).

As a result of these efforts from the disability rights movement, an early historic shift in disability public policy occurred in 1973 with the passage of Section 504 of the 1973 Rehabilitation Act, which banned discrimination on the basis of disability for recipients of federal funds (Baird & Rosenbaum, 2008). 17 years later the Americans with Disabilities Act (ADA) passed in Congress. This monumental act prohibits discrimination on the basis of disability just as other civil rights laws prohibit discrimination on the basis of race, color, sex, national origin, age, and religion. The important part, however, is that the ADA guarantees that people with disabilities have the same opportunities as everyone else to enjoy employment opportunities, purchase goods and services, and participate in state and local government programs (*Introduction to the Americans with Disabilities Act*, 2024). Accessible sidewalk designs resulting from the passage of the ADA have formed essential principles of universal design that continue to affect modern designs and concepts of universality.

Example 1: Curb Cuts

One extremely important product of the ADA is curb cuts. Curb cuts are ramps in a curb that create a gradual downward slope until the sidewalk is flush with the street. The ramp's slope is gradual enough so that it can be easily climbed, and wide enough to enable one to maneuver a wheelchair with ease. For curb cuts to be effective, there must be one located at each corner of an

intersection so that wheelchair users can cross streets quickly and safely (Elin, 1996). Before the 1960s and 1970s, most curbs of sidewalks included a sharp drop-off into the street that made it difficult for those in wheelchairs or with other physical disabilities to cross from the street to the sidewalk or vice versa. Curb cuts were first implemented in the United States after World War II, when many veterans returned home with disabilities and struggled to participate in their communities due to inaccessible sidewalks and streets. Wheelchair users were forced to find the nearest driveway and sometimes cross busy streets in order to reach the sidewalks.

Although the ADA stated that designs like the curb cut must be used in certain spaces, the actual adoption of these designs was by no means immediate. Cities and towns were not quick to adopt curb cuts as they would require investment in money and time. Many municipalities were already operating on strict budgets and some were close to bankruptcy with no room for added expenses. Due to the failure of municipalities to implement curb cuts, in November 1993, the U.S. Court of Appeals for the Third Circuit held in *Kinney v. Yerusalim* that every time a municipality resurfaces a street, it is required to make curb cuts in the adjacent street corners regardless of the cost to the municipality or taxpayers (Elin, 1996). This struggle outlines one of the greatest arguments against universal design which is the upfront financial cost.

Example 2: Accessible Pedestrian Signals (APS)

Modern sidewalk design incorporates the principles of universal design. Universally designed streets have aspects such as wide sidewalks and pathways to allow wheelchairs and pedestrians to move freely, perpendicular tactile paving that gives physical feedback of where you are and what you will encounter, small places of enclosure that can allow those with sensory

processing issues to feel less overwhelmed, and flexible seating to fit the needs of different people among other design features (*Universal Design: Streets | Asla.Org*, n.d.). These designs can have incredible impacts on both the inclusion of the disabled but also the general enjoyment of the non-disabled population in these spaces. The adoption of these principles increases the usability and accessibility of these spaces for all people, which is the purpose of universal design.

Accessible Pedestrian Signals (APS) help pedestrians who are blind or have impaired vision to cross the street. APS devices are installed on poles at sidewalk corners near crosswalks, and they play a low tone to help pedestrians locate the APS. Each device has a button with a raised arrow pointing in the direction of the crosswalk. When a person presses the APS button and the "don't walk" signal is displayed, a voice message will say "wait" followed by a slow audible beep. When the walk interval begins the button vibrates and a rapid beep or voice lets the pedestrian know that they may cross the street (*NYC DOT - Accessible Pedestrian Signals*, n.d.).

To assess the cost of implementing APS, it can be broken down into the cost of replacing existing pedestrian signals and installing new ones and maintaining these signals. We can analyze the costs required for implementing APS in intersections across the United States in order to assess the economic burden. The cost of using APS rather than conventional signals for replacements is approximately $38.9 million per year, and the cost of equipping new intersections with APS rather than conventional pedestrian signals would be $8.3 million per year. Overall, total compliance costs would total $47.1 million per year over a 25-year signal replacement cycle (Volpe National Transportation Systems Center, 2010). This is a significant additional expense, but it would provide immense levels of accessibility and social good.

Conclusion

The universal design of sidewalks has significant financial costs compared to conventional sidewalk design. The costs, however, would provide a great level of social utility through the inclusion of all members of society. While universal design may take investment of time and resources that could be spent elsewhere, the social benefits gained can be argued to outweigh the monetary cost. When we embrace the inclusion of every member of our community, then we benefit from the diversity of everyone's experiences and perspectives.

Counter Arguments

Critics of universal design argue that while it provides useful and beneficial theoretical concepts, the weakness of universal design is that it is simply impossible to adapt the environment completely to the users. Adaptability is deemed more important as it is hard to justify that all users should be 'penalized' for universal design, and the possibility to adapt a design to every user can be justified more easily than a 'universally accessible' design whose capacities are underused (Cauwer et al., 2009). It can be argued that because the majority of people do not suffer from afflictions that require non-standard designs, it would be a better use of resources to design for the majority and adapt for the minority. The comparative cost of implementing universal designs relative to the benefits gained may not be the most efficient solution. The market for adaptable designs for current technologies is large and increasing. The worldwide market for disabled and elderly assistive technology is reported to be 46.11 billion USD in 2021 and is projected to grow to 66.84 billion USD by 2030 as the worldwide population increases in age (Custom Market Insights, 2023). As this market continues to grow, it may be a

better commitment of resources to continue to invest in these adaptive technologies rather than try to redesign technology to apply universally.

A progressive critique of universal design argues that by aiming to create environments in which every person has the same experience, it discounts the real discrimination that historically and currently affects disabled people. Critical disability theory criticizes the disability-neutral approach of universal design marketing because of how it creates the notion that ableism has been eradicated. It creates a framework that necessarily assumes discrimination on the basis of disability does not and can not exist in universally designed spaces. This is similar to arguments of critical race theory that racism is not gone because laws have been passed to make racism in certain forms illegal (Hamraie, 2016). While universal design may provide improved accessibility, it could fail to address the underlying social discrimination against disabled people that could still perpetuate in these universally designed spaces because it remains as a prevalent bias. Advocates of this ideology would argue for more explicit solutions that look to advantage disabled people rather than vague ideas that theoretically provide everyone with the same experience. In order for these inequalities to be addressed and dismantled, they must be acknowledged.

Universal design and the related Universal Design for Learning (UDL) draw similarities to the debunked idea of learning styles. UDL uses the concepts of universal design and applies them to teaching methods in order to try to maximize the learning experience for all people. The concept of different learning styles stated that people were best suited to learn in certain ways such as auditory learning, visual learning, or learning through hands-on work. Every person had an optimal style that if met would lead to the maximum amount of learning. This idea has been debunked and shown to be an overgeneralization of neuroscience research. UDL may fall victim

to this same generalization. Both ideas emphasize diversity in learning over universal learning principles and hypothesize that matching instruction to students' unique way of learning leads to increased learning. Universal Design is touted as a maximally inclusive and effective method due to its application to the maximum number of people, however, it may be the case that trying to design for every single person leads to ineffective or inadequate designs for many (Boysen, 2021). This ties into the idea of comparative costs in relation to universal design in that it can provide great value for some but could diminish the experience of others.

Analysis

Universal design has both economic and societal benefits. It creates a space where all people regardless of physical or mental ability can function in the same way. The inclusion of disabled people would provide great societal benefit as their participation in society is good for them but other members of society as well. The inclusion of disabled people in the workforce would increase economic output and wealth of the population that would have positive downstream effects on the economy. These benefits are difficult to specify in tangible ways, however, and they require speculative analysis. Along with these benefits come economic and societal costs as well. The financial costs discussed in the case study are significant compared to current standard developments. Additionally in the field of web design, on average, ADA compliance services cost $1500 to $5000 to make a website compliant. ADA compliance includes adherence to improvements on perceivability, operability, understandability, and robustness (*ADA Compliance Pricing: The Cost of Accessible Web Design*, n.d.). Many websites could get away without investing in these improvements and provide a satisfactory experience for most of their users. This would, however, exclude a potential portion of the market which

could decrease overall profitability for the sake of upfront savings. The societal costs of sacrificing the experience of the many to improve the experience of disabled people are notable, but the net positive from the drastic increase in well-being of disabled people makes the investment worthwhile. The comparative costs of universal design discussed indicate that the implementation of universally designed technologies would provide overall societal good along with an associated economic burden and possible societal cost associated with the concept of disability-neutral designs. Engineers shape the world as we experience it and are responsible for the collective well being of society. The inclusion of disabled people through universal design is a necessary good for society and provides long term economic and social benefits. Universal design has limits and it may not be feasible to adopt it in every single facet of our society, however, where principles can be applied at least in part will contribute to a more equitable and healthy society.

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