Analysis of Government Incentive Structures in Adopting Accessible Technology

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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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The State of Technological Adoption

In 2022, the US Bureau of Economic Analysis reported 10% of the US GDP is purely electronic (US Bureau of Stat. Analysis, 2022). From legal automation to industrial agriculture, technology has continually reshaped the roles and responsibilities of traditional jobs. This transformation holds significant promise for individuals with disabilities, who now have unprecedented opportunities to engage with the world around them.

More specifically, the advent of supplementary technological devices with dictation and eye-tracking enable those with disabilities to take roles that had previously been unobtainable (WebAIM, 2020). However, there remains a significant gap between the capabilities of digital technology and the practical technological devices that companies market into our daily lives. A large part of this can be attributed to the breakneck pace of technological innovation that is powered by the private sector, a population focused on creating gloves that are "one-size-fits-most" (Nielsen & Norman, 2015).

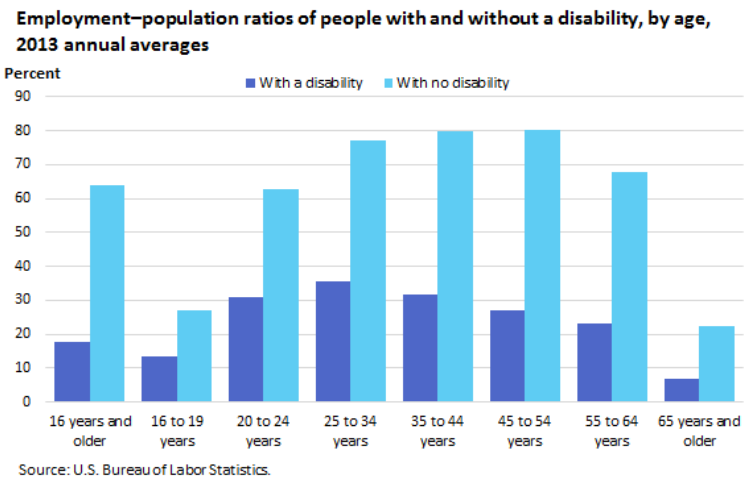
The consequences of this gap are far-reaching, affecting the educational and professional opportunities of individuals with disabilities. Ning Qiu, a professor at Shandong Jianzhu University, estimates that disability related deprivation constitutes an almost 60% decrease in the level of employment given to those with serious disabilities worldwide (Qiu, 2023). This number is further exacerbated by the number of "livable salaries" continuing to dwindle, with an expected 44% of all workers earning below the necessary amount of money needed to pay for basic necessities (US Bureau of Statistics on Employment, 2020).

However, accessible technology has the potential to break this cycle by providing a more accessible and personalized digital landscape. By enabling workers to be far more productive and providing intelligent online education, the overall GDP per capita can be greatly improved. The technological capabilities to make this change has existed in research and continues to proliferate in accessibility and design circles (Zaina, 2022). However, these

accessible technologies can often take over 20 years to become mainstream (WebAIM, 2020). In this paper, I argue that the examination of incentive structures that fuel the adoption of technology is critical in delivering intelligent intervention of accessible technologies. Through an analysis of the current state of technological adoption, the strengths and weaknesses of various incentive structures are assessed. These evaluations draw upon ideas from Mesthene's "Economic and Political Organization" as they form an analytical basis for developing holistic, non-intrusive methods of proliferating accessible technology to empower individuals with disabilities.

Potential for Technological Disruption in Accessibility

The current job market presents a unique set of challenges for individuals with disabilities. In 2021, the employment rate for persons with a disability was 19.1%, significantly lower than the 63.7% employment rate for persons without a disability. This disparity is evident while controlling for all factors: race, age and education, with individuals with disabilities consistently being less likely to be employed (BLS, 2022).



However, specific types of technology have the potential to radically improve employment opportunities for individuals with disabilities. Assistive technology, including software, devices, or equipment, can help individuals with disabilities perform functions that might otherwise be difficult. For instance, virtual or augmented reality technology is being explored to help individuals return to employment after a stroke or injury (BLS, 2022).

Other types of technology such as AI create unique opportunities for workers with disabilities. AI-powered chatbots can guide disabled people through extensive dialogue to determine what kind of work they may be qualified for and also help people determine what kind of training they could benefit from (BLS, 2022). AI also can modify computer usage to better accommodate disabled workers, enabling them to better see, hear, and reason (BLS 2022). However, technology doesn't just hold promise in leveling up individuals with disabilities, but can also streamline a more inclusive hiring process. Research from leading accessibility institutes such as Peatworks shows that artificial intelligence can help reduce bias against all candidates, including those with disabilities (Peatworks, 2023). For instance, an accessible chatbot that allows applicants to speak their skills instead of typing them can make the application process more manageable for individuals with limited hand dexterity (Peatworks, 2023).

One of the most promising advancements in recent years is the development of brain-computer interface (BCI) technology. This technology, which can decode words from a person's thoughts, is particularly targeted at individuals who have lost their ability to speak. Teams at Stanford University and UC San Francisco have achieved word decoding rates of 62 words per minute (wpm) and 78 wpm respectively using this technology. BCI technology has the potential to revolutionize communication for individuals with severe speech and physical impairments. By translating brain signals into speech, it can provide a new way of expression for those who have lost the ability to speak due to conditions such as stroke, ALS, or spinal cord injury. Brain-computer technology like this could open up a world of possibilities, enabling individuals with severe disabilities to engage in conversations, express their thoughts and feelings, and participate more fully in society.

Another example of an interesting application is "Ava", a software designed to provide instant captions for online and in-person meetings. This application makes meetings more accessible for deaf and hard-of-hearing individuals by providing real-time transcriptions. It also

color-codes who is speaking in a conversation, making it easier to follow along. The Ava application represents a significant step forward in making communication more accessible. By providing real-time captions, it allows deaf and hard-of-hearing individuals to participate in conversations and meetings that they might otherwise be excluded from. This can have far-reaching implications, opening up new opportunities in education, employment, and social interaction (Ava, 2021).

In addition to research, there are many other organizations actively trying to improve accessibility for individuals with disabilities. The Kessler Foundation, funded by the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR), has developed a Virtual Reality Job Interview Program. This program is designed to help individuals looking to re-enter the workforce after a traumatic brain injury or stroke. By simulating job interview scenarios in a controlled virtual environment, the program allows individuals to practice and improve their interview skills, thereby increasing their chances of successful employment (Ramihi, 2019).

All of this innovative technology holds significant promise for improving accessibility for individuals with disabilities. With recent advancements such as BCI technology and consumer applications like Ava, there exists many powerful tools to break down barriers while opening up dozens of new opportunities in the realm of accessibility.

However, these technologies are only potent changemakers if they can actually reach the hands of consumers. Pressures from shareholders continually push private companies to make profit-focused decisions. While some larger companies have begun to factor in accessibility after achieving higher levels of critical mass (Apple, 2023), private companies continue to fail to consider it as a core part of their engineering design.

It's critical to address the systemic limitations of free markets in supporting minority populations, particularly those with lesser economic influence. This is highlighted in the observation that free markets often don't inherently prioritize the needs of such groups (IMF, 2020). Therefore, deliberate and strategic interventions are essential to ensure equitable access and integration of accessible technological innovations, especially those designed for enhancing accessibility for people with disabilities. Since the government plays a huge role in correcting the economic factors that decide what products to create, its important to explore various examples where government intervention has successfully influenced the priorities of private enterprises through incentives. Specifically, this paper will focus on two distinct methods of intervention: Competitive Solicitation, which encourages private companies to innovate in accessible technology through market competition, and Long-term Regulatory Programs, which mandate sustained commitment to accessibility in technological development. This exploration aims to highlight the factors hindering the widespread adoption of assistive technologies and to propose effective strategies to overcome it.

Case Study #1: Competitive Solicitation

The Super Efficient Refrigerator Program (SERP) was a pioneering initiative in the United States that used a competitive solicitation approach to accelerate the development and commercialization of super-efficient end-use technologies (Eckert, n.d.) The program was designed to award $30 million to the refrigerator manufacturer that developed and commercialized a refrigerator exceeding 1993 federal efficiency standards by at least 25%. This incentive-based approach encouraged manufacturers to innovate and improve the energy efficiency of their products (Eckert, n.d.)

The operation and success of SERP were influenced by several factors. Firstly, the program was funded by 24 public and private utilities, providing a necessary financial support

basis that wasn't purely a result of government spending (BLS.gov, 2022). Secondly, the program was designed to stimulate market demand for energy-efficient refrigerators, thereby encouraging manufacturers to innovate and produce more efficient models (Eckert, n.d.). This allowed the major manufacturers in the market to maintain control of their strategic decisions while still pushing energy efficiency as a priority.

Another large part of its success was from the regulatory context. Federal laws and requirements mandated that agencies purchase ENERGY STAR-qualified or FEMP-designated products in all product categories covered by these programs and in any acquisition actions that were not specifically exempted by law (Energy Gov, 2020). This created a favorable environment for the adoption of energy-efficient products, including refrigerators. Moreover, the cost-effectiveness of energy-efficient products was a key factor. An efficient product is considered cost-effective when the lifetime energy savings exceed the additional up-front cost compared to a less efficient option (Energy Gov, 2020). For example, refrigeration accounts for close to half of a grocery store's total electricity usage, making investing in more efficient refrigeration a great solution to immediately start cutting utility bills. This economic incentive likely encouraged both manufacturers and consumers to participate in the SERP.

In terms of the impact on regulation, programs like the SERP can influence policy and regulatory frameworks by demonstrating the feasibility and benefits of energy-efficient technologies (CARB, 2018). This is supported by the activities of organizations like United for Efficiency, which assist developing countries and emerging economies in setting up effective product registration systems to facilitate a complete market transformation to energy efficient lighting and cooling appliances (National Academies of Sciences, 2022). In terms of incentivizing positive solutions, SERP's model of providing financial rewards to manufacturers who exceed federal efficiency standards encourages globalized innovation and pushes the

technology to its max (BLS Gov, 2022). This level of rapid innovation helped speed up the development and market penetration of the super-efficient technology (BLS Gov, 2022).

Ultimately, the Super Efficient Refrigerator Program (SERP) was a successful initiative that used a competitive solicitation approach to encourage the development and commercialization of energy-efficient refrigerators. For example, in 1974, the average consumption per refrigerator was 1,800 kilowatt hours per year (kWh/yr), but by 1990, average energy consumption dropped to 916 kWh/yr, and today, the average is 450 kWh/yr (National Academies of Sciences, 2022).

The SERP's success was the result of a holistic strategy integrating financial incentives, regulatory frameworks, and market demand to foster the development of energy-efficient refrigerators. The large financial prize motivated manufacturers to innovate, while a growing market demand for energy-efficient appliances provided a great environment for these new products. Regulatory measures, such as mandatory purchasing of energy-efficient products by federal agencies, guaranteed a stable demand, encouraging manufacturers to invest in efficient technologies. This approach was bolstered by the cost-effectiveness of these appliances, where long-term energy savings justified the higher initial costs, appealing to both consumers and businesses.

This program showed a mutually beneficial incentive structure that promoted positive solutions without resorting to stringent regulations. Manufacturers benefited from financial incentives and new market opportunities, consumers enjoyed lower energy bills and environmentally friendly options, and the environment benefited from reduced energy consumption. The success of SERP not only transformed the refrigerator market towards greater energy efficiency but also set a precedent for similar initiatives. This case study

demonstrates the effectiveness of combining competitive incentives with supportive regulation and market demand to drive innovation and widespread adoption of beneficial technologies.

Case Study #2: Long-term Regulatory Programs

The California Air Resources Board (CARB) adopted the first Low-Emission Vehicle (LEV) regulations in 1990. These regulations required automobile manufacturers to introduce progressively cleaner light- and medium-duty vehicles with more durable emission controls from the 1994 through 2003 model years. The LEV I regulations included tiers of exhaust emission standards for increasingly stringent categories of low-emission vehicles, a mechanism requiring each auto manufacturer to phase-in a progressively cleaner mix of vehicles from year to year with the option of credit banking and trading, and a requirement that a specified percentage of passenger cars and light-duty trucks be zero-emission vehicles (ZEVs) with no exhaust or evaporative emissions (CARB, 2018).

Building on LEV I, the second generation LEV II regulations continued to reduce criteria pollutant emissions from new light- and medium-duty vehicles starting with the 2004 model year. In 2004, CARB approved the Pavley regulations to control greenhouse gas emissions from new vehicles for the 2009 through 2016 model years. In 2012, CARB adopted the LEV III regulations as part of the Advanced Clean Cars rulemaking package that also included the state's ZEV regulation. The LEV III regulations included even stricter emission standards for criteria pollutants and greenhouse gases for new passenger vehicles through the 2025 model year.

The LEV and ZEV programs were influenced by a variety of factors. One of the primary factors was the need to reduce emissions from mobile sources, which accounted for a significant portion of the emissions contributing to ozone, particulate matter, and greenhouse gas emissions in California . The regulations were also influenced by the need to address public health concerns, as emissions from motor vehicle engines can harm public health, welfare, the

environment, and the climate in multiple ways. Economic considerations also played a role. The Advanced Clean Cars II regulations were expected to provide public health benefits of at least $12 billion over the life of the regulations by reducing premature deaths, hospitalizations, and lost workdays associated with exposure to air pollution.

The LEV and ZEV programs faced several challenges that hindered the adoption of the technology. One of the main issues was that CARB did not collect or evaluate sufficient data to determine whether or how its incentive programs, which pay consumers in exchange for purchasing low- and zero-emission vehicles, reduce greenhouse gas emissions beyond what CARB's regulations already require (Libgober, 2022). Another challenge was that the technology to satisfy the ZEV mandate was not forthcoming from manufacturers (Libgober, 2022). Furthermore, the demand for electric vehicles (EVs) amongst low- and middle-income households is price-elastic, meaning that these consumers are sensitive to price changes. However, the subsidies provided to promote electric car adoption were not sufficient to overcome the high upfront costs of these vehicles for many consumers.

Other issues arose in the execution of the regulations. For instance, CARB was found to have not done enough to measure the greenhouse gas emissions reductions its individual transportation programs achieved (IMF, 2020). Moreover, CARB was criticized for not consistently collecting or analyzing data to determine whether some of its programs provide the socioeconomic benefits that CARB has identified for those programs, such as maximizing participants' economic opportunities (IMF, 2020).

Despite these criticisms, the LEV and ZEV programs have not been discontinued. Instead, they have evolved over the years into LEV II and LEV III, furthering criteria pollutant emission reductions and controlling greenhouse gas emissions in California. Furthermore, the

Advanced Clean Cars II regulations have been established to ensure that by 2035 all new passenger cars, trucks, and SUVs sold in California will have zero emissions.

The regulatory measures involved in the LEV and ZEV programs indicate the problems associated with introducing an overwhelming amount of regulation into a market with such thin margins. By forcing car companies to a certain standard before the necessary auxiliary technology had been developed, forced them to undertake major amounts of developmental debt or attempt to cheat the system. As compared with the incentive based model, we see that the regulatory measures placed upon car companies didn't spark the level of innovation required. However, the LEV and ZEV programs did face the challenge of disrupting an industry that had never seen wide adoption of electric vehicles, a problem that consists of an uphill battle on both the financial and social fronts.

As the programs evolved overtime, the technology was able to partially catch up to the demands of the government. However, the artificial push towards electric vehicles seems to have come from the intrinsic benefits of creating and selling electric vehicles rather than the government's regulatory measures. This natural inclination to take the route that to return to adopt technology only as its features meet the need is noted in Mesthene's Economic and Political Organization, "Because of this kind of built-in efficiency, the corporate system has served us well—better than most, one is inclined to agree-when our greatest need as a society was feeding, clothing, and sheltering our population and raising our standard of living, that is, when our greatest need was for translating our technological progress into an abundance of private goods and services" (Mesthene, pg. 72). Overall, the regulation seemed ineffective in impacting long-lasting change and pushed the EV industry into an uncomfortable decade of misplaced money and underwhelming advancements.

Contrasting Government Incentive Structures

Overall, the contrast between the two approaches provide a nuanced understanding of how government incentive structures can facilitate or hinder technological innovation and adoption, especially in the context of accessibility for individuals with disabilities.

The success of SERP highlights the potent role financial incentives can play in stimulating technological innovation. This approach could be transformative when applied to accessibility technologies. By creating competitive financial rewards, governments could encourage technology companies to innovate and develop more accessible, user-friendly software and hardware for individuals with disabilities, such as those with visual or auditory challenges. The financial lure could spur significant creativity and technological advancements, leading to the development of products and services that are not just compliant, but truly tailored to the needs of disabled users.

By contrast, the LEV and ZEV programs show the challenges of over-ambitious regulation that fails to account for the current state of technological progress and market readiness. In the realm of accessibility, while it is vital to have regulations that mandate inclusivity, overly stringent or advanced regulations will stifle true innovation. Companies might resort to superficial compliance, developing solutions that meet regulatory criteria but do not genuinely address the needs of the disabled community. On the other hand, weak regulations could lead to an industry complacent with mediocrity, overlooking the specific needs of those with disabilities.

Both case studies emphasize the significance of initial costs as a barrier to technology adoption. This is particularly relevant for individuals with disabilities, who may have limited financial resources. In this context, government subsidies or incentive schemes, akin to those used for promoting electric vehicles, could play a crucial role. By reducing the financial burden,

these initiatives can make advanced, accessible technology universally attainable, thus ensuring equitable access.

The contrasting outcomes of SERP and the LEV/ZEV programs provide valuable lessons for policymakers. An effective strategy for promoting accessibility technologies would involve a balanced approach that combines the strengths of both models. This could include well-designed financial incentives to stimulate innovation in the private sector, coupled with regulations that set realistic, yet progressive standards for accessibility. A two-pronged approach would ensure that companies are motivated to innovate beyond compliance, and give them the opportunity to focus on developing technologies that enhance the lives of individuals with disabilities.

Conclusion

The goal of this paper was to evaluate how we can effectively integrate technological innovation into our lives to enhance accessibility for individuals with disabilities. After careful analysis of the current advancement in accessibility and assistive technology, the problem that was identified seemed to stem from the market demands of private companies. Therefore, government incentive structures were analyzed such as the SERP and the LEV/ZEV programs which allowed for an analysis of the interplay between government incentives, market readiness, and technological advancement.

The stark contrast between the success of SERP and the mixed outcomes of the LEV/ZEV programs highlights one core truth: the path to technological accessibility will not be linear. The triumph of SERP seemed to lie in its alignment with market capabilities and the provision of tangible incentives which creates a conducive environment for innovation. This approach holds immense promise for the realm of accessibility technologies. One can imagine a world where competitive financial rewards can foster a lot more demand in developing assistive

technologies, leading to cutting-edge solutions that are not just compliant but inherently designed for the unique needs of individuals with disabilities.

However, other programs offer the potential of intervention pitfalls. The LEV/ZEV programs, while well-intentioned, were stifled by premature regulation and a mismatch between market readiness and technological expectations. This serves as a warning of the risks of stringent regulations, and how ignorance about the current technological landscape and market dynamics can stifle genuine innovation.

Nonetheless, our focus on only two specific case studies, while providing depth, may not capture many of the possibilities and challenges when enabling accessible technology. Further, the rapidly evolving nature of technology itself means that our findings, while relevant today, must be continually re-evaluated in the context of emerging innovations and market shifts.

In conclusion, this paper is a call to action for policymakers, technologists, and advocates alike. We find that it will take a holistic analysis of technological readiness and proper incentive structures to enact profound change. However, past case studies optimistically show that by harnessing the power of well-structured financial incentives and regulatory measures, we can build a future where technology is not just a tool, but a beacon for a more inclusive and empowered society.

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