

Joint Center for Housing Studies
Harvard University

Facing Digitalization at Home: Commentary on Digitalization Technologies for Energy and Aging in Place

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May 2023

This paper was presented as part of “Panel 4: How Is Digitalization Transforming How Housing Is Used?” at the symposium “Bringing Digitalization Home: How Can Technology Address Housing Challenges?”, hosted by the Harvard Joint Center for Housing Studies in March 2022 and funded by Qualcomm. Participants examined the changes that digitalization—the use of automated digital technologies to collect, process, analyze, distribute, use, and sell information—is spurring in the way housing is produced, marketed, sold, financed, managed, and lived in.

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Abstract

Digitalization promises to improve lives in homes, reducing energy consumption and costs while increasing convenience and comfort and enabling an increasingly senior population to remain in their homes and age in place. The papers by Martín, and Molinsky, Scheckler, and Hu, describe the benefits and challenges of digitalization—in home energy and aging in place respectively—in addressing pressing social, economic, and environmental challenges in the US. Both papers point to equity as a major challenge in rolling out digitalization technologies in homes; further research, collaboration, training, and policy can overcome some of the barriers. A focus on the faces—the heterogenous recipients of these smart technologies—may empower the approach to digitalization technology adoption.

Commentary

Both Martín's paper, *Empowering Up, Powering Down: The Evolution, Effects, and Efforts to Digitize Energy Controls and Digitalize Energy Information in US Homes*, and Molinsky, Scheckler and Hu's paper, *Centering the Home in Conversations about Digital Technology to Support Older Adults Aging in Place*, outline the benefits and challenges of digitalization. These papers discuss digitalization in addressing climate change mitigation goals and the dignity of our growing aging population. Each provides a broad review of the technologies, policies, and issues at hand.

An Energy-Smart Home and Digitalization

Martín's paper provides a comprehensive review of the issues in smart energy homes, interweaving discussion of *circuits* (smart home technologies, history of policy, energy demand, and technology diffusion); *resisters* (benefits (are there any? to whom?); data sharing/privacy issues; profit and equity issues; and *power* (the forces that drive digitalization). The immediate goal of halving emissions by 2030 requires the diffusion of electrification of home appliances and more closely matching energy demand with supply, especially solar. Data from interval utility meters—which measure electricity in near real-time and communicate wirelessly back to the utility and potentially the consumer—and other data on energy consumption (such as from thermostats/HVAC systems, EV chargers, water heaters, and other large loads) can potentially help consumers manage load to reduce costs, match renewable energy supply, and provide grid resilience. Martín brings up the problem of affordability and equity; adding to the typical discussion of those missing out on digitalization (people of low income, seniors, those who lack internet bandwidth) is the issue of *energy literacy*: the importance of understanding the language, units, and concepts of energy. A review of demographics shows that lower-income households living in

smaller homes are paying more energy per square foot, but they are less likely to participate in programs that would benefit them.

Martín calls for “improvements in the methods for understanding disparities in individual energy, housing, and residential energy digitalization conditions—but also in their implantation and outcomes on energy, finances, and well-being.” He suggests digitalization will be most effective if paired with home performance, electrification, and renewables and appropriate rate pricing. He ultimately places the onus on “digitalization’s vendors, advocates, utility supporters, and regulators” to “address the lived experiences of households and the real physical qualities of their homes and energy activity to design better, more accessible, more sensitive, and more affordable versions of their innovation.”

Digitalization and Aging in Place

Molinsky, Scheckler, and Hu describe how these digital technologies—telehealth, wearable sensors, apps that remind people to take medication/medicine dispensers, monitors—can help aging in place. “Digital technologies focused on health maintenance, management, and care... have the potential to change the role that the home plays in daily life and enable older adults to remain in their own homes longer as their functional capabilities evolve.” The technologies of focus are “ambient assisted living” in a person’s daily environment “to enable individuals to stay active longer, remain socially connected, and live independently into old age.” Molinsky et al. lay out the promise of these digital technologies in supporting an aging population by providing increased independence and convenience and lower costs; then they dive into considerations and challenges: in the home (digital divide, accessibility, affordability, care provision), relationship of person and the home (surveillance/privacy concerns and changing the meaning (home feeling more like hospital)), adequate regulation of the home, and training for caregivers who may not have technical literacy.

Molinsky et al. describe equity issues, such as lack of broadband or technical literacy. “How effective can these technologies be when implemented in housing that is physically inadequate, does not meet accessibility needs, or is unaffordable—conditions that already face millions of older adults, particularly people of color, those with low incomes, and renters.” They call for more comprehensive collaboration between healthcare and housing professions—opportunities, incentives, and training—as well as more research, especially on topics like hospital-in-the-home, and how these topics impact minority populations.

Giving People Faces

For vendors, program designers, researchers, or regulators, a crucial step for all is identifying the faces of the people that live in these homes, and recognize the heterogeneity of these households. Two approaches might inform a successful deployment of digitalization technologies from smart thermostats to wearable sensors: empowerment and usability.

Empowering Faces

The 6 I's of improving the adoption of digitalization technologies—from smart thermostats to wearable sensors—build on David Wyon's 3.I principle of empowerment¹ related to office workers and energy, but these principles can apply to residents and health. Wyon writes, "The purpose of most of the energy used in buildings is to improve environmental conditions for users. This process is only energy efficient if it promotes user health, comfort and productivity...." The first I is *Insight*: how do you facilitate insight into how a person's house or health care works and the consequences of that person's actions? The second I is *Information*: When a stream of data is organized and structured to provide meaningful context, it is turned into information. People must be given information (such as feedback) so they can appropriately adopt and use digitalized devices and services. The third I: armed with insight and information, people must be provided with *Influence* or a means of control of these systems around them. Insight, information, and influence are all essential for motivation and learning to take place; that is one way diffusion of these technologies occurs.

To update this framework, I add three more I's, starting with *Interoperability* of devices (mentioned by Martín). Multiple devices can interfere with each other or create unwanted complexity; device interoperability may simplify and reduce sensor redundancy. The fifth I is mentioned by Molinsky et al. at the end of their paper: *Inter- (and multi-) disciplinary* collaboration as a means to promote equitable solutions that are more inclusive of people of color, culture, orientation, and age. The final I is *Inclusion and diversity*: the path to equity involves diversity and inclusion of all voices: underserved, rural, low income, and seniors.

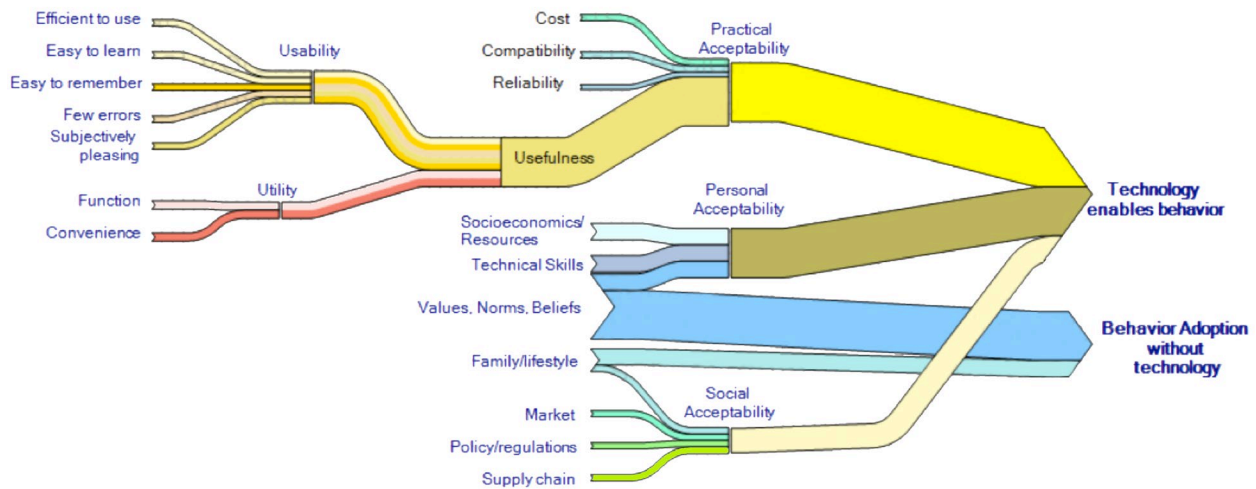
Enabling Adoption

Usability of these new digitalization technologies also strongly influences adoption. Diversity, equity, and inclusion (DEI) training and usability design both start with understanding individual persons—each

¹ Wyon 1997

person’s values, skills, culture, age, language, wealth, and so on. Inclusivity of the design of a product or a pilot program on digitalization means understanding that there is not a “one-size-fits-all” solution. Some people want to fiddle with the controls, to dig into the details; others want to “set it and forget it” and let automation control for them. Borrowing from Jakob Nielsen,² in order for digitalization to be adopted (Figure 1), it must be *useful*—both *usable* (easy to use, learn and remember) and serve a purpose (*utility*); it must be practically acceptable (cost, reliability) and socially acceptable (here I add market forces, policy, and supply chain influences). Digitalization could manifest in a physical device or data, e.g., an app on the phone. Thus, I add to Nielsen’s framework a behavioral component: enabling energy-saving behavior or health-promoting behavior with or without a physical device. I include personal acceptability to include the influences of values, norms, beliefs, skills, and wealth.

Figure 1: Behavior Adoption With and Without Digitalization Technology



Source: Pepper, building on Nielsen 1993

Conclusion

Both Martín’s paper and Molinsky et al.’s paper delve into the issues surrounding digitalization in homes to address pressing environmental and social issues. Martín’s paper provides the context of the technology, policy, and social aspects of the state of digitalization of energy controls and energy information in homes. Molinsky et al.’s paper outlines the promise and barriers of digitalization in supporting aging in place.

² Nielsen 1993

What forces can we harness to enact change in addressing these barriers? We must confront equity issues that face the digitalization of homes. This may include identifying the faces of the end users and empowering them through insight, information, and influence, supported by interoperable devices, interdisciplinary collaboration, and inclusion of diverse voices in the solutions. Understanding the factors of adoption—usability, social and practical acceptability—also may inform diffusion of digitalization. Let us continue the conversation and collaboration!

References

- Martín, Carlos. "Empowering Up, Powering Down: The Evolution, Effects, and Efforts to Digitize Energy Controls and Digitalize Energy Information in US Homes." Draft paper for Bringing Digitalization Home: How Can Technology Address Housing Challenges? Symposium, Cambridge, MA, March 2022.
- Molinsky, Jennifer, Samara Scheckler, and Baley Hu. "Centering Home in Conversations about Digital Technology to Support Older Adults Aging in Place." Draft paper for Bringing Digitalization Home: How Can Technology Address Housing Challenges? Symposium, Cambridge, MA, March 2022.
- Nielsen, Jakob. 1993. *Usability Engineering*. San Francisco: Morgan Kaufmann.
- Wyon, D. P. 1997. "Individual Control at Each Workplace for Health, Comfort, and Productivity." Paper Presented at the Creating the Productive Workplace Conference, London.