

Unlocking the Power of Community: Rethinking Open Hardware Adoption from the Ground Up

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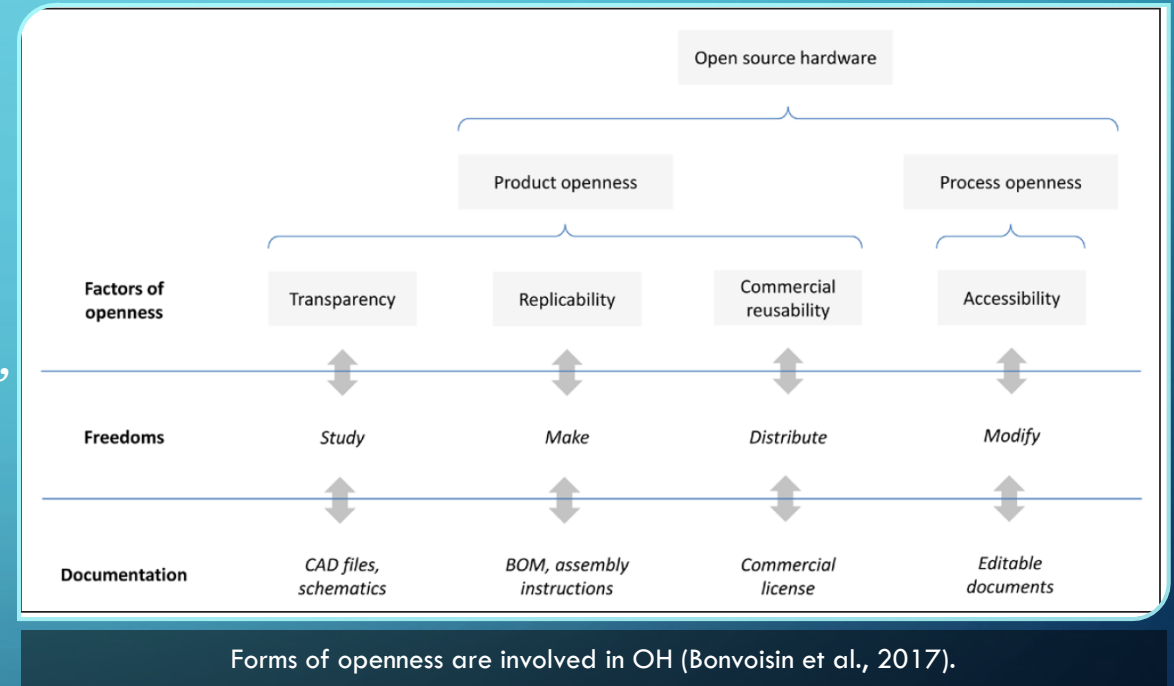
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INTRODUCTION

- Open Source Software (OSS)
 - Defined as software that is distributed under a **unique copyright license** that permits **unlimited usage, free redistribution**, access to the **source code**, and the production of **derivative works** (*Androutsellis-Theotokis et al., 2011*)
 - OSS has recently started to be seen as **high-quality, safe, and dependable** which leads to a gradual **increase in adoption** (*Ro et al. 2024*)
- Open Source Hardware (OH)
 - The OH is a “hardware whose **design** is made **publicly available** so that anyone can **study, modify, distribute, make** and **sell** the design or hardware based on that design” (*Open-Source Hardware Association, 2020*)



WHY STUDY OPEN HARDWARE ADOPTION?

- Significant potential for innovation, sustainability, affordability.
- Relevance in **underdeveloped areas and underfunded sectors** (e.g., education, healthcare, agriculture).
- Tangible, impactful, but **adoption literature is still fragmented**; few integrated models for OH uptake.
- Existing frameworks focus on OSS; **OH has physical constraints** (e.g., sourcing materials, legal complexity).
- OH is not just a technology phenomenon, it's a **sociotechnical movement** involving DIY, community, and educational practices.

METHODOLOGY

RQ: How do community narratives shape the adoption of Open Hardware, and in what ways do traditional and emergent factors interact to influence this process?

Data: 28 OH-focused online podcasts (2019-2025)

Participants: Developers, CEOs, educators, makers, users

Selection Criteria:

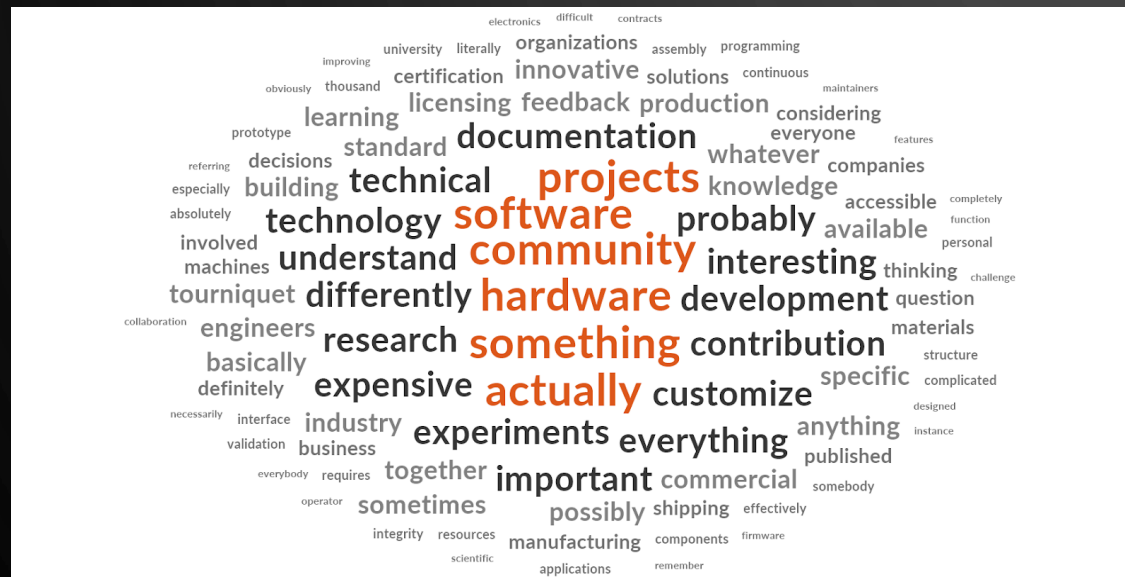
- Must include OH-related content
- 30+ minutes
- Publicly available
- Participants should belong an OH community

Analysis:

- Transcribed using Whisper AI (*552 pages of transcript - Total Interview Time: 24hrs 31mins*)
- Thematic analysis via Nvivo
- Abductive approach (Dubois & Gadde, 2002): Theory refinement via empirical surprises.
- Codes rooted in UTAUT 2, plus open coding for emergent themes.

Outcome: Rich quotes and patterns emerged from real maker experiences.

WORD MAP AND HIERARCHY OF CODES



SUMMARY OF KEY FINDINGS

CONSTRUCT	INSIGHTS FROM COMMUNITY PODCASTS
Performance Expectancy	OH seen as cost-effective, customizable, impactful
Effort Expectancy	Learning curve, lack of documentation is a barrier
Social Influence	Peer networks, community support boost adoption
Facilitating Conditions	Infrastructure/tools essential, but not always available
Hedonic Motivation	Creative joy and emotional connection drive engagement
Price Value	Low upfront costs; some hidden maintenance issues
Habit	Repeated use builds confidence, reduces perceived complexity

ADDITIONAL THEMES FROM PODCAST ANALYSIS



Educational Value

OH empowers STEM learning and hands-on experimentation.

Democratizes tech access for students and engineering communities.



Recognition Benefits

Participation in OH enhances credibility and visibility.

Community recognition motivates continued contribution.

SOME DIRECT QUOTES FOR KEY FINDINGS

Construct	Selected Quotes on First Order Codes
(Additional) Educational Value	“(On contribution processes of OH projects) I’ve had to learn things from a more hands-on practical perspective and then fill in the gaps with self-learning on concepts and higher levels and you know that's something that lasts for your whole life and not just the four years of college like if you rely on learning from a professor you're done after four years, or you have to pay for another thing” (P9) “I like about programming was you get to learn all sorts of stuff sure and I fell into this maker community and these people were teaching me about machining and teaching me about how to design and they are like we should make something and so we started contributing to an older project called heaks cad ...” (P16)
(Additional) Recognition Benefits	“No matter how small a contribution may be to the person who added it might be a major section on their resume it might be a 15-minute discussion that in a job interview that gets them their dream job yes it's really important to celebrate this stuff and to like recognize it” (P6) “...they're still giving you that gift of feedback of information of expertise so like do everything you can to pull that in and showing other people that you do empowers you and that means you're also perpetuating a community that is open to the idea of giving feedback which is exactly what you want so you know you kind of have to walk the walk here” (P7)

KEY THEMES FROM COMMUNITY VOICES

Hands-on Learning: People emphasize learning by doing. Makers say building hardware taught them more than theory. Sharing tutorials and workshops was a big focus.

Community & Mentorship: Makerspaces, forums, and meetups are vital. Many stories described experienced makers guiding newcomers through problems.

Intrinsic Joy: Excitement and creativity motivate people. Enjoyment of tinkering keeps makers engaged even when facing difficulties.

Resource Challenges: Sourcing parts and tools is a common hurdle, especially in regions without easy supply.

Storytelling: Personal and project stories inspire others. Blogs, videos, and talks about successes ignite interest and trust.

KEY THEMES FROM COMMUNITY VOICES

Complexity & Costs: Building hardware can be more complicated and expensive than writing code (special parts, tools needed).

Documentation Gaps: Many projects lack clear, beginner-friendly instructions or videos, which slows adoption.

Funding & Sustainability: Keeping projects alive (materials, support) is hard when they're free. Long-term maintenance often needs new resources.

Legal/Standards: Choosing an open license and meeting safety certifications (FDA, CE) can be confusing for hobbyist makers.

PRACTICAL IMPLICATIONS



DESIGN FOR LEARNING

OFFER ACCESSIBLE DOCUMENTATION, TUTORIALS, AND KITS



RECOGNIZE CONTRIBUTORS

USE BADGES, MENTIONS, AND PUBLIC CREDITS TO BOOST ENGAGEMENT



SUPPORT ONBOARDING

CREATE BEGINNER-FRIENDLY TOOLS AND GUIDES



EMBED OH IN EDUCATION

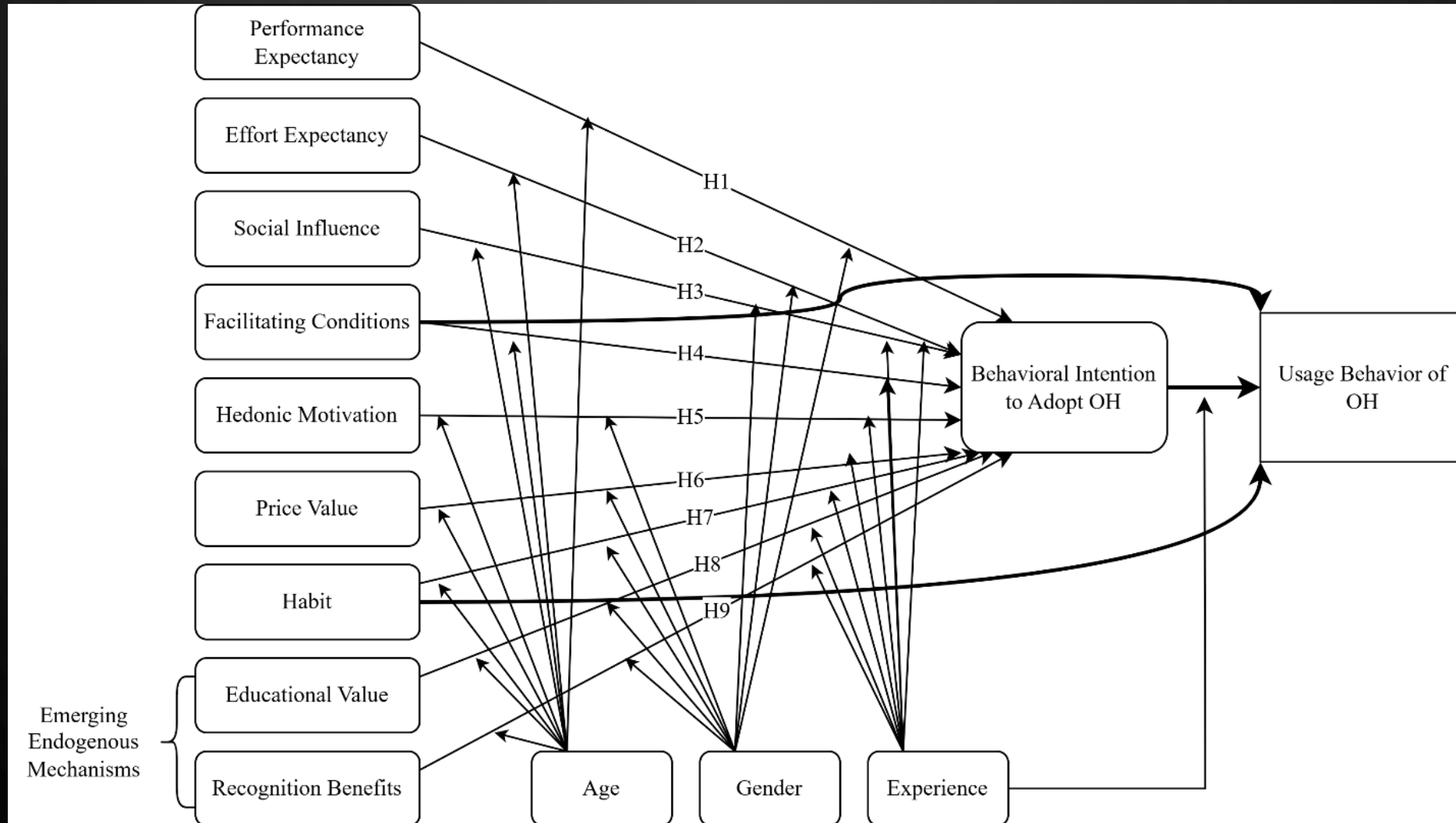
PROMOTE USE IN STEM PROGRAMS AND INFORMAL LEARNING SPACES



POLICY SUPPORT

PROVIDE LEGAL CLARITY, AND LOCAL PRODUCTION INFRASTRUCTURE

FUTURE RESEARCH DIRECTION : CONCEPTUAL MAP FOR THE SURVEY STUDY

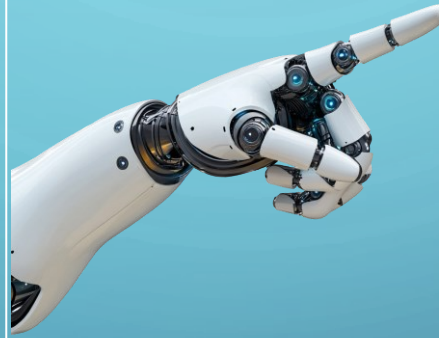


Conceptual Model Adapted from Venkatesh et al. (2012) UTAUT2.

THANK YOU FOR LISTENING!

OPEN HARDWARE ADOPTION SURVEY

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SCAN ME

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