The AI-Augmented Maker: Challenges and Opportunities in Designing Intelligence for Community-driven DIY Cultures

Marwa AlAlawi
malalawi@mit.edu
MIT CSAIL
USA

Ticha Sethapakdi
ticha@mit.edu
MIT CSAIL
USA

Dishita Turakhia
Emory University
USA

Katherine Song
Delft University of Technology
Netherlands

Ilan Moyer
MIT
USA

Liang He
UT Dallas
USA

Lvmin Zhang
Stanford University
USA

Ruofei Du
Google XR Labs
USA

Stefanie Mueller
MIT CSAIL
USA

Abstract

At its core, the maker movement is driven by a highly adaptable community that repurposes new creative technologies through the open exchange of skills and knowledge. Recent advances in generative Artificial Intelligence (AI) have enabled makers to synthesize, on demand, the knowledge traditionally curated by the maker community. As AI tools become increasingly integrated into creative ecosystems, this workshop aims to chart new directions for maker-centric tools by unpacking the concept of the "AI-augmented maker". Bringing together interdisciplinary experts across fabrication, AI, and community-centered design, this workshop will explore how integrating on-demand AI to different facets of making can preserve—or disrupt—the conditions that give the maker movement its meaning.

1 Introduction and Background

The maker movement is rooted in a people-driven ethos, defined by community, participatory learning, and hands-on acquisition of skills [16, 30]. Maker culture represents a highly collaborative framework where knowledge is provided by experienced practitioners and shared between peers. This exchange takes many forms, ranging from digital practices like open-sourcing software and hardware, to physical interactions such as peer mentorship in shared workshop spaces. Within HCI, researchers have facilitated these knowledge-sharing practices by developing software abstractions with low learning thresholds, allowing novice users to more easily perform tasks that require specialized training [19]. In their personal fabrication manifesto, Baudisch and Mueller [4] articulate how software abstractions for domain- and machine-specific knowledge represent the operative mechanism through which the abstraction is achieved. In its most basic form, this begins with the provision of part libraries; it then progresses to offering templates and parametric workflows, and ultimately extends to generating final design outcomes and providing real-time feedback at successive stages of the fabrication process. The personal fabrication approach shifts the paradigm of knowledge transfer from direct instruction to encoding of knowledge into tools, but still preserves the communal knowledge-sharing that defines the maker community.

Today's generative AI tools have undoubtedly changed the dynamic of communal knowledge-sharing and skill-building. Rather than waiting for domain experts to build dedicated tools or share community-vetted workflows, makers can leverage AI systems to generate personalized guidance on demand. Instead of navigating multiple tutorials, forums, or documentation repositories to realize a fabrication concept, a maker can articulate their intent in natural language and receive tailored instructions, code-bases, or design scaffolds. This workflow mirrors what Don Norman describes as "community-based design" or "the rise of the small", wherein everyday, do-it-yourself creators can be self-sufficient in solving design tasks [20]. In this scenario, the AI assumes a position similar to that of an on-demand 'expert', sometimes as an agent that executes on behalf of the user, other times as a facilitator that provides toolkits and feedback at each stage of the process. While on-demand generation provides makers with convenience, a drawback of these outputs is that they lack the intentionality that comes with expert-designed systems or community-curated repositories.

As AI tools become increasingly integrated into creative ecosystems, this workshop aims to chart new directions for maker-centric tools by unpacking the concept of the "AI-augmented maker". How do we preserve the community-driven ethos of making in an ecosystem if the loop between learner, practitioner, and tool could be mediated by AI? How can we design maker tools of the future to augment, rather than replace, crucial maker skills? Our workshop aims to address these questions by exploring how introducing on-demand AI to various aspects of making can preserve—or disrupt—the conditions that give the maker movement its meaning.

2 Scope and Workshop Themes

This workshop brings together HCI researchers and industry practitioners interested in exploring the intersection of AI and maker culture, with a particular focus on skill augmentation and the evolving nature of expertise within maker communities. Toward this goal, the workshop will feature: **(1) Talks** from invited speakers sharing perspectives on AI-augmented tools and systems developed for the maker community, **(2) Group Brainstorming Sessions** where

Conference'17, Washington, DC, USA
2026. ACM ISBN 978-x-xxxx-xxxx-x/YYYY/MM
https://doi.org/10.1145/nnnnnnn.nnnnnnn

participants collaboratively identify opportunities and challenges across four maker skill domains, and **(3) Panel Discussions** where participants and speakers synthesize findings and reflect on how to implement AI augmentation in our field while still preserving the values of community-driven craft cultures. Our intended audience includes researchers, tool builders, and practitioners working across fabrication, HCI, AI, craft, and community-centered design.

As maker culture is inherently interdisciplinary, this workshop organizes its discussion around four broad categories of maker skills:

- **Physical Crafting:** Procedural and tool-specific competencies acquired through practice and repetition.
- **Design Thinking:** Creative thinking skills like brainstorming and subjective aesthetic judgment of form, character, and visual placement of components in space.
- **Cognition and Analysis:** Understanding the underlying physical and mathematical reasoning behind key features in the design such as dimensioning, material selection, and structure. On the software end, it can entail simulation and CAD practices. This category also encompasses the reflective capacity to evaluate and iterate on one's own work.
- **Ethics and Inclusivity:** The social and ethical dimensions of making, including designing with empathy towards diverse users, and actively working to make spaces and tools accessible. This encompasses ethical design practices, sustainability, and accountability for the broader social and environmental impact of what is being made and how.

During the workshop, we aim to explore the following questions:

- Across these four skill domains, where does AI present the greatest opportunities to augment maker practice, and where does it introduce the most significant challenges to the skills and values the community depends on?
- Which skills are most important for makers to develop and retain, and which can be more readily supported or delegated to AI systems without compromising the integrity of the learning process?
- What workflows and feedback loops can we, as HCI researchers, put in place when developing these systems to ensure AI-augmented making remains a generative and enriching experience rather than a purely consumptive one?
- How do we maintain alignment between the AI-augmented maker and the foundational philosophy of the maker movement, one centered on shared knowledge, open exchange, and community-driven practice?

3 Workshop Schedule and Activities

We anticipate a half-day workshop (≈3 hours) accommodating 20–25 participants. There will be groups of 5–6 people each, organized around the four maker-skill categories. The workshop is structured around two overarching discussion topics:

- **Topic 1**: Building AI-augmented tools that serve maker-specific skills
- **Topic 2:** Preserving alignment between the AI-augmented maker and the values of the traditional maker community

Our tentative schedule is as follows:

- **Ice-breaker Session (10 minutes).** The workshop opens with an interactive ice-breaker activity that introduces participants to one another and sorts them into their groups.
- **Invited Talks (20 minutes).** Invited speakers will deliver a short talk sharing their work and perspectives on making and AI.
- **Group Session 1A — Topic 1 (30 minutes).** Participants rotate through two of the four thematic tables (30 minutes per table), brainstorming opportunities and challenges around building AI-augmented tools for maker-specific skills. Each table features a shared board where participants can build on ideas left by the previous group.
- **Group Session 1B — Topic 1 (30 minutes).** Participants rotate through the remaining two tables, continuing the same format. Followed by a 10-minute break.
- **Panel Discussion 1 — Topic 1 (20 minutes).** Invited speakers reconvene to share perspectives on what emerged from the group sessions. Participants are invited to contribute observations and reactions from their table discussions.
- **Group Session 2 — Topic 2 (30 minutes).** Participants return to their tables to brainstorm the second topic: preserving alignment between AI-augmented making and the core values of the maker community. Same format as before.
- **Panel Discussion 2 — Topic 2 (20 minutes).** Speakers and participants synthesize the key themes, tensions, and opportunities that emerged across both topics.
- **Closing Remarks and Actionables (10 min).** The organizers summarize key takeaways, propose open research questions, and outline concrete next steps, including potential collaborations, publications, or community initiatives emerging from the discussion.

4 Organizers

Our organizing committee comprises an interdisciplinary team of researchers and practitioners spanning digital fabrication, AI, and maker practices. **Marwa AlAlawi** [2, 3, 21] and **Ticha Sethapakdi** [23–25] anchor the organizing effort with their work on digital fabrication tools and physical crafting workflows for maker communities. **Dishita Turakhia** contributes expertise on how makers learn and reflect within these fabrication contexts [1, 13, 31, 32]. **Liang He** extends this perspective by examining who gets to participate in making, having developed AI-integrated fabrication tools that broaden access for users with diverse needs [9–11, 14, 35]. **Katherine Song** complements this inclusion-oriented lens with a focus on sustainable community-centered making practices [27–29]. **Ilan Moyer**, co-founder of Shaper Tools [26], brings first-hand experience building tools for maker communities [17, 18, 22]. **Lvmin Zhang** pioneered controllable neural network architectures that support creative workflows [33, 34]. **Ruofei Du** contributes industry-grounded knowledge of AI systems and their practical deployment at scale [5, 12, 15, 36]. **Stefanie Mueller** made substantial contributions to digital fabrication [4], and more recently examines how AI can meaningfully engage both the creative and analytical dimensions of making [6–8].

Acknowledgments

This work was generously funded by the Bahrain Crown Prince International Scholarship. We also thank the MIT-Google Program for Computing Innovation for their support. Finally, we thank Faraz Faruqi for providing valuable feedback.

References

[1] 2023. Understanding the educators' practices in makerspaces for the design of education tools. *Educational technology research and development* (2023).

[2] Marwa Alalawi, Noah Pacik-Nelson, Junyi Zhu, Ben Greenspan, Andrew Doan, Brandon M Wong, Benjamin Owen-Block, Shanti Kaylene Mickens, Wilhelm Jacobus Schoeman, Michael Wessely, Andreea Danielescu, and Stefanie Mueller. 2023. MechSense: A Design and Fabrication Pipeline for Integrating Rotary Encoders into 3D Printed Mechanisms. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 626, 14 pages. doi:10.1145/3544548.3581361

[3] Marwa AlAlawi, Regina Zheng, Sooyeon Ahn, Katherine Yan, Ticha Sethapakdi, Junyi Zhu, and Stefanie Mueller. 2025. Meta-antenna: Mechanically Frequency Reconfigurable Metamaterial Antennas. In *Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25)*. Association for Computing Machinery, New York, NY, USA, Article 36, 19 pages. doi:10.1145/3746059.3747760

[4] Patrick Baudisch and Stefanie Mueller. 2017. Personal fabrication. *Foundations and Trends® in Human–Computer Interaction* 10, 3–4 (2017), 165–293.

[5] Ruofei Du, Benjamin Hersh, David Li, Nels Numan, Xun Qian, Yanhe Chen, Zhongyi Zhou, XingyueLuna Chen, Jiahao Ren, Robert Timothy Bettridge, Xiang'Anthony' Chen, Faraz Faruqi, Steve Toh, and David Kim. 2026. Vibe Coding XR: Accelerating AI + XR Prototyping with XR Blocks and Gemini. In *arxiv*. 13 pages. doi:10.48550/arXiv.2603.24591

[6] Faraz Faruqi, Amira Abdel-Rahman, Leandra Tejedor, Martin Nisser, Jiaji Li, Vrushank Phadnis, Varun Jampani, Neil Gershenfeld, Megan Hofmann, and Stefanie Mueller. 2025. MechStyle: Augmenting Generative AI with Mechanical Simulation to Create Stylized and Structurally Viable 3D Models. In *Proceedings of the ACM Symposium on Computational Fabrication (SCF '25)*. Association for Computing Machinery, New York, NY, USA, Article 24, 15 pages. doi:10.1145/3745778.3766655

[7] Faraz Faruqi, Ahmed Katary, Tarik Hasic, Amira Abdel-Rahman, Nayeemur Rahman, Leandra Tejedor, Mackenzie Leake, Megan Hofmann, and Stefanie Mueller. 2023. Style2Fab: Functionality-Aware Segmentation for Fabricating Personalized 3D Models with Generative AI. In *Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology* (San Francisco, CA, USA) *(UIST '23)*. Association for Computing Machinery, New York, NY, USA, Article 22, 13 pages. doi:10.1145/3586183.3606723

[8] Faraz Faruqi, Maxine Perroni-Scharf, Jaskaran Singh Walia, Yunyi Zhu, Shuyue Feng, Donald Degraen, and Stefanie Mueller. 2025. TactStyle: Generating Tactile Textures with Generative AI for Digital Fabrication. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25)*. Association for Computing Machinery, New York, NY, USA, Article 443, 16 pages. doi:10.1145/3706598.3713740

[9] Liang He, Gierad Laput, Eric Brockmeyer, and Jon E. Froehlich. 2017. SqueezaPulse: Adding Interactive Input to Fabricated Objects Using Corrugated Tubes and Air Pulses. In *Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction* (Yokohama, Japan) *(TEI '17)*. Association for Computing Machinery, New York, NY, USA, 341–350. doi:10.1145/3024969.3024976

[10] Liang He, Huaishu Peng, Michelle Lin, Ravikanth Konjeti, François Guimbretière, and Jon E. Froehlich. 2019. Ondulé: Designing and Controlling 3D Printable Springs. In *Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology* (New Orleans, LA, USA) *(UIST '19)*. Association for Computing Machinery, New York, NY, USA, 739–750. doi:10.1145/3332165.3347951

[11] Liang He, Jarrid A. Wittkopf, Ji Won Jun, Kris Erickson, and Rafael Tico Ballagas. 2022. ModElec: A Design Tool for Prototyping Physical Computing Devices Using Conductive 3D Printing. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 5, 4, Article 159 (Dec. 2022), 20 pages. doi:10.1145/3495000

[12] Erzhen Hu, Mingyi Li, Jungtaek Hong, Xun Qian, Alex Olwal, David Kim, Seongkook Heo, and Ruofei Du. 2025. Thing2Reality: Enabling Spontaneous Creation of 3D Objects From 2D Images Using Generative AI in Distributed XR Meetings. In *Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST, 53)*. ACM, 1–16. doi:10.1145/3746059.3747621

[13] Alexandra Ion, Carmel Majidi, Lining Yao, and Amir H. Alavi. 2024. Bridging Disciplines for a New Era in Physical AI. In *Adjunct Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology* (Pittsburgh, PA, USA) *(UIST Adjunct '24)*. Association for Computing Machinery, New York, NY, USA, Article 92, 3 pages. doi:10.1145/3672539.3686704

[14] Ben Kosa, Hsuanling Lee, Jasmine Li, Sanbrita Mondal, Yuhang Zhao, and Liang He. 2026. Not Seeing the Whole Picture: Challenges and Opportunities in Using AI for Co-Making Physical, DIY-AT for People with Visual Impairments. In *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26)*. Association for Computing Machinery, New York, NY, USA, Article 286, 20 pages. doi:10.1145/3772318.3791815

[15] David Li, Nels Numan, Xun Qian, Yanhe Chen, Zhongyi Zhou, Evgenii Alekseev, Geonsun Lee, Alex Cooper, Min Xia, Scott Chung, Jeremy Nelson, Xiuxiu Yuan, Jolica Dias, Tim Bettridge, Benjamin Hersh, Michelle Huynh, Konrad Piascik, Ricardo Cabello, David Kim, and Ruofei Du. 2025. XR Blocks: Accelerating Human-centered AI + XR Innovation. In *arxiv*. 9 pages. doi:10.48550/arXiv.2509.25504

[16] Silvia Lindtner, Garnet D Hertz, and Paul Dourish. 2014. Emerging sites of HCI innovation: hackerspaces, hardware startups & incubators. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 439–448.

[17] Ilan E Moyer, Samuelle Bourgault, Devon Frost, and Jennifer Jacobs. 2024. Don't Mesh Around: Streamlining Manual-Digital Fabrication Workflows with Domain-Specific 3D Scanning. In *Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology* (Pittsburgh, PA, USA) *(UIST '24)*. Association for Computing Machinery, New York, NY, USA, Article 36, 16 pages. doi:10.1145/3654777.3676385

[18] Ilan E Moyer, Samuelle Bourgault, Devon Frost, and Jennifer Jacobs. 2024. Throwing Out Conventions: Reimagining Craft-Centered CNC Tool Design through the Digital Pottery Wheel. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 347, 22 pages. doi:10.1145/3613904.3642361

[19] Brad Myers, Scott E Hudson, and Randy Pausch. 2000. Past, present, and future of user interface software tools. *ACM Transactions on Computer-Human Interaction (TOCHI)* 7, 1 (2000), 3–28.

[20] Don Norman. 2013. *The design of everyday things: Revised and expanded edition*. Basic books.

[21] Mehmet Ozdemir, Marwa AlAlawi, Mustafa Doga Dogan, Jose Francisco Martinez Castro, Stefanie Mueller, and Zjenja Doubrovski. 2024. Speed-Modulated Ironing: High-Resolution Shade and Texture Gradients in Single-Material 3D Printing. In *Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology* (Pittsburgh, PA, USA) *(UIST '24)*. Association for Computing Machinery, New York, NY, USA, Article 121, 13 pages. doi:10.1145/3654777.3676456

[22] Nadya Peek, James Coleman, Ilan Moyer, and Neil Gershenfeld. 2017. Cardboard Machine Kit: Modules for the Rapid Prototyping of Rapid Prototyping Machines. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 3657–3668. doi:10.1145/3025453.3025491

[23] Ticha Sethapakdi, Laura Huang, Vivian Hsinyueh Chan, Lung-Pan Cheng, Fernando Fuzinatto Dall'Agnol, Mackenzie Leake, and Stefanie Mueller. 2023. Polagons: Designing and Fabricating Polarized Light Mosaics with User-Defined Color-Changing Behaviors. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 268, 14 pages. doi:10.1145/3544548.3580639

[24] Ticha Sethapakdi, Maxine Perroni-Scharf, Mingming Li, Jiaji Li, Justin Solomon, Arvind Satyanarayan, and Stefanie Mueller. 2025. FabObscura: Computational Design and Fabrication for Interactive Barrier-Grid Animations. In *Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25)*. Association for Computing Machinery, New York, NY, USA, Article 109, 16 pages. doi:10.1145/3746059.3747629

[25] Ticha Sethapakdi, Maxine Perroni-Scharf, Mingming Li, Jiaji Li, Justin Solomon, Arvind Satyanarayan, and Stefanie Mueller. 2025. FabObscura: Computational Design and Fabrication for Interactive Barrier-Grid Animations. In *Proceedings of the 38th Annual ACM Symposium on User Interface Software and Technology (UIST '25)*. Association for Computing Machinery, New York, NY, USA, Article 109, 16 pages. doi:10.1145/3746059.3747629

[26] Shaper Tools. 2025. Shaper Tools: Where Digital Precision Meets Craft. https://www.shapertools.com/en-us Accessed: June 25, 2026.

[27] Katherine W Song, Fiona Bell, Himani Deshpande, Ilan Mandel, Tiffany Wun, Mirela Alistar, Leah Buechley, Wendy Ju, Jeeeun Kim, Eric Paulos, Samar Sabie, and Ron Wakkary. 2024. Sustainable Unmaking: Designing for Biodegradation, Decay, and Disassembly. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI EA '24)*. Association for Computing Machinery, New York, NY, USA, Article 489, 7 pages. doi:10.1145/3613905.3636300

[28] Katherine W Song, Aditi Maheshwari, Eric M Gallo, Andreea Danielescu, and Eric Paulos. 2022. Towards Decomposable Interactive Systems: Design of a Backyard-Degradable Wireless Heating Interface. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 100, 12 pages. doi:10.1145/3491102.3502007

[29] Katherine Wei Song and Eric Paulos. 2023. Vim: Customizable, Decomposable Electrical Energy Storage. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 180, 18 pages. doi:10.1145/3544548.3581110

[30] Theresa Jean Tanenbaum, Amanda M Williams, Audrey Desjardins, and Karen Tanenbaum. 2013. Democratizing technology: pleasure, utility and expressiveness in DIY and maker practice. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 2603–2612.

[31] Dishita G Turakhia, Yini Qi, Lotta-Gili Blumberg, Andrew Wong, and Stefanie Mueller. 2021. Can Physical Tools that Adapt their Shape based on a Learner's Performance Help in Motor Skill Training?. In *Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction* (Salzburg, Austria) *(TEI '21)*. Association for Computing Machinery, New York, NY, USA, Article 17, 12 pages. doi:10.1145/3430524.3440636

[32] Dishita G Turakhia, Andrew Wong, Yini Qi, Lotta-Gili Blumberg, Yoonji Kim, and Stefanie Mueller. 2021. Adapt2Learn: A Toolkit for Configuring the Learning Algorithm for Adaptive Physical Tools for Motor-Skill Learning. In *Proceedings of the 2021 ACM Designing Interactive Systems Conference* (Virtual Event, USA) *(DIS '21)*. Association for Computing Machinery, New York, NY, USA, 1301–1312. doi:10.1145/3461778.3462128

[33] Lvmin Zhang, Chengze Li, Tien-Tsin Wong, Yi Ji, and Chunping Liu. 2018. Two-stage sketch colorization. *ACM Trans. Graph.* 37, 6, Article 261 (Dec. 2018), 14 pages. doi:10.1145/3272127.3275090

[34] Lvmin Zhang, Anyi Rao, and Maneesh Agrawala. 2023. Adding conditional control to text-to-image diffusion models. In *Proceedings of the IEEE/CVF International Conference on Computer Vision*. 3836–3847.

[35] Zhuohao (Jerry) Zhang, Haichang Li, Chun Meng Yu, Faraz Faruqi, Junan Xie, Gene S-H Kim, Mingming Fan, Angus Forbes, Jacob O. Wobbrock, Anhong Guo, and Liang He. 2025. A11yShape: AI-Assisted 3-D Modeling for Blind and Low-Vision Programmers. In *Proceedings of the 27th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '25)*. Association for Computing Machinery, New York, NY, USA, Article 84, 20 pages. doi:10.1145/3663547.3746362

[36] Zhongyi Zhou, Jing Jin, Vrushank Phadnis, Xiuxiu Yuan, Jun Jiang, Xun Qian, Jingtao Zhou, Yiyi Huang, Zheng Xu, Yinda Zhang, Kristen Wright, Jason Mayes, Mark Sherwood, Johnny Lee, Alex Olwal, David Kim, Ram Iyengar, Na Li, and Ruofei Du. 2025. InstructPipe: Building Visual Programming Pipelines in Visual Blocks with Human Instructions Using LLMs. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI)*. ACM, 1–30. doi:10.1145/3706598.3713905