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Co-creation of a Safety Culture in Digital Fabrication

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ABSTRACT

This workshop is intended to anyone (students, teachers, practitioners, technologists, designers, academics, etc.) working within or interested in the digital fabrication field. The workshop focuses on promoting, adopting, and developing a safety culture in digital fabrication. During the workshop, the participants will share information and experiences about safety in digital fabrication. A co-creation activity is organized where participants engage in the ideation, design, and prototyping of a storyboard for promoting safety in digital fabrication.

CCS CONCEPTS

• Social and professional topics → Codes of ethics; Sustainability • Information systems → Multimedia content creation • Human-centered computing → Collaborative content creation • Applied computing → Collaborative learning

KEYWORDS

Digital fabrication, Safety culture, Co-creation, Participatory media, Instructional design, Experiential learning

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1 Introduction

Digital fabrication is a new manufacturing paradigm for business, community, or personal projects. Information and communication technologies' advancements make it possible to create novel, high-quality, and personalized designs that can be produced locally and at a low cost. Moreover, digital fabrication became an effective tool to learn science, technology, and design disciplines because it provides hands-on experience of abstract concepts that are otherwise difficult to understand.

Typically, a fabrication process involves four phases of product development (design, manufacturing, use, and disposal) to ensure the product is produced and used in the best way in and for society [1]. In established production settings, there are strict standards, rules, and laws that govern the production process to ensure that the safety and quality standards are met. The product development has also different sustainability indicators which need to be considered because the production process will eventually somehow affect the society [1].

Among the quality and sustainability dimensions that are important in manufacturing, safety is one factor that must be considered (see e.g., [1,2]). However, safety issues are on the one hand difficult to communicate and enforce, and on the other hand easy to overlook in various professional settings (see e.g., [3]).

In this workshop, we focus on exploring effective ways to communicate safety issues and to develop a safety culture among makers in their different roles as students, teachers, educators, designers, producers, academics. We engage participants into sharing their views and experiences on safety culture in digital fabrication contexts including makerspaces, fab labs, and personal fabrication. We organize a co-creation exercise for developing an instructional safety video through ideation, design, and prototyping a storyboard.

2 Safety Culture in Digital Fabrication

Digital fabrication involves various rapid prototyping techniques and technologies such as 3D printing and laser cutting. These machines require adequate training and supervision to be used safely. Each equipment comes with instruction manuals, safety guidelines, and safety material data sheets that are incorporated in the laboratory safety policies. Safety issues related to digital fabrication include hazards to humans, machines, and environment. Safety issues originate from incorrect use of equipment, omitting personal protection equipment, using wrong materials, poor waste management, and not adopting chemical hygienic practices in the lab (see e.g., [4,5]). Makerspaces and fabrication labs provide training on safety practices, as well as different instructional materials on various media such as wikis, videos, warning signs, and posters. However, the literature documenting how

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sustainability, safety, and risks are *actually* managed in makerspaces and fabrication labs is very scarce [4]. In this workshop, we address the concept of safety culture and apply it to digital fabrication from a communication perspective using a participatory approach.

The safety culture concept originated after the Chernobyl accident to incorporate both safety management issues (technical attention to hazards, the deployment of operational procedures, regulatory compliance programs) and organizational and individual safety mindsets [3]. The latter include principles of leadership and value-sharing, enhanced communications and organizational learning, and knowledge about the factors which shape individual and group behaviors [3].

Though the concept of safety culture is getting more attention in industry [6], there are a lot of variations on how this concept is defined, understood, and applied in practice [3]. For example, in the design and research domain, safety culture focusses on understanding and preventing risks that users of a design may face in future [6]. In healthcare, safety culture refers to risks to both personnel and patients [7]. Typically, the safety culture is assessed through surveys that measure the safety climate in an organization (see e.g., [7]) or through safety culture maturity models to indicate a progress from 'emerging' to 'continually improving' safety culture [6]. As an organizational culture issue, safety culture deals with defining and adopting a safety behavior within that organization.

For digital fabrication projects in open makerspaces and fab labs, safety culture translates into defining and adopting by both staff and makers of safety rules for using the space, the equipment, materials, for waste disposal, and for chemical hygiene. These general aspects include social interactions with the staff and other makers, responsibilities to keep the space clean, training, reporting of safety issues, optimizing the use of materials, supervising the fabrication process. Safety culture is achieved best by employing a participatory approach where all stakeholders are involved in developing the safety culture [3].

3 The workshop

This workshop builds on the participatory philosophy to engage stakeholders in a co-creation exercise to ideate, design, and prototype a storyboard for an instructional safety video presentation. We invite participants to share their experiences and understanding of safety in digital fabrication. Moreover, we select several safety rules that are found fundamental and engage the participants into a co-creation activity of the instructional safety presentation.

The workshop method [8] is employed in this context both as a research method to gather knowledge about safety culture in digital fabrication and as a means to achieve the goal of the co-creation exercise. The latter refers to the ideation, design, and prototype of a storyboard for possible, further development into an instructional video and for increasing safety awareness through participatory practice. The workshop is conducted following the guidelines of research ethics. Written informed consent is asked from all participants, who may opt out if they do not want their participation to be used for research purposes. The outcome of the workshop will be documented and published as a workshop report in a scientific publication and also be made available online to the participants. Participants are free to use, share, distribute, refine, develop the co-created materials such as drawings and storyboard and derivate new artifacts.

The workshop exercise builds upon communication and design methods and theories that are 'user-centered' such as experiential learning [9], co-creation, user-centered and participatory design [10], and participatory media [11,12].

The workshop's structure will be as follows:

- presentation of workshop facilitators and participants (cca. 10 min),
- introduction to safety in digital fabrication (10 min),
- sharing of experiences of and views on safety issues in digital fabrication (15 min),
- introduction to participatory video making with focus on storyboard co-creation (20 min),
- short break to form the working groups (10 min),
- group work (30 min) including the selection of one safety issue to be presented in a storyboard, and the ideation, design, and prototyping of the storyboard,
- presentation of the storyboard to the workshop participants (10 min),
- feedback, discussion and evaluation (10 min),
- conclusion (5 min).

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REFERENCES

[1] D. Chen, S. Heyer, S. Ibbotson, K. Salonitis, J.G. Steingrímsson and S. Thiede (2015). Direct Digital Manufacturing: Definition, Evolution, and Sustainability Implications. J. of Cleaner Prod., 107, 615-625.

[2] I. Gibson, D.W. Rosen and B. Stucker (2015). *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*. 2nd edition. New York: Springer.

[3] M. Baram and M. Schoebel (2007). Safety Culture and Behavioural Change at the Workplace – Editorial. Safety Science, 45(6), 631-636.

[4] C. Kohtala and S. Hyysalo (2015). Anticipated Environmental Sustainability of Personal Fabrication. J. of Cleaner Production, 99, 333-344.

[5] D.B. Short, A. Sirinterlikci, P. Badger and B. Artieri (2015). Environmental, Health, and Safety Issues in Rapid Prototyping. Rapid Prototyping J., 21(1), 105-110.

[6] R. Gordon, B. Kirwan and E. Perrin (2007). Measuring Safety Culture in a Research and Development Centre: A Comparison of Two Methods in the Air Traffic Management Domain. Safety Science, 45(6), 669-695.

[7] R. Flin (2007). Measuring Safety Culture in Healthcare: A Case for Accurate Diagnosis. Safety science, 45(6), 653-667.

[8] R. Ørngreen and K. Levinsen (2017). Workshops as a Research Methodology. J. of E-learning, 15(1), 70-81.

[9] K. Hawtrey (2007). Using Experiential Learning Techniques. The J. of Economic Education, 38(2), 143-152.

[10] E.B.N. Sanders, 2003. From User-Centered to Participatory Design Approaches. Design and the social sciences (18-25). Taylor & Francis, London.

[11] U.S. Harris (2014). Communicating Climate Change in the Pacific Using a Bottom-up Approach. Pacific Journalism Review: Te Koakoa, 20(2), 77-95.

[12] H. Rheingold (2008). Using Participatory Media and Public Voice to Encourage Civic Engagement. Civic life online: Learning how digital media can engage youth, 97-118. The MIT Press, Cambridge, Massachusetts.