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Infrastructuring & Digital Fabrication

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Abstract: We try to provide an insight into digital fabrication from the point of view of *infrastructuring* as a holisitc research and practice lens from Computer Supported Collaborative Work. Our position paper serves as a discussion contribution for the workshop "Additive Fabrication/3D Printing – Technology, Impact and Chances" at *Informatik 2016*.

Keywords: position paper; digital fabrication; infrastructuring; cscw

1 Introduction and Background

In computer supported collaborative work (CSCW), *infrastructuring* is a school of thought which identifies the division of the domains of *design* and *use* as a cricital factor in the development of technological systems. Instead, widening one's view to encompass *socio*-technical systems is proposed; systems in which people, organisations and communities actively design, develop, engineer, use, apply, hack or are otherwise engage in "infrastucturing" activities without clear role boundaries. These activities take place in specific contexts which sometimes overlap. They lead to the formation of localized practices and often comprise both digital and physical artefacts and places as important elements. At certain points the activities converge which makes the action, use development and other activities of the various actors, which were formerly not (consciously) perceived, visible. *Infrastructuring* can also be understood as a methodological framework for development processes of socio-technical systems, whereby key findings in this area include i.a. criticism of heavyweight processes (steered from the top down) and development models; the importance of design and development as *in-situ* activities; as well as the diversity of reciprocal references of socio-technical infrastructures to social practices, requirements and values.

The background of this paper consists of the *infrastructuring* activities of numerous actors, organisations and communities scattered around the world, with whom the authors cooperate and interact within the framework both of ethnographically motivated fieldwork as well as participation in the sense of *research through design* and *action research*, including the incubation and development of Fab Lab Siegen as a local community, fabrication and research infrastructure (including close involvement in the organisational practices of the public sector, the development of new inter-facultative teaching concepts and collaboration with regional medium-sized enterprises, etc.). Our argumentation is also based on data and findings from discourses around the CHI- and (E)CSCW-conferences;

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the summit on *Rethinking technology innovation: Factories, Fabrication & Design Research*[3]*;* and collaboration and research work over several years in the *global innovation gathering*[4], a global network of community and fabrication hub managers, entrepreneurs from the socio-technical area and hackers, as well as (N)GOs. In the following, we would like to sketch some of the places which we believe digital fabrication informs socio-technical infrastructures. In doing so, there are a number of reasons which currently rather lead us to understand additive fabrication to be a very topical (and legitimately very promising) subarea and the driving force behind digital fabrication itself.

2 Fabrication Infrastructures

2.1 Plurality

Digital fabrication is thought, developed and used in numerous domains which have long exceeded the boundaries of traditional production. In the subset of additive fabrication, the bandwidth ranges from printing of components within interdisciplinary engineering contexts, e.g. in airplane construction or medical applications, through the fabrication of commodities from chocolates to prostheses up to completely open activities in hackspaces, fab labs and similar hubs. In such different areas, related practices are often developed and might benefit from better collaboration. One case example of this is the professional (vocational) training and work with (CNC-) milling machines in comparison to the approach taken and tools employed in nonprofessional communities which engage in additive fabrication (such as the *Maker*-culture). In many aspects, both share aims, values and tools – but are separated by different vocabularies, practices and constraints. The means inefficiency at best, friction and (resource-)conflicts at worse.

2.2 Politics, Economy and Governance

A growing but sometimes diffuse cloud of actors and communities is engaging in innovation and (digital) fabrication domains – which adds to questions about concepts, control(lability), and value of work and resources – and, ultimately, about power structures - to quote the call for papers for this workshop: "*Due to the spread of additive fabrication, it currently seems possible to bring […] production back to Europe again."*. Such questions can be analysed and discussed from very different perspectives. Some proclaim the next (industrial and/or) social revolution; post-Marxist, some understand them as the appropriation of (digital-physical) means of production. Yet from a capitalistic growth perspective, immense potential, e.g. with a view to mass individualisation, is also attributed to digital, distributed fabrication – especially additive fabrication.

[3] See https://hci.sbg.ac.at/sites/ffdr/ - proceedings currently in production.
[4] See http://globalinnovationgathering.com/

2.3 Globality and Locality

One of the central aspects of digital fabrication is the prospect to get *from bits to atoms* (and back again), anywhere, anytime. This goes hand in hand with concepts of mobile work, the understanding of the term "work" itself, collaborative tools and distributed infrastructures as well as the sharing of knowledge and resources. At the same time, it can be noticed that particularly new, creative opportunities for use, business models and methods often emerge from (hyper-)local places (hubs) such as co-working spaces, labs, think tanks, maker and hacker spaces or fab labs. Global networks which adopt open source and cross-border collaboration on equal terms allow such local hubs to be active at a global level as a matter of course. This position may help to develop and sustain innovative, socio-technically grounded business models with new value chains.

2.4 Education

There is significant market movement and discussion about the role of digital fabrication for education. Especially simple FDM-3d printers and microelectronics are being used more and more in educational settings. They seem to show significant potential, especially when combined with project-based and learner-focussed learning theories such as constructionism - as illustrated by a considerable bandwidth of well published research in this subject area. It should be underlined that exactly these methodical aspects in connection with the tangibility and concreteness of digital-physically (and ideally collaboratively) produced artefacts as well as the ever more differentiated range of tools and machines available also seem to support a more gender-equitable and inclusive approach to socio-technical educational topics. Examples for resulting changes in educational systems include Great Britain, where curricula now include socio-technical aspects and every pupil gets a single-board-computer to hack and make things with or the USA where the Maker culture seems set on bringing back tangible, fabrication-related aspects back into educational practices after the politically ordained end of shop classes in schools. Finally, it is worth looking at the domestic scene: Digital fabrication infrastructures can help people to think and understand appropriate design and fabrication as a global, collaborative process with enough room for local autonomy, participation and individuality.

At this point, critical voices come into play, speaking out against the inclusion of interdisciplinary aspects of fabrication and making in broader educational contexts and warn against e.g. overload, the disintegration of competence profiles, technical determinism, faith in technology and many other valid criticisms. Very serious attention should also be paid to these voices but on the basis of the state of art and as well as our own experiences[5] over several years utilizing digital fabrication in educational contexts,

[5] i.a. the development and implementation of experimental educational events on digital fabrication in tertiary education, projects in developmental contexts as well as the development and implementation of introductory workshops in 3D-printing in which we have worked together over the years with hundreds of participants of all ages and in a variety of contexts.

we believe open access to digital fabrication and community innovation during youth and education may not only be a tool for a very broad and interdisciplinary spectrum of concrete educational projects but can also be understood as (creative) media including benefits for self-conception and self-expression, communication, collaboration and quite a few other educational challenges.

2.5 Closing Remarks

We were able to thematize only a few infrastructure aspects of digital fabrication. However, we do hope that these points will stimulate discussion at the workshop and can be expanded upon collaboratively. Infrastructuring as a very broad lens on (global) innovation and fabrication necessitates – not least on the part of researchers – new, interdisciplinary collaboration (particularly *in* situ) as well as taking seriously an unexpected variety of actors and hubs in formerly professional domains.