Chapter 10
Resisting – Incalculable and Unloved Working Conditions

The feelings of love and fear show that care is invested in the making of innovative technology. This care is characterized by human-machine relationships that defy the challenges of technology development through calculative making. However, technology developers are not only confronted with challenges such as resource scarcity stemming from Kenya's positionality, but also with daily life hierarchies that manifest in the workplace. The existence of hierarchies is somewhat surprising given that makerspaces are praised for being non-hierarchical organizations in which collaboration and knowledge-sharing are central values (see Chapter 4): as Fred Turner (2006: 239) notes, "[i]n many industries today … hierarchies have been replaced by flattened structures, long-term employment by short-term, project-based contracting, and professional positions by complex, networked forms of sociability". Nevertheless, an increase in makers' flexibility also represents a capitalist recuperation of a seemingly liberating work organization (Wenten 2019). Thus, the entrepreneurialization of making in Kenya results in employees as well as members of makerspaces being confronted with competition and hierarchies when working for their economic livelihood.

In this chapter, I shed light on workplace hierarchies and depict the incalculable and unlovable working conditions of technology developers. I analyze how makers use technology development not only to re-work Kenya's positionality within global technocapitalism, but also to position themselves within their workplace. First, I show that the aim to produce predictability through calculations such as plans, lists, and CAD drawings is disrupted due to incalculable decision-making processes within makerspaces and startups. Second, further empirical insights demonstrate that authorities fail to appreciate de-

sign work and thereby invisibilize those work efforts. Third, I show that technology developers regain agency by appropriating the methods of rapid prototyping and their context-specific calculative making to visibilize their work, try to minimize interactions with those in authority over them, and silently resist workplace hierarchies.

10.1 The Incalculability of Technology Development

All efforts to plan a digital model as perfectly as possible and to calculate the resources and costs needed in order to eradicate failures can be thwarted by unpredictabilities. Drawing a CAD model and compiling lists of necessary prototyping material cannot circumvent all possible failures; 'unpredictable electrons' (see Chapter 9), or simply discussing a prototype can have unpredictable results. In this regard, the vignette in Chapter 9 about the calculative making of a co-working table highlights that the CAD model as a calculative tool has always initiated discussions, but does not necessarily convince the viewers. It showed that the co-workers and bosses involved constantly criticized the functionality, aesthetics, and predicted costs of a design, for example, the criticism that the suggested metal supports would not be stable enough for supporting a wooden tabletop. This seemingly impossibility of making a perfect model of an idea reveals "engineering design [a]s a decision making process" (Kroes et al. 2009: 567) in which numerous actors have to be convinced to co-operate. As depicted in Chapter 8, turning an idea into a tangible technology is a process based on affective collaboration rather than a single stroke of genius as told in innovation stories (see Chapter 3). Thus, the care of makers and machines is necessary to produce a professional prototype. However, the following pages illustrate that agreements between technology developers, their co-workers, financial bodies, and prospective users are also inevitable.

One of the various stages of incalculable design work is the rapid prototyping method of user-centered design (UX or design thinking) that incorporates failure, meaning the constant readjustment of prototypes based on the feedback of potential users. Although the iterative process of going back and forth between your idea, model, and prototype is praised by UX proponents (see Chapter 9), makers in Nairobi often report that the process of having to 'go back to the drawing board' is tiring:

> Another reason for failing or not coming to an end, is because you started off very hype-ish and then you realize that research and development ain't that easy. You make something, it doesn't work right, you come back again, it doesn't come right – that's a research and development graph. It's not that you make something and tomorrow it's in the market. There is always a hiccup; there is always human-centered design. When [the user] tells you 'Okay, yes you've come up with a solution for me, but I can't operate it', you go back to the drawing board and start thinking again. So all this is research and development which people get tired of. You get tired of always going back and forth and you're like 'What the hell?! I just leave it'. (Interview, mechanical engineer, April 2017)

This maker calls human-centered design a 'hiccup' in technology development and therefore defines human preferences as irregularities that complicate the design process. In this vein, Kroes et al. (2009: 568) state that "unpredictable changes in the context of the design process that may affect resources and time schedules, make engineering design practices often messy and unruly" – and, I would add, incalculable.

The unpredictability of technology development is not only influenced by user feedback, but also decisions by CEOs and other high-ranking co-workers. In the case of the future co-working space table for the makerspace's new premises, a day came when it was finally agreed to make the table legs out of metal sheets with wooden edging and structural supports from water pipes. Initially, everyone at the makerspace was amazed by the materialized metal construction of the future co-working space table. Two weeks later, the construction became irritating:

Figure 12: Co-working space table without its tabletop or wooden edging, 2017 (author's photo).

> Singular and lonely, the construction was placed in the middle of an almost empty room that promises to be a co-working space one day. However, the table was still missing its top and thus not able to fulfill its functionality. The irritation about the unfinished table was the topic of numerous conversations. (Research Diary, April 28, 2017)

The reason for the unfinished prototype of the future co-working table was a disagreement about the material to be used for the tabletop: "*Mbao*[1] is too expensive", said one of the makerspace managers (Research Diary, April 19, 2017). According to him, wood is one of the most expensive materials in Nairobi and the makerspace could not afford to buy eight to twelve wooden tabletops. However, the designers of the co-working table could not imagine a table without a wooden tabletop: "How can you have a tabletop made only of metal sheets? A table needs mbao" (ibid.). The lack of financial means to buy wood and the disagreement on how to handle that restriction, led to the stalling of the build of

1 *Mbao* means 'wood' in Kiswahili.

the first table prototype. Even disagreements between technology developers and their bosses can cause the stagnation of projects:

> [The boss] enters [an employee's] office. He just wants to give back some keys, but [the employee] asks him to sign checks. He looks at them and says 'What's that?' [and the employee] answers that this is a check for the engine bought for 36,000 Kenyan shillings. He looks astonished and asks 'What engine?' She tells him about the specifications of the engine and the car it is from. 'But for what?!' 'For building the coffee table that we already told you about.' 'Yeah, you sent me the designs, but I haven't checked them yet. I'm not going to sign for something that I haven't agreed on', he says and leaves. [The employee] sighs. (Research Diary, April 11, 2017)

The above conversation between a makerspace manager and one of his employees demonstrates the hierarchies in place. Due to the employees' financial dependence, the management is able to stop work projects and issue unloved work assignments as shown in the following.

10.2 Unloved Design and Calculation Work

Financiers of technology development – be they CEOs or investors – demand digital design models and calculations from their employees and startups, but often without acknowledging that designing a model, planning its implementation, and negotiating about it is arduous work. According to Susan Leigh Star and Anselm Strauss (1999: 24), the design work of makers is invisibilized as soon as it is embedded in "organization[s] with certain structures, a formal and informal balance of power, explicit and implicit goals". A makerspace employee exemplified this invisible work of calculating and designing by describing how the makerspace staff have to go through many steps of 'thought-through' planning before these efforts become visible:

> Somebody will think we are not working, but funnily enough a lot of things have happened: the floor has been repaired to be polished, to be smooth, and to be shiny. The next thing you will see, before we place the machines, are lights. So the lights have to be agreed on. Which lights? Placed where? How many? The budget? We painted the walls. You have to agree what should be done to the ceiling. We have to put up safety markings. All that is in preparation for placing the machines. A lot of things are happening in

> the space before you see them. The machines just have to be placed, but the preparation has to be very thought through. The walls, the ceiling, the floor have first to be thought through. The electrical wiring has to be thought through. The ventilation, the extraction units have to be thought through. The water, the plumbing have to be thought through. (Interview, April 2017)

Planning the implementation of a makerspace is similar to the work of drawing digital designs; it is usually work that is taken for granted or routinized: "the workers themselves are quite visible [at the workplace], yet the work they perform is invisible or relegated to a background of expectation" (Star and Strauss 1999: 15). During the development of technology, higher ranking staff relegate (digital) design work into the background by thoughtlessly demanding the creation of new models and calculations. A maker explained this hierarchical circumstance:

> As [the boss] doesn't do designs, he thinks that's not *kazi*[2]: "*Ah, kuchora design nyingine sio kazi sana*.[3] You'll do it very fast". But I know that the [employees], they barely sleep, so they are not feeling well and then no one likes their ideas. We don't get any acknowledgement. (Research Diary, March 30, 2017)

The lack of acknowledgment can cause worlds and people to collapse, so that makers describe their higher-ranking co-workers and CEOs as "destabilizing everything" (Research Diary, April 11, 2017). The technology developers who digitally model their designs encounter this lack of acknowledgement in particular because progress in computing is less visible than, for example, lights that have been fixed by electricians (Research Diary, April 10, 2017).

According to a mechanical engineer, the people who do not understand the process of designing and planning a technological idea:

> want things done as fast as possible. So they come to me and tell me, 'I want a bottle'. They go away, come back tomorrow and want to find a bottle. It never happens like that and they get angry about that. But they don't want to sit down and listen to the process that comes with making that bottle. So many people, they don't give time to ideas. They don't give time to the people who are building them. (Interview, April 2017)

2 Kazi means 'work' in Kiswahili.

3 Kiswahili for 'Ah, drawing another design is not much work'.

The fast-paced world of capitalist work that requires quick results and the continuous making of products often ignores the workload that is entailed in the intangible work of designing and planning the manufacturing of an idea. In this regard, Yana Boeva (2018: 75) describes how the many intermediary steps in creating CAD files "remain undocumented and incorporeal unlike their equivalents of printed design visuals". The practices of planning and drawing a design include "practices of scribbling and sketching on paper, of model construction, but also the materiality of the computer-aided design are beginnings or steps of a materialization … [but] not the full realization of manufacturing" (ibid.: 74). Thus, technology developers and managers who are not responsible for creating designs easily overlook and disregard design and calculation work because it is not tangible.

Despite the necessity of calculative making in Nairobi, design work is not appreciated by the authorities of makerspaces or startups. Thus, the work of the entrepreneur who must thoroughly design and plan the fast and failureless manufacturing of technology gets 'deleted'. According to John Law (1994), who refers to Star's (1991) 'deleting of work', deletions in organizations are always connected to rankings and hierarchy. He argues that the deleted work is mainly "the work of subordinates: to assume that technical or low-status work gets done 'automatically', as if people were programmable devices" (ibid.: 131). In Kenya's tech scene, managers and project leaders delete design work from the efforts of technology development because the work's simplified representation in digital models and calculations means that the challenges of getting components, incorporating feedback, or handling daily power cuts are not visible or tangible.[4]

10.3 (Resisting) Positionalities within the Workplace

Technology developers, who have to deal with the incalculable und unloved facets of their work, appropriate methods of rapid prototyping and calculation to make their work visible, avoid stressful interactions with those in a position of authority where possible, and silently resist workplace hierarchies. As such, they form socio-material relationships with prototypes, recycled material, and computers to change their (subordinate) positionalities within the workplace.

4 As analyzed in Part I, the storytelling about technology development in Kenya also deletes the uncomfortable and precarious aspects of the makers' work.

As elaborated above, the basis of every technological project, that is, design work and its accompanying decision-making processes, is not valued because it is difficult to quantify. Therefore, I argue that technology developers use the tangibility of their prototypes to earn appreciation for their work. I draw again on the above-depicted example of the co-working space table to exemplify this argument:

> The situation when the metal table construction was arriving at the makerspace was remarkable. Some weeks after the first design meeting about the co-working space table, the two designers entered the makerspace, carrying the first parts of their design. Everyone at the makerspace gathered around the table legs made from metal sheets and expressed amazement at how beautiful the design looked in reality. They wondered why there had been concerns that the metal construction would not be stable enough because it was now clearly visible that it was, indeed, stable. (Research Diary, April 27, 2017)

Although the CAD drawings of the co-working table were unable to convince the doubters of its stability, the tangible metal legs functioned as a piece of material evidence and therefore, proved convincingly that they would serve the function of stabilizing the table. Thus, a prototype serves as a proof of a digital model and makes the invisible background work of design tangible for those who were previously excluded from the work process. In this regard, the great care that makers and machines invest in the building of prototypes signifies not only the desire for professionalism, but also the desire for appreciation of invisibilized (design) work efforts. As such, the caring socio-material relations between developers and prototypes go beyond the mere increase in technology development's efficiency and jointly worry about the appreciation of their deleted knowledge work.

As well as making design work tangible and loveable, makers try to avoid the time-consuming negotiations with their superiors. As such, the recycling of materials has been always appreciated because then the costs of procurement can be minimized and negotiations with bosses avoided. For example, the construction of the makerspace's new workshop floor resulted in an abundance of 'old' material; because the floor of a makerspace has to be of firm cement to withstand the vibrations and movements of its machines, the wooden floor had been torn out. The recycling of these floorboards and other things, such as lamps and glass, was not done out of ecological idealism, but as a way

out of scarcity and the negotiations revolving around resource acquisition. In this vein, in every design meeting, someone referred to material like wood or glass that could be recycled to build something new. Glass was laminated to build display cases and new offices were created by building partitions out of the former floorboards: "We don't invent something new, it's just assembling", explained a makerspace employee (Research Diary, April 7, 2017).

Additionally, makers resist their authorities by appropriating the necessity to calculate. Every time appreciation of work efforts was felt to be missing, the sitting in front of a computer was used to do things other than designing. Conscious decisions to not work were made. This resistant behavior was carried out silently through simply not working or not taking responsibility for pending tasks. A manager told me that she thought that her employees were lazy:

> They legitimize it with not being paid well, but I don't understand why they don't work self-responsibly. If you tell them you are responsible for what a specific design looks like, they work really slowly until I tell them 'Okay, do that this way and that thing like this'. If they get orders then they work. (Research Diary, April 10, 2017)

One of the criticized employees claimed that she was grateful for working at a makerspace instead of sitting at home being bored, but doing work for which she was not appreciated, displeased her. Therefore, employees strategically use their work time in front of computers to educate themselves, play games, or watch movies:

> One day, [a maker] was sitting in the computer lab, just staring in front of her. I asked her if she had no work to do today. She laughed loudly and said that her job today was the main door: "Look, I have the keys. Everyone can give me a phone call and I have to open the doors".[5] She laughed again and pointed to the people on the other side of the room: "They're not working; they just look busy with their laptops. Look, he is watching a movie". (Research Diary, April 20, 2017)

The silent resistance against the lack of appreciation from authorities is incorporated in the objects of work, for example in a computer or a door key.

5 At that time of the makerspace's construction, the reception area had yet to be completed and so, for security, the door was kept locked.

10.4 Conclusion: The Resistant Appropriation of Making

The absence of appreciation, agreements on designs, and perceived insufficient salaries result in the appropriation of prototyping methods and calculative making to resist the hierarchies in the workplace. Technology developers position themselves in the powerful field of work deletions by using prototypes to make their invisibilized work tangible, by using the calculation of scarcity to avoid negotiations with those in authority over them, and by appropriating their work objects to silently resist workplace hierarchies. As such, the developers' care of making technology in a professional and calculative manner establishes socio-material relationships that enable them to change the workers' positionalities within work organizations.[6]

6 For a thorough conceptualization of emancipatory caring relationships within (agile) workplaces, see Coban and Wenten (2021).