Chapter 7
Hustle – The Making of Technologies in Kenya

Technology entrepreneurs all over the world face challenges during the production of their technological ideas. In Kenya, the already difficult hardware development is worsened by a lack of state support, difficult access to global commodity flows, a scarcity of investors, and overall colonial legacies. These context-specific challenges form the peripheral positionalities of Kenyan tech entrepreneurs and make technology development a time- and money-consuming process, not allowing for failure-intense prototyping. As a result of the unequal economy of global technocapitalism, Kenyan technology entrepreneurs are almost entirely dependent on international ties to investors, supporters, or family to escape their financial and material resource constraints (see Chapter 6).

The following vignette and further empirical examples below illustrate the Kenyan tech entrepreneurs' hustle to handle the challenges of developing an innovative product in a material periphery of technology production. The vignette tells the anonymized[1] story of an entrepreneur's attempt to develop new technology in Kenya and is based on an interview (May 2016) and several private conversations.

Making Hardware in Kenya – The Story of John and BrightVest

Hello, my name is John and I am from Nairobi, Kenya. I run a wearables startup called BrightVest that tries to reduce motorcycle accidents with wearable technology. BrightVest is a vest for motorcycle riders and their passengers that transmits the motorbike's light systems to their backs. The vest contains

1 I have anonymized the name of my research partner as well as the name of the company.

bright LED lights that turn red when braking and amber to indicate right turns, left turns or hazards. Thus, the motorbike's indication is made more visible to other motorists and road users. BrightVest is wirelessly connected to the motorbike and can be worn over your favorite riding jacket while being water and dust proof.

Let me tell you the story of why hardware is called HARDware. The journey of developing hardware technology is tough, that's why. It entails a lot of bootstrapping: it takes a lot of resources, time, and research. I did not know that when starting five years ago. What I did know was how to fix and disassemble things. When something broke down at home, I helped my father fixing it. When the bulbs did not work, I fixed them. When my dad's radio did not get signals, I disassembled it. I helped my father in repairing his car, handing him the tools he needed. I grew up doing this and did not have much time to play outside as a child. Most of the time I was making; and probably spoiling everything in the house as I started playing with electricity when I was really young.

As you can see, I have no formal education in engineering. I'm one of those guys who have learnt through participating in hackathons and attending events run by Intel and Microsoft. I gained all of my engineering skills from working at co-working spaces like iHub. And that's also how I met my co-founder: we both participated in a German hackathon; a two-day boot camp in which we realized 'Oh, we both have good skills in making hardware'. That was a surprise because he was the first maker I'd met in a co-working space. I realized that he was a maker because he knew about Arduinos although they were not yet in the Kenyan market. Other makers I've met were not really into engineering and robotics, more into the recycling of e-waste through designing fashion, art, and furniture. In that hackathon, we won six months of incubation at a business accelerator and ended up starting BrightVest together.

From that moment on, it took us two years from the idea to the actual product. When we started BrightVest we wanted to sell fancy clothes with lights on them but after joining the business accelerator, we found out that there was no business model around that. Asking people, "Would you buy a shirt with lights?", they were like "Oh no! Why would I wear a shirt with lights?! So I can get robbed at night? People could see me everywhere!" We had funny conversations that forced us back to the drawing board. That was when we

stumbled over reports from the World Health Organization, saying that if we increased the visibility of motorcycle riders, we could reduce the chances of accidents by 70%. As the tech scene in Nairobi puts emphasis on building products that solve problems in Kenya and other developing countries, we came up with the business model around BrightVest as a vest for motorcyclists.

We started building the vest and had a complete prototype in only two weeks. The first one had cables running from the vest to the motorbike. That was easy. But after some days we had problems with short circuiting and cables coming loose from motorbikes at high speeds. So we had to sit down and think: 'Now we need a wireless technology'. Getting the components for a wireless device was quite a challenge. The components available in Kenya were all power hungry. So this other issue came up: we first had to find low power consumption devices. All of this was challenging because the only components available on the market were the usual ones that we had already used. Trying to get the required parts from China to Kenya was extremely expensive because there is a huge tax on imported goods. My co-founder didn't have a job and I had to quit my job to work on BrightVest, so we were limited on capital and boot-strapping with family and friends. That was quite demanding.

In addition, a small company can't order small quantities of five hundred components of each part needed. To place an order you need to order almost 4000 components at a time. If you somehow manage to find a company in China that will sell you a small number of electrical components, it takes about three weeks to get them. During those weeks, the only thing you can do is to wait. By the time you wait, it's almost a whole month. This means that your process is delayed. You have six months in an incubator to work on your project and have demos to present but you cannot deliver anything because essential components for the prototype are missing. So we got the few parts that were available here and hacked around those, like using lights from bulbs instead of the right LEDs.

If we had had a maker community around us back then, maybe we would have finished a marketable product faster. But we didn't have access to tools or manufacturing plants and thus, we had to find alternatives. That is why we decided to do crowdfunding. With that money, we managed to fly out to the Netherlands to meet with engineers and build the complete thing from scratch. Finally, we managed to build our product after two years full of chal-

> lenges. I can tell you, the two things that most helped us to reach our goal were thorough research and exchanging experiences with other Kenyan hardware companies. We spent a lot of time doing research, reading books, and talking to other companies that had been on the same journey but with different devices, just to see how they got started.
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> Luckily, we have now reached the point where we can make the vests manually and have already produced almost fifty vests. We have even shipped some to Malawi and Uganda. In Kenya, we still have a market of over 600,000 motorcycle riders. Thus, we need to automate the process of making our vests which is why we are now looking to go to China for mass production.

Meeting John again a few weeks after our interview, he told me about his countless contacts all over the world. That evening he had a skype meeting with an entrepreneur in Germany, the day after he would talk to someone from the Massachusetts Institute of Technology, and the Dutch engineers had become close friends and technical advisers. When I told him that he seemed to be the best networker that I knew and that his connections would possibly help him to find funding to scale his enterprise, he sighed and told me despondently that he had sacrificed everything – his family, his friends – over the last few years. He had not seen or talked to his sister in over a year although she had recently given birth to her first-born and lived not far from him. He sighed several times more and emphasized how hard it was to be a hardware entrepreneur in Kenya. John listed all the funding proposals he had written and explained that most of the replies came in the negative; no-one wants to finance a hardware project. During this conversation, John told me that he had made up his mind with a heavy heart and decided to stop working on BrightVest and anything else with hardware unless he received investment (Research Diary, June 24, 2016).

7.1 The Scarcity of Prototyping Resources

John's experiences of developing hardware are not unique, but resonate with the whole hardware tech scene in Nairobi. The following additional ethnographic insights show that technology developers perceive themselves as disconnected from global economies. They blame colonial path dependencies for Kenya's peripheral status in commodity flows and compare themselves to their role model, Silicon Valley, where procurement is described as "easy"

because "you can simply order components from online distributors … and parts arrive quickly, with familiar shipping options" (Mellis 2011: 54).[2] I argue that Nairobi's makers feel that they exist in a place that is antithetical to Silicon Valley as they are confronted with restricted and complicated access to resources that makes technology development more time-intense and costly than it would be in countries holding central economic positions in technocapitalism.

For Kenya's technology developers, access to machines and components to prototype and manufacture electronic devices is limited. High taxes on imported resources, such as basic soldering wire, 3–5mm screws for electric circuits, or CNC (Computerized Numerical Control) machines render imported goods too expensive to buy (Mungai 2015: n.p.). Complaints about high taxes and the overall problematization of Kenya's government and its missing support of the manufacturing sector are made and heard daily. Technology entrepreneurs complain that making in Kenya is challenging because national laws and policy frameworks restrict cheap prototyping. A researcher at the Centre for Intellectual Property and Information Technology Law (CIPIT) at Strathmore University confirmed that most makers in Nairobi are concerned about the tax laws in Kenya that make it too expensive for them to import resources such as machines, components, and other parts necessary to execute their work (Interview, April 2017). The high taxes defined in the customs regulations and the high costs of production in Kenya in general, makers claim, prohibit the local development of technology:

> Our hardware is designed here, but it is produced in California. Even producing it there and bringing it over to Kenya is still cheaper than having it produced in Kenya. The manufacturing license here, just a license, a piece of paper, costs ten thousand dollars. (Interview, hardware company employee, November 2015)

2 The description of the USA or other industrialized countries as challenge-free places of technology entrepreneurship is a homogenization. Making, and technology development in general, is predominantly done by high-income status groups. In this vein, Avle et al. (2019) describe how makers in low-income areas in Detroit experience challenging access to funding and material resources due to categories of class and race. In addition, gender inequality and its resulting restrictions are also present in tech hubs and makerspaces worldwide (Jiménez 2019; Eckhardt et al. 2021).

The hardware company employee went on to elaborate that everyday political affairs have implications for his company, for example, on the product's pricing. Therefore, he concluded, hardware companies "do not operate in a vacuum", but within a legal environment that enforces the "rule of law" (ibid.). According to him, the Kenyan government tries its best to cope with the demands of technological innovation and the pace of technology development was a challenge for governments worldwide (ibid.). Nevertheless, specifically in Kenya:

> The institutions of the day were set up by the colonial masters – the policies, customs, and law. And if you look at the laws that exist, a lot of them need to be updated to the realities of today. When the law was put together, they didn't anticipate that we were going to build this kind of hardware here. So there is a gap between what we are doing and the rigidity of the legislative environment. (ibid.)

This is a good example of how hardware entrepreneurs problematize the lack of state support. The Kenyan government is said to complicate manufacturing because of its prohibitive tax laws, outdated business legislation unsuitable for technological development, and overall "bureaucracy and corruption" (Gearbox 2016: 2).[3] Despite the existence of various government departments, initiatives, policy papers, and agendas that aim to support the manufacturing sector in Kenya (see Chapter 2), difficulties in acquiring components and machines to prototype still exist; resulting in a scarcity of prototyping facilities and industrial factories to manufacture locally.

Engineers who tried to import resources in the 2000s had even more problems:

> I tried to do online importing when there were only a few online shops. I had to go to a bank but no bank would accept my international money order. So I

3 Corruption as a challenge for entrepreneurs was mentioned on various other occasions; for example, at a panel discussion on tech entrepreneurship in November 2015. Corruption was mentioned in the first five minutes of this discussion, and from then on, the topic was present throughout the evening. Amongst others, stories about the absurdity of licensing processes were told: entrepreneurs have to go to six different offices to license a business; each visit entailing extra 'payments'. One of the panelists felt that if face-to-face interactions were reduced through digital systems, corruption would decrease tremendously.

> had to find an international check and send it by post not knowing how long it would take. (Interview, mechanical engineer, November 2015)

An electrical engineer and expert in Nairobi's hardware innovation scene observed that the hardware scene improved around 2012:

> Before, it was so hard to get stuff. There were two stores in the city where you could buy components. Later on, one company went online and you could order from a limited selection online. What I realize when I look back is that this particular company really influenced how people were approaching making. If they had Arduinos, people would rush in and start working on Arduino. Then Raspberry Pi. I don't think they are aware of it, but they really affected how people interacted with electronics. Because when it's available, then you build something with it. (Interview, May 2016)

Although internet penetration and thus access to international knowledge and sellers has increased dramatically, the cost of machines and components are still restrictive. A daily practice at makerspaces is the online search for new projects and the latest components for making. One day, a makerspace member showed me the website of a new Russian startup who had built the "smallest computer". He complained that he could not order one because the initial cost of 45 dollars would increase to 100 dollars due to the Kenyan taxes. Further, he doubted that it would actually be delivered to Nairobi successfully (Research Diary, June 23, 2016).

'Waiting' characterizes the acquisition of material – both locally and internationally. The local purchase of prototyping material is determined by the supply of well-known local shops (see quote above) or an exhaustive search for the required parts. If fortunate, technology developers will find their specific components somewhere in Nairobi after having called numerous sellers around the city. To find suppliers in Nairobi is difficult because:

> Often, they are family-owned companies. They have a stable, reliable customer base and they don't need to advertise. Therefore, they don't have websites, catalogues, or pricelists and are extremely difficult to find. You have to ask around and ask who does what. (Interview, mechanical engineer, April 2017)

The search for locally available parts causes daily absences from the makerspace because people have to go to 'Tao' (Nairobian slang for "Town") to buy essential

components. At this point, it should be said that a purchase in the Central Business District or Industrial Area, where most of the sellers are located, means losing at least half a working day due to Nairobi's notorious traffic jams.

Sitting in a traffic jam for two hours is one way to wait for a component; another is to wait six to eight weeks for components, machines, or whole prototypes ordered from abroad. If specific components are not available in Kenya, they are usually imported from countries such as China or the USA. These imports include long waiting times which make prototyping a tiring process as a hardware company founder explained:

> I got someone to take me to town to go to where the electronic components were sold. I hoped to find microprocessors, surface melt technology, you know SMT components, and instead I found those big capacitors and resistors and things that aren't very useful to do embedded electronics. And, you know, that was all that existed. And so we did the best we could with the parts that were available. From that we learned and said, 'Okay, what we really need is one of these and one of these'. And so we were able to import stuff. Sometimes it would come in one week, sometimes it would come in eight weeks. It was really challenging in those early days. (Interview, November 2015)

A common strategy to make prototyping cheaper and quicker is to send a digital model of the prototype to specific companies in the USA or China, have it built there and then shipped back to Nairobi. Nevertheless, according to my research partners, the international outsourcing of prototyping makes technology development in Kenya even more time- and money-consuming than it is for engineers in the USA or UK:

> Prototyping is expensive, even doing it in China. Because prototyping involves putting an idea out there to test it, so you are paying someone every time you are testing. So every time the prototype goes out, you are spending money because you have to pay freight. And you, you have to sit back and wait until it comes back. And be surprised about 'Does it work or does it not?' It takes ten times more money and time than for a person prototyping in the US or UK. (Interview, mechanical engineer, November 2015)

The international purchase of components and prototypes is not only challenging for individual makers, but also for Kenyan startups. They face barriers to acquiring resources because they are often not eligible for discounts or deals with

global hardware suppliers. In the example of BrightVest, it became clear that startups who experiment with hardware and therefore need only a small number of components, do not qualify for orders from manufacturers in China. The hardware company BRCK also had experience of being "a small Kenyan company":

> It is very difficult for us to get the attention of electronic part suppliers. Therefore, one of the issues we had from the beginning was our modem. A company called Novatel makes our modem. They are used to dealing with billions of units, so a deal with a small Kenyan company for one thousand units is not exciting to them. That meant that they changed their modem and did not tell us. And then we had issues. So we had considerable component constraints – even getting those 25,000 units. Only our partnership with Intel Education and their strength and power, allows us to get access to manufacturing and component suppliers as they are now paying attention to us. (Interview, co-founder of BRCK, November 2015)

The example of BRCK's partnership with Intel, a multinational tech company, shows that Kenyan technology developers are greatly dependent on international ties in order to access other countries' markets and escape resource constraints. The vignette at the beginning revealed that John and his co-founder were only able to build their final prototype in the Netherlands. Makers who have an international background often use their personal travels to the USA or Europe to purchase material: "I brought pumps from San Francisco last time I was there, just because I saw them in a hardware store and it was 70 dollars. That exact same model here in Nairobi costs almost 700 dollars" (Interview, makerspace employee, November 2015). The co-founders of BRCK also brought various components with them when they moved to Kenya: "We literally brought our piles of stuff into a room, dumped it on the table, and put together the first working BRCK from those components" (Interview, co-founder of BRCK, November 2015).

7.2 The Scarcity of Financial Resources

The fact that international relations ease technology development through, for example, giving access to global electronics markets, is a privilege not granted to many. In the case of BrightVest, the startup was unable to secure funding

to scale the production of their vests, and John was forced to give up his hardware innovation after two years of work. The difficulty of finding investors is a challenge bemoaned by many (Black) technology entrepreneurs (see Chapter 6). One reason for the lack of investment in hardware technology is that the investors in Nairobi focus on software innovation. This means that money-bringing competitions such as hackathons suit software and coding projects better than those tinkering with electronic components.

A hackathon's limited period of 24 to 48 hours also excludes the making of hardware, as an electrical engineer explained: "The timelines are very unrealistic to come up with an MVP [Minimal Viable Product] for hardware. Additionally, the hackathon organizers do not provide the hardware components needed to experiment and research" (Interview, November 2015). Despite the engineer's critique, he and his team had managed to win six months of incubation at a hackathon, as John and his co-founder did (see Vignette). Nevertheless, he soon realized that this six-month period is far too short for developing hardware. The reiterative process of prototyping hardware takes more time than coding software due to the long waiting times for components and machines. Based on these experiences, the interviewee was convinced that some investors are not willing to support hardware ideas:

> [The international companies that are involved in Nairobi's tech scene] just come here for a beer and marketing to show that they are in Africa. If they were committed to building stuff and going to market, they would figure out an ecosystem to help Kenyan innovators. It can't work within a short period of six months. No, it can't work. And even if it is a competition – what is the spirit of a competition? Just to have an MVP at the end? You shouldn't have a process where you eliminate guys, you have to at least help us along the process. … Hardware projects are time-consuming and very painstaking, so the companies should consider how they can actually support the participants. (ibid.)

As well as accusing technology investors in Kenya of not being serious about their work, a hardware company founder had a different explanation for the scarce investment in hardware innovation in Kenya:

> Hardware scares people. And the ones you find that are willing to invest in hardware are genuinely scared of Africa. So to find people who aren't scared of hardware and aren't scared of Africa is a bit of a challenge. (Interview, November 2015)

A global stigma also seems to cling to hardware innovation; it is too difficult to understand and assess for non-engineers. As such, it is difficult enough for a hardware company in the USA or Europe to find investors, but working in an African country that has the additional stigma of being a homogeneous frightening context for investment makes the search for hardware investors even more challenging (see Chapter 6). As depicted, the scarcity of investment causes many startups to fail at scaling up their enterprise or even at testing their prototypes.

7.3 Conclusion: The Challenges of Postcolonial Technology Entrepreneurship

The illustrated hassle of accessing prototyping resources due to the lack of support from the state and investors shows that "the context of East Africa makes a hardware project very resource hungry – the manufacturing course, patent issues, and getting a VC fund" (Interview, hardware innovation expert, May 2016). Without having access to abundant capital and resources, the already difficult development of hardware is exacerbated for technology entrepreneurs in Nairobi. A Kenyan makerspace summarized a similar status analysis of the hardware innovation scene:

> There is a vibrant culture of designers, engineers, and entrepreneurs creating products designed to improve people's lives, … [but it] is highly constrained by a lack of skills training, access to quality tools and materials, and an insular culture in the face of regional and international competition. The best local organizations and talent are forced to design and develop abroad, increasing costs and time to market and spurring brain drain. (Gearbox 2016: 7)

The makerspace's analysis of entrepreneurial challenges in Kenya draws on experiences of local hardware startups and further explains how a makerspace can help to solve the challenges faced by companies, makers, and other people who aim to develop new technology. In an interview, a co-founder of BRCK admitted laughingly that they had built the makerspace Gearbox for them-

selves: BRCK and Sanergy,[4] two of the founding companies of Gearbox, shared their experiences of prototyping problems and subsequently decided to launch a makerspace that supported companies like them (Interview, November 2015). By offering digital fabrication tools to develop prototypes more cheaply, the establishment of makerspaces should serve to alleviate the challenges inherent in the peripheral positionality of Kenyan startups in technocapitalism. Chapters 8 and 9 illuminate the perceived preciousness of the local making of high-tech that conforms to global standards, as it promises to re-make Kenya's positionality.

4 Sanergy is based in Nairobi and builds sanitation solutions for informalized settlements.