II. Methodological Approaches and Empirical Analysis

I would like to begin by discussing the methodological approach of the ethnographic study. Although the respective cases with their material data are not discussed until Chapter V, individual interview excerpts are already included in the theoretical framing of this work, which represents an attempt to create a nexus between theory and empiricism and to link the material with the literature. Therefore, I describe the study's methodology, the methodological approach, and the handling of the material upfront to indicate how and under what circumstances the data were collected and the results obtained before commencing with the ethnography. Since most surveys took place during the COVID-19 pandemic in 2020 and 2021, this aspect cannot remain unnoticed as it was a significant obstacle when conducting the research.

To begin with (subchapter 2.1), I explain why I decided for the prototype to be the artefact of the investigation as it is more than a mere concept on the way to fulfilling a product. Further, I will elaborate on why the aspects of care in the context of medical prototypes initially seemed to be appropriate for approaching the field, although, as it subsequently emerged, the care aspect might generally be inherent in developing an idea once a problem has been discovered.

The next section (subchapter 2.2) explains the methodology of this study. Hence, I introduce grounded theory (GT) supported by a few arguments from 'Method Assemblages' by John Law (Law, 2004). Especially concerning marginalised data that threaten to get lost in large amounts of material, e.g. because they appear very subjective, this extension of GT seemed reasonable.

In subchapter 2.3, I present the research sites and introduce the informants in the field. I mainly spoke to people in the medical area from different makerspaces and incubators and to one private investor. I chose my informants based on their work with medical technologies or their strong emotional connection to their work in technology development.

To investigate the influences and effects of the actors' emotions that surround and influence the development paths of their prototype, e.g. in moments of decision-making, I used four different methods, in particular, to obtain various data materials following an ethnographic approach (subchapter 2.4), which includes (1)

participatory observation, (2) in-situ narratives such as work-alongs, and (3) semi-structured interviews (both on-site and online) with innovators, incubators, and other actors in the workplace. Finally, (4) I analysed websites, videos, and brochures of the available prototypes and products.

The chapter closes with subchapter 2.5 and my reflections during and after the fieldwork, which is meant to shift the focus to the obstacles and general challenges in innovation-making.

2.1   Medical Prototypes as a Resource of Care

Prototypes as quasi-objects (Dickel, 2019; Latour, 1993) are particularly suited for the study because they are still in development and, therefore, not a finalised manifestation. Through their 'openness' and their resulting intermediate stage, they offer the possibility to compare their previous development with an original concept and, at the same time, examine the reasons why they are moving in the given direction of development. In this respect, the work contributes to innovation and science research against the background of the critical rationalisation of knowledge production processes whereby evaluation criteria and patterns are examined through the aspect of emotionalisation.

The research focused on medical technologies because it appears that the medical field, in particular, is often highly emotional, and moral reasons are frequently highlighted in connection with *care* when describing the original motives and reasons for the development of various medical aids/devices. The explanations around these artefacts seemingly include a posture that wants to 'fix' or 'heal' a given mental or physical deficit (Puig de la Bellacasa, 2017: 69; Tronto, 1993: 103). Thus, a simplified approach to emotions seemed feasible at first, as physical deficits are especially emotionally indicted because they are associated with pain, fear, shame, and the loss of dignity (Fineman, 1993: 19), to name but a few and, therefore, need special attention. However, aspects of care allow for a stronger focus on the sphere of emotions.

While emotions take on a greater role in the context of care, this connection does not only apply to technologies in the medical field since emotions are generally influential in technology development, as this book will highlight. On the contrary, regardless of the aspect of care, it can be stated that emotions require consideration as part of human cooperation. Although there are well-developed emotional motives in the field of medical technology development, it is challenging to approach these. As indicated in the course of this work, this is not due to emotions but rather to the field of innovation in general. Spheres that are labelled with the term 'innovation' are untransparent and challenging to enter, and it seems as if there are invisible walls of silence built around this theme. This difficulty is constantly apparent when de-

scribing the empirical study, whether concerning the approach, (not) surmounting hurdles to gain interviewees' favour, or how interviews are anonymised.

Despite the outlined challenges, the study still provides significant insights into innovation-making and the med-tech sector, primarily because qualitative methods are used so that the supposed 'marginal' can come to light. By 'marginal', I mean that access via emotions, whether narrated or observed, allows us to encounter subjective narrative forms about the motivations for innovating that do not otherwise occur, as the field is usually subject to rationalisation. In addition, emotions sustainably report on patterns of evaluation and categories that tell us something about the social issues of society.

In the following section, I present the applied methodology, which, while primarily representing the programme and approach of ethnography, is also exemplary of the inherent processes of the research field.

2.2 Methodology

To illuminate a diverse and sometimes vague research field such as innovation-making with questions that examine the emotional co-constitution in innovation-making, it is necessary for the researcher to frequently change perspectives and resort to various methods. It is precisely the subjectivity of emotions, or what the interlocutors describe as 'feelings', that opens up a vast arena of what can be researched in this field as an influencing factor in technology development. Additionally, I have found that feelings and emotions are often hidden in subordinate clauses and incidental situations that need to be crystallised. Therefore, implementing the approach of diversity in terms of methods and perspectives is necessary, not least to avoid potential one-sidedness or oversimplification. Further, the complexity of the data and its origins must be sorted and systematically arranged in the mosaic of its multiplicity, which GT helps to achieve.

GT is a proven methodology that was developed in the 1960s by the American sociologists Anselm Strauss and Barney Glaser which uses various qualitative methods to describe, classify, and interpret existing knowledge and, in this case, existing emotional states and treat them as social phenomena in social worlds including various actors. Doing so allows us to derive a theory from the material or to expand or modify already existing theories (Morse et al., 2021:3–4). Generally speaking, GT as a methodological approach is helpful for explorative studies that are open to creatively spinning together the results into one bigger picture. Although it is primarily used to study interactions or social behaviour, it has been no less successful in studying experiences in the past. However, it is just as suitable for studying relationship structures (Breuer et al., 2019; Morse et al., 2021: e.g. 50, 165). Studying experiences and relationship structures is particularly important for a closer look at social behaviour,

which I examined here and provides insights into creativity and the understanding of innovation. In the context of GT, however, I will take the liberty of integrating John Law's idea of 'method assemblages' (Law, 2004: 13), although I do not treat it as a second methodology next to the first but rather as a conceptual extension of it. The integration has the purpose of not losing sight of the 'hidden, small details' that are also part of the mosaic, although they initially do not seem to fit the systematisation. This is not to say that GT would not allow this, although I would like to extend the focus to the subjective, which sometimes threatens to disappear. Above all, I found inspiration in not having to talk about concrete emotions to access them. The idea is thus not to have a conversation that starts with discussing feelings since, as I mentioned in Chapter I, this caused misunderstandings. Instead, the idea was to develop a conversation full of emotions regardless of the concrete naming of personal feelings. In my material, sentences such as 'I feel sad because…' are rarely found, and instead, sentences widely occur that elaborate at length, describing a situation, followed by an emotion, sometimes abstractly, sometimes concretely. However, this is not because I attempted to stage a therapy session, as this would have been inappropriate and presumptuous, but because it is part of the work that is to be located at the places of work and beyond—in private.

Accordingly, it is not only the methods but also the researcher's gaze or approach that play a significant role in how (and what) data is collected.

Therefore, I avoided the problem of a static view by using various methods recommended by GT. In this respect, my flexibility in view and method was indispensable, not least because of the different obstacles that had to be overcome and which emerged during the research. In the work process, it became increasingly clear how important it is to critically examine the topic in addition to having a reflexive attitude towards oneself and the field. Studying the handling of innovations and the term itself is a very vague undertaking, and the fact that the results are sometimes ambiguous is not due to the 'messiness' (Law, 2004: 18) of the study but to the intricate policies of the matter itself. The mere conveying of emotional content says nothing about when it has contributed to a decision, and a very reflexive attitude towards one's emotions can filter them down to such an extent that no content worth mentioning remains.

The accompaniment of various actors from different groups and disciplines ensured a constant change of perspective. By this, I mean that the field is first seen through the eyes of the informant, and only the researcher who accompanies them can finally bring the different perspectives together and provide an overall picture.

Following John Law's proposal to move away from the classical understanding of methods toward 'method assemblages' requires 'a combination of reality detector and reality amplifier' (Law, 2004: 14). This involves discovering the respective quality of a method and applying the method against this background and with this claim. Methods are less to be seen as already given and only used as a means to an end, sig-

nificant only in their self-evidence. With this in mind, Law criticises a researcher's all too common approach in his methodological approach to the field as the standard routine possibly tempts one to become redundant in applying it and not remain purposeful. This results in everyday descriptions that reproduce themselves but cannot provide any significant gain in knowledge. Instead of investigating 'the everyday', the method produces 'an everyday' with perennial answers to one's questions (Law, 2004: 45 f.). Hence, to avoid the error of one's own bias and discover the many realities out there, researchers are encouraged to develop quiet, slow, and modest methods that do not tempt us to be overly imperialistic (Law, 2004: 15).

To return to GT in combination with the method assemblages according to Law, it is important to note, especially for this work, that one's own perspective is not only challenged by constantly aligning itself with new disciplinary cultures. As I will demonstrate in the empirical part, this approach reflects the overall attitude of this research topic. Not only does the topic require me, as a researcher, to constantly be flexible in changing perspectives, but the same applies to the actors in the field who, in the course of their work, have to engage with many others who do not share the same background or perspective. Apart from following the prototype, it was about observing how many cultures situationally become one to create something together. Thus, a story of innovation and prototyping unfolds in different places, in different group constellations, and through various languages.

> So assemblage is a process of bundling, of assembling, or better of recursive self-assembling in which the elements put together are not fixed in shape, do not belong to a larger pre-given list but are constructed at least in part as they are entangled together. This means that there can be no fixed formula or general rules for determining good and bad bundles, and that (what I will now call) "method assemblage" grows out of but also creates its hinterlands which shift in shape as well as being largely tacit, unclear and impure (Law, 2004: 42).

Accordingly, stories and realities are '[n]o longer independent, prior, definite and singular as they are usually imagined in Euro-American practice. They become, instead, interactive, remade, indefinite and multiple' (Law, 2004: 122). This approach is compatible with GT in the following way: while a systematisation can be undertaken for some narratives, this is not possible for all findings. Thus, I have made it my goal to go beyond the 'pre-given lists' (which I will revisit in subchapter 2.3) and embed individual, non-sortable inferential analyses, for it is precisely the seemingly marginal that comes into effect through contextualisation. Consequently, on the one hand, realities and associated narratives develop very differently, and on the other hand, they are interconnected and refer to the same phenomena. Interestingly, however, the difference in the narrative does not depend on the person who narrates but much more on the place and time. Hence, it can be that a person speaks and feels

differently at different times and in other places than previously described (Gammerl, 2012; Law, 2004). Similarly, different people may develop a similar narrative at varying times in other places. This observation is eminent because the person in space and time makes the difference. Therefore, it is again justified that the focus of the study is on something such as human emotion and what is detected as a feeling.

> Narratives and their enactments are not fixed [...]. They are negotiated and renegotiated. The fact that they are negotiable and in need of negotiation is entirely explicit. So too is the fact that those negotiations are strategic in character. The implication is that if singularity is achieved (and the extent to which this is the case is contingent and uncertain) then this is a local and momentary gathering or accomplishment, rather than something that stays in place (Law, 2004: 129).

It is precisely this demand for flexibility and fluidity, justified by vagueness, that only further substantiates the question of the emotionality of technology development, which ensures a new approach to innovation practices. All too often, these are pseudo-rationalised processes that are treated as such. In this respect, the investigation using qualitative methods makes sense and, further, an approach that does not exclusively ask about policies and structures. The connection between the question and the chosen method examines, on the one hand, the communicative forms of and around prototypes, such as translation narratives (translations) of innovation.

In what I have examined, I refer to feelings and emotions that are generally considered as such. These include, for example, anger or frustration. In addition, I draw on the statements of my interview partners who, for example, describe their gender in connection with discrimination as a feeling of oppression. Finally, so-called meta-emotions (Archer, 2000: 224), such as trust, are also part of the investigation, although I do not make an explicit distinction every time I name them. While emotions and their temporality and the above-mentioned differences may seem fragile to some, they refer to an object, relationship, or activity. Therefore, GT is able to grasp these expressions because they refer to these fields.

2.3 The Research Sites

As already indicated, I do not describe individual case studies based on their prototype examples. By contrast, I will describe and analyse the research sites visited that were relevant to the work. In the later evaluation, it will nevertheless become clear to which location and prototype I refer.

While the collected consideration of the phenomena may seem unusual, it has the advantage that they can be considered independently of their context, as they

do not represent individual cases. In this respect, the emotions that occur do not represent a single case scenario per se but have recognition value for others.

Furthermore, for reasons of confidentiality and intellectual property (IP), only partial details of the prototypes will be provided. In concrete terms, this means that the descriptions of the respective prototypes are more like the published descriptions of the inventors and teams and do not reveal any technical details beyond this.

In total, I visited four different sites of invention and/or innovation, where I was able to observe several developments, and I will now discuss both the places and the prototypes in more detail. The first site is an *incubator* that is connected to a university hospital, where I studied two different teams and their invention. Secondly, I did research at a *makerspace*, which I observed as a whole complex, meaning that I was not observing particular teams. The third site was a *creative space*, which I did not observe as a geographical space like the makerspace but rather as a mental one where ideas develop amongst people. Finally, I looked at team dynamics in an established *company* that has been operating since the early 1990s. In addition, I consulted an *innovator* and private investor. His work and inventions are examined from two different angles, and describe independent impressions that are very similar to those of the others. In this section, I will also mention who or how many technological artefacts were specifically accompanied.

To ensure confidentiality, all names, those of the innovation spaces, the company, the teams, and the interviewees, were anonymised and changed.

1) The Med-Tech Incubator: Health Hub

The digital labs of the publicly funded incubator are dedicated to biomedical developments and form part of a more extensive healthcare network that is exclusively available to doctors at a specific clinic and research centre in a German city. The doctors at this site pursue the mission of translational medicine, aiming to transfer biomedical research results and inventions to patients or launch them in the healthcare market. In this respect, the incubator uses an annual call to invite doctors from one clinic to realise their ideas. After a successful application, they are given money for a certain period, at best – provided that they successfully fulfil their milestone plans– several years. In addition, they are released from their work at the clinic for this period while they continue to receive their salary.

The incubator initially provides its successful applicants with a room and the necessary equipment. Most of the time, these are ordinary office rooms that resemble co-working spaces. In addition, the doctors and later teams are advised by the incubator and external consultants. They have access to a wide range of services and can distribute orders, e.g. have preliminary prototypes developed or hire developers. Before they have to take part in so-called demo days to demonstrate their prototype to a selected public, they can participate in drama workshops to reduce their ner-

vousness and practice performing for events. In these workshops, they are taught how to deliver the best possible performance in order to market their idea, e.g. to representatives of health insurance companies. In addition, the incubator grants them access to a broad network and interdisciplinary collaboration in the labs.

During my fieldwork in the incubator, I alternated between talking to the Head of the Incubator and Accelerator Programme, *Jan*, and an externally contracted consultant, *Felix*, who advises and discusses milestone plans with the teams during their time at the incubator. In addition, there were informal discussions with other incubator staff, and although these were not part of the evaluation, they helped to establish connections and structures. The incubator's portfolio has broadened considerably in recent years and involves some software and hardware developments. I dealt with two hardware developments in my ethnography: a sensory insole (*Feety*) and a pulse-measuring headband for anaesthesia (*Ellie*).

I accompanied the two teams for different lengths of time. I had my first contact with team 'Feety' in 2019 and maintained it until the end of this work in 2022. On the other hand, I only accompanied team 'Ellie' for a brief period, although it was still in the early stages of its development.

Team Feety: 'Feety' is an insole for postoperative patients. After a knee or hip operation, the sensory insole, inserted into the shoe, helps measure the weight of the load. In this postoperative phase of a couple of weeks, a maximum of 15 kilos of weight is allowed on the operated side, which is why the insole, which is connected to a mobile phone app, then sends a warning to the user to remind them of the load limit.

In this team, I spoke with the physician and project and team leader, *Bahar*. She developed the idea for the sensory sole together with her sister. I also spoke with *Hendrik*, her husband, who was hired as an executive officer in her project. Lastly, I talked to *Viktor*, an externally employed developer, who was hired full-time for the project. Most of the interviews with this team were with him. This is simply because, during the time of my investigations, the other team members, including the team lead, left.

Bahar and her sister applied to the accelerator programme in 2018, together with their supervisor, the chief physician at the clinic. The head doctors are part of the application process but only play a role in the background and do not actively work on the projects at the incubator. Their application was successful, and Bahar started working on the project with her sister, but the latter soon dropped out due to her medical school commitments. In the meantime, Bahar hired Viktor, a successful founder of a social media platform in Romania, who had studied at the Massachusetts Institute of Technology (MIT) and previously worked in Shanghai. He brings a lot of experience and expertise and also has had a similar idea to Bahar's, which is why he started working on the project in the first place. In 2019, Hen-

drik, Bahar's husband, was hired, and they worked as a team of three for a while. In 2020, the first summer of the COVID-19 pandemic, Bahar and Hendrik stopped working on the project, and Viktor remains the only active employee and developer in the project. The conversations with Jan, Felix, Bahar, and Hendrik took place in German. The conversations with Viktor and Ryan were in English.

Team Ellie: 'Ellie' is a type of headband that measures the brain's pulse waves under anaesthesia during surgery. The headband, with its sensors, thus measures the blood supply while the body is immobilised. After an anaesthetic is administered, the so-called Postoperative Cognitive Dysfunction (POCD) syndrome can occur, which is characterised by postoperative delirium and cognitive dysfunction. This dysfunction is caused by a lack of blood supply to the brain. POCD occurs relatively frequently and does not always have a lasting impact on the patient, although the undersupply can lead to a long-term problem, which means that people can no longer live independently afterwards. The headband is designed to help monitor the blood supply during surgery to improve the blood supply if necessary and thereby prevent POCD syndrome.

I spoke to Ryan, 'Ellie's' project and team leader, twice in English. He is also a physician and applied for a position at the incubator in 2019 with his supervisor and chief physician. The idea for 'Ellie' did not come from Ryan himself; he was introduced to it by his supervisor, who already had contacts with an external development company that develops engineering services for the medical sector, such as pulse measurement. In this collaboration, the chief physician and the company came up with the idea that pulse measurement could also be used in anaesthesia. Ryan was enthusiastic about the idea and developing it further in the clinic's incubator. He worked alone until mid-2021, when he hired a developer who now supports him in his daily work. With 'Ellie', too, the chief physician stays in the background, working at the clinic. Ryan and his developer, Shahaf, are now fighting several battles. Due to the inclusion of the external service provider for medical technologies, which already took place before their application to the incubator, conflicts often hinder the project work.

2) The Makerspace: *M.lab*

This makerspace is a 4,500 m² hard tech innovation hub that is home to over 70 start-ups and has more than 500 members today. The space was founded in 2015 by Christian, Filip, and Baris. The website indicates that, like many start-ups, it started with a small idea and very personal challenges. As for the founders, it involved implementing their own idea: a bicycle with an alternative drive. Through their work on the bicycle, they figured out how helpful and necessary it was to have adequate space, equipment, and a network to rely on. Therefore, they founded this makerspace after

discovering the need for such infrastructure. When I visited the space for the first time in 2018, it was still in its infancy compared to its present developments and offerings.

Today, in 2023, the space disposes of an advisory and mentoring programme. One can get advice on various levels, also concerning a suitable space and the operation of large-scale equipment, such as the 3D printer or the laser cutter. Above all, one can be advised regarding one's idea and a potential start-up. There is an extensive network comprising business angels, i.e. investors that one can draw on or be referred to. The so-called academy also offers support with concrete problems that have to be overcome in prototypes and design.

I conducted interviews with Christian, one of the three founders of the lab, in German. Christian is their frontman and works full-time for the lab, whereas the others operate in the background or have other obligations. Christian also had the idea for the alternative bicycle drive, and his prototype adorns the makerspace's lobby. He is in his 40s and manages the place at present. When he enters the makerspace, people salute him. He has a little chat at the counter or with people he runs into. He usually knows the people who are currently working on some project, is in touch with the people and is open to conversations, especially when it comes to the point where inventors need feedback, advice, or contact with the network.

The makerspace usually differs from hubs or incubators as people rent a space in the lab and initially invest their private funds since they usually develop their ideas with their own money and are not sponsored by investors in the early stages of development. This approach makes their work comparatively risky in terms of financial losses. Further, the inventors do not receive any salary and usually live on their savings or work on their projects in parallel to their regular employment.

3) The Creative Space: The Believer School

The creative space *The Believer School* differs from the makerspace in that it is not a space for rent or to develop a project over a more extended period. The space offers workshops at the interface between art, technology, design, and human connection. Susan, the founder and manager of the school, wants her students to deeply engage with their daily life surroundings and to be critically minded when it comes to interactions with what they want to create. Susan's understanding of the school is to enforce its students' curiosity and creativity. The student body comprises artists, researchers, designers, and others who intend to find new topics to work on or who want to gather inspiration or a starting point for what they might call a vague idea they want to discuss. The programmes are either held for one weekend or take place for several weeks, and the participants can work alone or team up with others from the workshop. Sometimes, ideas overlap, or others are enthused by an idea that they want to work on. The workshops initially discuss in what environment people work,

live, or spend most of their time. After such discussions, the instructors may ask further questions that take place on an emotional level, such as: 'What bothers you most on your way to work?' or 'When you think of your first/ last kiss, can you describe what your skin felt like?' Although these questions may appear random at first, they are intended to encourage people to think of something they connect with in their daily lives and to be able to describe such things on an emotional level. These workshops live from felt experiences that leave lasting impressions on people's lives as what comes up in the discussions or through such questions serves as a starting point for later ideas. Afterwards, people can introduce their thoughts or ideas they already have or tell others what they want to achieve during the weekend or over the next couple of weeks. Later, people are instructed in inspiring topics, tools, and maker sessions. Occasionally, the workshops are also about prototypical interventions in public spaces.

After a workshop ends, exhibitions or the first prototypes will often be further developed in another place, for example, a makerspace. Susan's creative space offers workshops on various topics. I took part in such a workshop, albeit not as a participant but as a researcher, and on two afternoons, I accompanied and observed people and their ideas and had several informal conversations. Additionally, I exchanged ideas with Susan about the programmes and prototypes that had a medical context and were meaningful to my work on a psychological-emotional level. Susan and I spoke in English.

4) The Firm: 'Hydro'

Hydro is a globally active company that has existed since the early 1990s and develops neurosurgical hydrocephalus valves. Johann, the Chief Executive Officer (CEO) and founder of the company applied for funding from the German Federal Ministry for Education and Research (Bundesministerium für Bildung und Forschung; BMBF) at that time with the idea of developing hydrocephalus valves and thus founded the company. Hydrocephalus is a pathological expansion of cerebral ventricles of the brain that are filled with cerebrospinal fluid, leading to increased pressure in the skull and displacing parts of the brain. During this displacement, vital parts of the brain can become trapped, and a valve like the one developed by *Hydro* can alleviate this.

Johann, amongst others, has developed improved technology to drain the water from the brain and used titanium for the valves, which are more suitable for insertion into the body. Today, the company, one of the biggest valve providers worldwide, is located in a middle-sized city in Germany.

I got to know Johann in a private context, in which he mentioned his firm. He immediately caught my attention, especially because he was talking about innovative medical technology. Conversely, Johann could also immediately relate to my re-

search question and support the focus on emotions in research. After our exchange, I got his business card and an invitation to his company.

Johann and I had one on-location interview and later had phone calls and informal exchanges via e-mail. I also took part in one team meeting. Later, he put me in touch with one of his product developers, *Leo*, with whom I had two interviews and who explained the technology and the physics involved again. However, he was careful not to share any internal details on new technology developments, and I was provided with a great deal of material that was innocuous for the company. I later decided to use the website as a database precisely because its content is rich in emotions and values.

What Johann and Leo repeatedly mentioned in the conversations, and which the website also postulates, is the importance of listening carefully. As a product developer, communicating with patients, their families, and neurosurgeons is a unique challenge that takes up much space. This remark came up repeatedly and also underscored the general guidelines of the company's cooperation with doctors and patients. All our interviews were conducted in German.

5) The Private Investor and Innovator: Karwen

Karwen is a private investor and innovator in his late 30s. He came to Berlin ten years ago as a developer from Lebanon to work in a former start-up that quickly became a big company. After a brief period, he and two of his colleagues began to realise their own ideas and founded companies themselves. Some ideas were more successful than others. He soon quit his job at the company to devote himself to his own ideas. In the meantime, he has been able to build up a financial cushion to invest in young innovators himself. Karwen knows the pitfalls of founding a company; not everything he has founded or invested in has been successful. To date, he has founded his fifth company and invested in four others.

To not endanger the currently emerging start-up and the still very young idea, Karwen's idea cannot be elaborated on in detail. However, his effort resulted in the development of a website in the medical field that primarily serves to refer patients with specific symptoms and diseases to suitable facilities, doctors, and other personnel in the medical area.

Karwen and I already knew each other, and we got back in touch when I heard about his current idea by chance. We had several conversations, which often took place during his lunch break. These were held in a mixture of German and English.

The interview partners and venues in relation to each other:

Next to the company *Hydro*, the incubator *Health Hub* is the most established and institutionalised innovation venue. What distinguishes the two is their funding.

Even though the BMBF initially financed *Hydro*, it is now an independent company that funds itself.

On the other hand, the *Health Hub* incubator is primarily financed from two sources: firstly, from public funds from the federal and state governments and secondly, by a foundation. This results in a different dependency for the incubator, which is thus obliged to report its expenditure. In addition, there are strict guidelines on what the funds are used for and whether tenders must take place. The company is also not a public place that random people can visit as in-house innovation, and further development of products take place on-site. The incubator mainly invites doctors from the university hospital to take part, and all other employees, such as software and hardware developers or consultants, are hired externally.

The makerspace is open to anyone who wants to rent it and further develop an idea. The infrastructure is equally available to those who have a membership, whereby they are free to determine the length of time needed to complete their work. As a creative space, *The Believer School* is not a co-working or makerspace like the *M.lab* but rather a mental space for developing ideas. Although tools and limited infrastructure are also provided, these are only available for as long as a workshop lasts. The concept is not about sections of space that can be rented individually but about coming together collectively, exchanging and using synergies. What is in the foreground here is the idea of a completely independent market.

It is different for Karwen, who is looking at the needs of the market. He runs out of competition compared to these described places because he wants to start his own business, and hence, the referential link is not the place but much more the activity description. What the interlocutors all ultimately have in common is the portrayal of their ideas, motivation, and the subsequent work process or activity. These all differ in their content, although they will also have similarities in how something is accomplished.

2.4 Materials, Methods, and Analysis

This study approaches the research question ethnographically. Ethnography is designed to mainly combine qualitative methods to draw closer to so-called everyday cultures (Breidenstein et al., 2020), whereby the concept of culture is broadly applied. In the context of this work, the concept of everyday culture is applied to the research question in two ways. Firstly, the term 'everyday culture' refers to the general multiple uses of the word innovation, which creates a culture of the term itself. Secondly, the concept of culture is applied to the everyday work life that I am researching here. Specifically, it is about interaction practices, the communication that takes place, and the potential structures that result from it, which in turn lead to

the development of a 'culture' negotiated by the people in the field and subsequently referred to as such (Ciaudo et al., 2021).

To get in touch with potential informants, their ideas and work, I first e-mailed them an interview request, expressing my interest and research question. I notably picked informants and institutions that develop medical technologies in an innovative context either because I came across them on the internet by explicitly looking for them or by chance. In addition, as the reflection section explains later, several interviews resulted from private encounters and referrals (snowball method) (Mannik & McGarry, 2017: 71), as simply contacting unknown institutions via e-mail often remained fruitless and mostly did not yield a response. After the voluntary informants mapped out the field, I used different qualitative-ethnographic methods to follow their ideas, prototypes, work, and working environment. I will list the methods used below and refer to the output generated.

To start with, participatory observation was the first step in my approach to the field, which yielded personal field notes, visual notes such as my drawings or sketches, and observation protocols as a reflection of my earlier notes and the photographs I took during my visits. I also used a preliminary field diary to reflect my position and relations with the interview partners. This diary became increasingly relevant when I sometimes found the innovation field inaccessible, as it provided a space to reflect on the ways of access that were not working so that these thoughts were supported to consider how access could alternatively be granted. Secondly, the first interviews with the individual institutions or interview partners who consented to participate, such as *Health Hub* or *Hydro*, involved a guideline-based approach in case the discussion would not develop freely. It was only in spontaneous group interviews that happened by chance or when the individual interviewees and I already knew each other that the conversations took place without a pre-formulated guideline. Further, sketches drawn by the interviewees outlining the prototype's genesis or work steps during the interviews were subsequently part of the generated data material. Along with conversations, I later tried to accompany them in their work (*go-alongs*) (Flick, 2018: 349). Accordingly, interviews and in-situ narratives (Amelang, 2012: 148) took place to understand the work and purviews of my informants. This method, however, is not necessarily valuable for recording dialogues or talks, which is why I often took minutes from memory. These three practices of narration differ in that interviews aim to answer concrete questions, and thus, the interviewer is primarily responsible for conducting the conversation and is more capable of guiding and directing it. In contrast, the *go-alongs* and *in-situ* protocols with their *sketches* follow the direction of the informants. Now and then, I also captured these activities as *photographs*, depending on whether or not a suitable moment arose, using the camera as a recording instrument. However, I did not want the camera to intrude, as, in addition to my presence as an observer, photo-taking might already be unnatural in the usual work habitat. Finally, I analysed websites, videos,

and brochures of prototypes and products that were developed by the teams. I did this to inform myself about earlier narrations of an idea or to observe how the storyline about a prototype developed over time, as well as in comparison to the interviews that were conducted. An overview of the methods and types of data generated is provided in *Table 1* below.

Table 1: Overview of Methods and Types of Generated Data

Method	Type of generated data
Participatory observation	Field notes: subjective notes and spontaneous thoughts on actors, sites, and theory or methodology (= descriptive notes); drawings; observation protocols (= reflective notes) Field diary: reflected own position and feelings in the field and dyadic relations with interviewees (sometimes recorded and transcribed afterwards); sometimes taken from memory if necessary Photographs
Following in-situ narratives: work-alongs	Recordings if possible → transcripts Minutes that were taken from memory Photographs
Taking semi-structured interviews	Recordings → transcripts Sketches obtained from interview partners
Comparative method: document analysis (websites, videos, brochures) as comparative material to interview content	Essence derived from websites and brochures Discrepancies in story telling

In this section, I discuss the definition of the material, the situation in which it was gathered, the direction of the analysis with the theoretical delimitation of the question, the type of coding, and the codes. Finally, I examine the compilation of the results and the respective interpretations. As previously mentioned, this study and its structure of the text analysis find inspiration in the approach suggested by GT. This qualitative analysis explores textual documents such as interview transcripts, websites, or brochures.

Moreover, the type of analysis helps to evaluate the data as objectively as possible. This means that, despite existing subjectivity, the researcher is encouraged through various work steps to reflect on the research question, the interview questions, and the analysis of the transcript and other text documents and to regularly check whether the evaluation is meaningful. To do this, I describe the various steps

I took during the text analysis below. Qualitative text analysis is to be understood as a method of analysis alongside those already mentioned and is not in competition with ethnography as such. Instead, it is intended to support applied ethnography and to help find an answer to the research question.

First, several questions need clarification before analysing the material. As a first step, all interview transcripts, as well as other documents such as the websites of the innovation locations, interview guidelines, drawings as made during the mentioned case studies, and photos, are defined as the material of this work. Secondly, it is important to mention that the participation of the interview partners was voluntary, i.e. without any compensation agreements and that they were either contacted directly by me or via acquainted interview partners. The interviews with the founders, innovation hub leaders and team members were initially conducted using guidelines. The formal characteristics of the material (third step) can be described as the fact that the interviews, which were recorded with a dictaphone, were transcribed on the computer with an artificial intelligence (AI) transcription aid and transcription software and then imported into the analysis software for coding the material. The analysis aimed to describe the object of the research dealt with in the interviews and the documents – the emotional impact on the technological development process – and to analyse it contrastively between the cases.

The fourth step clarifies the direction of this book's analysis, whereby the analysis of the material is interrelated between the actors involved and the artefact. Through the interviews and statements of the participants, comments about the structures, contents, procedures, processes, and effects of emotions on innovation will be documented. The theory-based differentiation of this question as the fifth step results from the fact that psychological and sociological studies on emotions and their impact on interpersonal relationships are available. However, it is now of interest whether these factors also have a similar effect on technological developments or to what extent evoked emotions have a relevant impact on development paths and whether the prototypes, in turn, can equally trigger something in their observers. During the code analysis of the material, the first step was to code in vivo. In vivo coding is part of the open coding approach and involves a more rigorous analysis of words and sentences with codes that emerged from the discussions with my interview partners. In the second step, I constructed codes myself if no suitable wording was provided by the interviewees. However, this applied more to general state descriptions, such as 'evaluation' as a cluster code differentiated into 'government aid'. This – as an example – was when an interviewee explained to me that they were financed publicly, and I knew that, therefore, they were dependent on successful out-licenced products to justify the funding. Alternatively, I coded sentences accordingly to further differentiate what was said, which resulted, for example, in an in-vivo code such as 'problem' and the further differentiation in my construction as 'gender relations'. This was done to provide an overview of the

material and and, in the spirit of method assemblages, not to examine the material in a biased way and limited to the theoretical framework. As a result, this also means that in places where it was impossible to group codes into clusters, the 'open codes' were left and marked with a specific colour. This is reflected in the material in individual analyses that only apply to a specific case that is nevertheless meaningful and significant. For example, certain decisions become visible based on personal history and ethnic origins (see, e.g. subchapter 7.4 on Karwen, who decides against the production of war technology or its field of application because of his experiences in his home country).

Precisely because the field of innovations can be both challenging and surprising, it is essential to maintain this potential, especially in terms of its emotionalisation, and not to rigidify it through previously determined units of analysis. The codes that emerged from the open analysis formed the first frame of reference, which was later aligned with the theory or used to build further theoretical concepts that I did not consider beforehand. This also ensures that the theory is expanded or replaced in case of doubt if inconsistencies emerge or assumptions from the theory do not fit the material. By comparing the open codes with the theory, theory-based codes could now be added, through which a second analysis took place. This occasionally resulted in theory-guided codes replacing already existing constructed codes with more suitable terms. However, this was only the case when the direction of the analysis pointed to the research question.

In contrast, the codes continued to coexist if they took different paths. It was thus essential to attach the code to a targeted definition so that no duplications or inadvertent changes in interpretation occurred in the repeated coding process. The codes were then thematically ordered and clustered so that the statement and weight could be read off in the subsequent analysis. Especially concerning the interpretation in connection with the comparison of the cases, the code cluster, meaning the superordinate theory line, was indispensable and particularly valuable. In this way, the weight of a code, i.e. the frequency of an occurrence, could be seen immediately, which was especially helpful when reading certain emotional expressions of the interviewees. The cluster designations reappear as superordinate sections in the empirical parts. The deductive derivation from the theory-led coding level provides the framework for the two theory chapters (III and IV), which are an extension of each other regarding their content. Imagination, experience, and emotion are thus equally the content-related frame of reference for the described innovation structures (geographical and conceptual) and the resulting evaluation patterns. Non-clusterable codes, on the other hand, remained as individual colour codes, as I have already described, and were embedded in the narratives as individual phenomena that stand for themselves.

2.5 Reflexions During and After the Fieldwork

As already indicated in the introduction, specific problems arose due to the research field and the timing of the research. In the following, I will describe the inherent issues in the field and refer to problems in the empirical survey, which mostly took place during the COVID-19 pandemic. The below descriptions are mainly based on my field diary notes.

1) Confidentiality and Discretion: Finding Adequate Interlocuters

As described, it is highly challenging to research a complex field such as innovation. Already at the beginning of the empirical study, when I approached potential institutions, guarantors, and patrons with the request to talk to them and research them, I mostly received refusals. Out of 28 interview requests, I initially received four acceptances, and it was even extremely difficult to get in touch with institutions that normally cooperate with the university and are publicly funded. Innovation sites are black boxes. Both their structures and what is to be developed are kept secret in the fragile stage of not-yet-being-finished. Even if I managed to get in touch with a person, an institution such as an innovation hub, or visit such a place, the encounter often ended after a first conversation. If I had the feeling of having a foot in the door and being in contact with several people, it could happen that I received an urgent e-mail prohibiting me from either conducting an arranged interview or a participant observation. This was frustrating, and I often felt like I was treading water or not progressing with my research. Being a researcher often gave me the status of an outsider who should not know too much, should not look too deeply, and should not know the structures intimately. I often got the impression that empirical research was misunderstood, and I had to explain the need to understand the whole fabrication process to the same person several times. However, even these efforts did not grant me access, and hence, I often gained access to the aforementioned informants through private contacts who referred me to them. This was the case, for example, with *Hydro*, whose CEO I met at a wedding and who invited me to visit his company. In the end, it was through his recommendation that I could talk to other employees.

Interestingly, the CEO was much more willing to talk than his employees, who feared that internal company information would leak out through me. Through repeated coordination, we were able to agree on what content could be shared that would be meaningful for me and would not harm the company. It was similar to Karwen, whom I have known for many years. By chance, we met again, and he was developing an app in the health sector at that very time. We quickly started talking about it, whereupon I asked him to conduct an interview with me for this work, which resulted in several conversations. I am convinced that the pre-existing acquaintance was a door opener and helped Karwen talk to me more openly than any other inter-

view partner about creating ideas, innovating, and monetarily investing in ideas. Susan, the founder of *The Believer School*, was the only contact who responded positively to an e-mail interview request and willingly told me about herself, her work, the school, and the workshops. The conversations with her were long and rich in information. Susan struck me as an extraordinary interlocutor, alive with ideas. Her creativity was palpable in what she shared. It was not just a description of an activity, as the way she described it was no less meaningful than the activity itself. Although these conversations sometimes led in different directions than I proposed – as seen in the material – what she said is particularly meaningful.

The situation differed from that of *Health Hub*, where access was difficult even though my supervisor paved the way for the first contact. Later, access was granted through another project I worked on, so I was able to use the access and the material in a double way. The initial contact with the hub's head was optimistic at first, and he put me in touch with a team. Afterwards, however, it quickly became clear that the contact with me should not be too close, and I wrote numerous e-mails to which I received no reply. Attempts at mediation often failed, and once, I was actively discouraged from further interviewing a team. This experience was frustrating. In addition, the hesitant impression was further reinforced even at a later stage. However, access already existed, and my research interest was known; I had to submit a written application and again set out in writing what my project entailed, what questions I had, and who exactly I wanted to talk to. After a clarifying conversation, I could be placed with another team, but no more guarantors emerged who were willing to talk to me. It became clear at that moment, however, that it was a public incubator affiliated with the university and, because of the partial public funding, was also subject to more stringent accountability.

2) Finding a Way to Talk About Emotions

The second difficulty I faced involved 'tracking down' emotions. As also evident in the empirical data, emotions hardly play a role in the context of knowledge production, and if they do, then only in a reflected meditated way.

The first problem related to my research question was the apparent lack of definition of the emotions I asked about. The informants wanted me to specifically name the emotions they were supposed to discuss, to which I did not comply. The open-ended nature of the question was intentional precisely because I did not want to prejudge the nature or definition of the emotions. Moreover, when we did get to talk about it, it quickly became apparent that innovators and their team members do so in a rather meditating way. By this, I mean they were talking about past emotions, by then reflections, that were already processed and, therefore, not pure or *raw* in terms of how they were experienced. Margaret Archer would call these 'second-order emotions' (Archer, 2000), and she refers to this process of reflection as an in-

ner dialogue that comments on the emotional state. These emotions are indeed constructive; however, their interpretational status is determined as it is already clarified for the individual who feels them. Coming to so-called first-order emotions was much harder as it required getting the interviewees into the mood to share emotions that they had not already reflected on. The purpose of these emotions is that their emotional content is not yet being guided, and consequently, there is more space for what people share when they need to explain situations to me. They do not shorten a narrative as they have already decided on the emotional stance, and thus, there is more material I could work with in the ethnography when coding the interviews.

Occasionally, however, it was helpful to be with the group during the observations and also the on-site interviews. Arguments, even those behind closed doors, could be observed more easily, and what is more, they could be discussed in the subsequent interview(s). These situations were so evidently emotional—just like the noisy slamming of a door—that I did not need to provide any further explanation about emotions to talk about them.

3) The Ambivalence of Talking

Another problem was keeping in touch with the people who were already willing to be interviewed. Interestingly, I found an *ambivalence* in 'explaining innovation'. For the aforementioned reason of secrecy, it turned out that my interviewees felt slightly afraid of talking 'too much', and they frequently interrupted an interview to tell me something that they did not want to be mentioned in my work. In such instances, they felt the need to talk about something but did not want it to be officially shared or opened up to the public and thus, they would pause the recording or tell me that I should not use specific information for the study. Some guarantors felt relieved by their participation in two different ways. On the one hand, they enjoyed talking to me and telling me secrets or inside information, while on the other hand, they also felt at ease once the interview was over. I reckoned that once an interview ended, the contact with a team leader or team member would terminate, and it often required a continuous effort to keep in touch with the teams, especially during the COVID-19 pandemic-related contact restrictions when it was not possible to meet in person.

Sometimes, I would not hear back from teams for months, and then, all of a sudden, they would invite me for an interview. In other instances, I needed to write three times before I would receive an answer, even though the respondents would tell me how much they enjoyed talking to me. However, the extra exertion was worth it, as it paid out every time, and I was also pleased to at least be able to keep in touch with this handful of teams I managed to convince to participate in this study.

4) Following the Prototype During a Pandemic

Another challenge in the context of keeping in touch with my guarantors was to then follow their materialised ideas, aka prototypes. The initial idea was to observe at least one team so closely that I could follow their idea from the very beginning to the final prototype. However, as the teams were often not working in their workspaces but from home, and not even as teams together in one room but online via video telephony, it was difficult to observe their work on the prototype. The work thus took place online or involved only one person working on the prototype at home. Workspaces were closed down; people were isolated or were also not interested in talking to me in the tough times during the pandemic when they had to cope with a great deal of stress. However, ultimately, it was the federal isolation regulations that separated the teams from each other, as well as me from the teams. At the height of the pandemic and the contact restriction regulations, conducting ethnography in the planned form was out of the question. As a result, I then conducted telephone calls or even conversations via video telephony to conduct interviews and also to keep in touch, as I had described before. Especially at the time when work structures and habits changed and the professional retreated into the private sphere, there were difficult conditions that had to be overcome each time. The research space suddenly became digital, which no one could previously have expected, and thus, an attempt was made to measure voice intonation and compare it with the content of what was said. However, the method did not go as hoped either because the desired amount of data did not materialise. For this to have been successful, it would have made sense if the subjects had kept some type of diary and recorded themselves without me being present. In two cases, this was successful via voice message.

In addition, I asked my interviewees to make sketches during the online interviews and to transmit them via the screen, similar to a virtual blackboard, which I could see during the interview. The virtual representation worked better, although some of the sketches cannot be represented in this work due to the stricter anonymisation agreement.