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The Invisible Backbone:
An Ethnography of *Tiefbau* Workers and Underground Infrastructure in
Germany

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ABSTRACT

This thesis examines how underground construction workers in Germany acquire, develop, and articulate embodied expertise within a context of persistent occupational stigma. Despite Germany's comprehensive vocational training system, strong labor protections, and the technical sophistication required for infrastructure work, construction labor remains socially devalued. While tacit knowledge, health and safety, and dirty work stigma have been studied, little is known about how underground construction workers connect their embodied expertise to mitigate the stigma. Drawing on contemporary short-term ethnographic fieldwork at a family-owned construction company in western Germany, this thesis investigates how workers utilize their embodied knowledge to navigate this paradox. The theoretical framework integrates body techniques (Crossley, 2007), carnal sociology (Wacquant, 2004), material engagement (Ingold, 2000), vocational education and training (VET) systems (Clarke et al., 2013), and dirty work (Ashforth & Kreiner, 1999). Empirical findings reveal that embodied expertise in construction emerges through: (1) repeated bodily engagement with materials, tools, and equipment, inseparable from their bodily history and personal experience, (2) a complementary relationship between formal vocational training and workplace learning, and (3) the strategic deployment of professional competence to counter dirty work stigma. This thesis concludes that workers derive a sense of empowerment and independence from this sophisticated knowledge to distance themselves from and resist external judgments.

Keywords: construction work, underground infrastructure, embodied knowledge, body techniques, vocational training, dirty work stigma, ethnography, Germany

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1. INTRODUCTION

‘Everywhere you look, there is a construction site’ is a common refrain in contemporary Germany. The remark resonates across diverse social circles, from friends and relatives to colleagues and strangers, as road closures, rail repairs, and station renewals have become routine features of daily life. Across Germany, citizens are voicing growing frustration with train delays, crumbling bridges, potholes, and neglected schools.

What easily slips from view is that infrastructure requires constant attention, including inspection, maintenance, coordination, and physical labor (Thiel, 2012, p. 101). According to the 2018 DWA survey, about 20% of Germany’s public sewer system requires immediate short-term repairs, with 13.5% of the network having not been surveyed due to inaccessibility. Although the average age of the network is 36.9 years, in many big cities with more than 250,000 residents, over 15% of the canals are older than 100 years (Berger et al., 2020).

While workers are often portrayed by construction companies as their key asset (Pathirage et al., 2007, p. 120), the scale of what these workers sustain, particularly in water and sewer systems, is less visible. In countries where formal safety regulations are absent, research highlights how construction workers must depend on embodied know-how and practical sensibilities to stay safe and productive on site¹. Nevertheless, much of the existing literature remains oriented toward safety and health concerns, including legal requirements and documentation practices, trade union issues², and broader managerial or organizational aspects of construction³. Other literature focuses on the skill, gender, or racial discrimination at construction sites⁴. While these perspectives are important, such approaches often frame construction work as dangerous, precarious, or

¹ For a discussion of tacit knowledge as a resource for accident prevention on construction sites, see Aboagye-Nimo et al. (2015).

² In this thesis, safety is understood as extending beyond physical safety at the construction site to include job security related to employment contracts, pension provision, and legal protection. See Walsh et al. (2022).

³ Detailing the organizational and economic aspects of infrastructure megaprojects, see Genus (1997) and Van Waeyenberge et al. (2021).

⁴ For skill-based discrimination in an infrastructure project in Dubai, see Iskander (2021). For water infrastructure shaped by poverty and economic segregation, see Anand (2012). For the interaction of public and private space in water infrastructure, see Öberg (2019).

low-skilled, especially in countries where labor rights are limited and unionization is weak.

Yet, Germany's construction industry landscape presents a markedly different picture. Construction work in Germany operates as a synergy between government regulations, trade unions, and employers, producing stable employment, regulated wage tariffs, and legal protections for workers in the event of accidents, injuries, or extreme weather (Clarke & Winch, 2007; Clarke et al., 2013; Kahmann, 2006; Lubanski, 1999; Thelen, 2019, pp. 2–3). Against this backdrop, the German underground construction sector constitutes a compelling case for examining embodiment and embodied knowledge in construction work, as many of the precarious conditions commonly associated with construction are institutionally mitigated, though not fully eliminated.

This institutional stability provides a context in which the cultivation of bodily expertise can be studied in its own right, rather than merely as a response to insecurity or deregulation. Drawing on sociological accounts of embodied practice from authors such as Crossley (2007) and Wacquant (2004), it argues that construction workers⁵ possess a complex, bodily form of expertise that is cultivated through experience, social learning, and interactions with materials (Ingold, 2000). Moreover, the German dual vocational system reinforces this embodied knowledge by training workers to carry out maintenance, repair, and new installation tasks, rather than dividing these functions across separate roles, which is common in other countries (Clarke et al., 2013).

These embodied competencies are central to keeping the society functioning safely, yet they are frequently overlooked in assessments of labor value and occupational worth. Yet, as De Coss-Corzo (2021, p. 2) observes, essential workers, such as construction workers, are often praised as heroes while simultaneously treated as replaceable. Even in Germany, where safety regulations and workers' rights are strictly enforced, underground infrastructure labor remains marginalized due to its association with both literal and symbolic dirt. Hence, construction workers are doing what Ashforth and Kreiner (1999) define as dirty work: occupations that are essential yet socially

⁵ I use construction workers, or *Tief- und Straßenbau* in German, which is a part of formal training, or *Ausbildung* in Germany, rather than civil engineering, or *Bauingenieurwesen* in German, which requires a university degree to avoid confusion.

devalued. This condition creates a persistent tension between societal reliance on such work and the occupational stigma attached to those who perform it.

While tacit knowledge and the dirty work stigma have been studied, little is known about how underground construction workers in Germany connect their embodied expertise to their occupational identity under conditions of stigma. Drawing on short-term ethnography and ethnographic interviews, this thesis explores this connection by treating workers as skilled practitioners rather than reducing their labor to manual or informal tasks. It does not provide a technical account of infrastructure. Instead, it offers an ethnographically informed sociological inquiry into how these workers understand what they do and how they do it.

1.1 Background and Motivation

This thesis began with a personal observation. During a Friday train journey, I saw a young man, perhaps still in his teens or early twenties, board the train at a regional stop. It was cloudy, and I remember it clearly because construction sites usually wind down early on Fridays. Unlike the other young adults on the train, dressed casually and chatting with friends, this man walked to the furthest corner of the carriage. He wore work attire and safety work boots, indicating manual labor, and he seemed almost embarrassed, quietly staring at the dirt he had left on the train steps. His work shirt bore the logo of “AB-Tiefbau,” a construction company specializing in below-ground infrastructure work. In Germany, the construction sector is categorized into distinct domains: *Hochbau* (above-ground construction, such as housing or commercial buildings), *Tiefbau* (below-ground or underground construction, including water infrastructures⁶ and sewer systems), *Straßenbau* (road construction), among others (Vogt, 2024, pp. 127–157). Given this context, it is likely that he works in underground construction. This observation raised questions regarding workers’ experience of social stigma. Did he feel diminished in the presence of other passengers who, though around his age, appeared to

⁶ Water infrastructures include tap water, rainwater, groundwater, and wastewater, which also include their channeling system and materials such as plastics, concrete, or soil (Guerrero, 2018, as cited in Wells et al., 2021). This became evident during the observations, where workers emphasized that water and sewer systems are not treated as separate domains in Germany and that their work routinely spans both.

be spared from such physically demanding labor, perhaps students or young professionals with more socially esteemed futures? Did he sense that his labor, though essential, was undervalued or misunderstood?

In my home country in Southeast Asia, construction work is among the least desirable occupations. The sector is often informal, with little job security, poor safety conditions, minimal insurance, low wages, and virtually no legal protections (Swider, 2024, pp. 23–34). It is an accessible industry where people can enter without formal qualifications. Physical fitness is often regarded as the only real requirement for the job. Occasionally, a school-leaving certificate is requested, but this is usually a formality (Arthur & Daryanti, 2019, pp. 162-163; Widaningsih et al., 2020, pp. 1–2).

By contrast, my wider social network in Germany is closely connected to the underground construction sector. Through these contacts, I noticed something striking: they spoke with genuine pride about their work. This stood in stark contrast to the young man on the train, whose posture and attire suggested he was ashamed of his job despite likely possessing similar skills. Witnessing these contrasting experiences of work and its external perception led me to focus on tracing how underground construction workers experience their everyday work in relation to the social meanings attached to it.

1.2 Aim

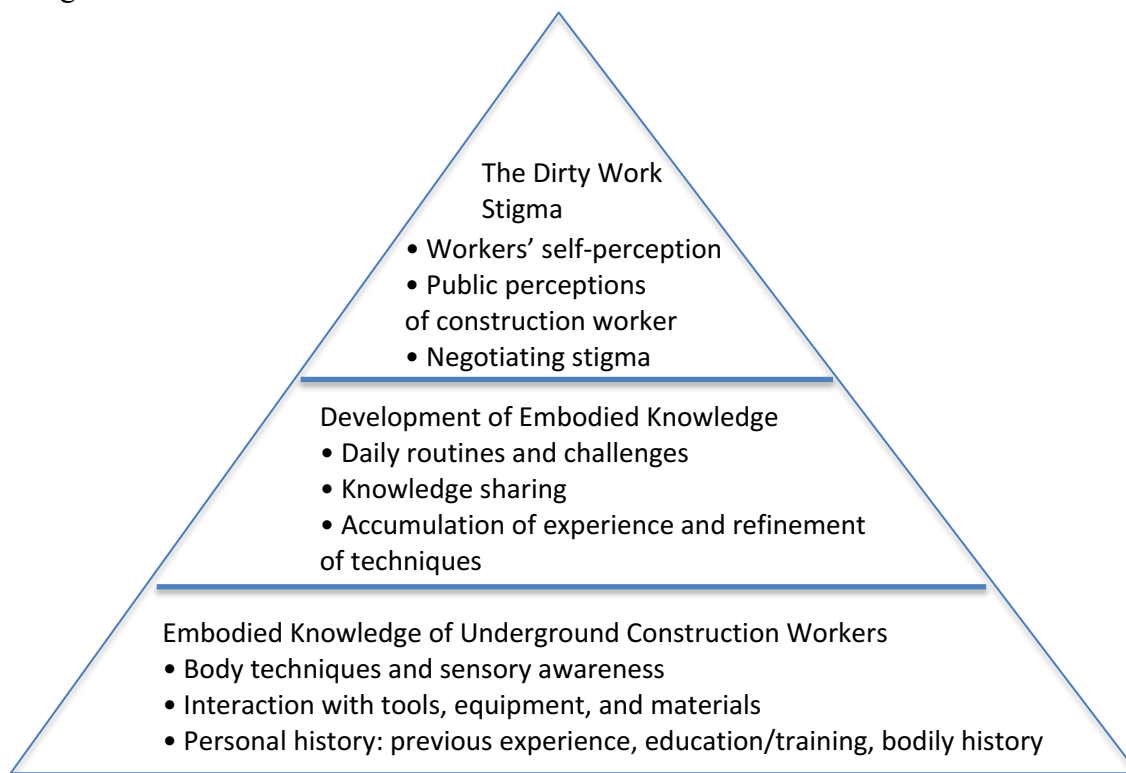
This thesis examines how underground construction workers develop, practice, and articulate embodied expertise within a context of occupational stigma.

1.3 Research Objectives

The structure of this thesis develops like a pyramid, moving from foundational skills toward broader questions of meaning and perception. At its base, the thesis investigates how underground construction workers acquire their embodied knowledge. Embodied knowledge consists of body techniques and material engagement, which, in construction, involves tools and equipment, not just raw materials. It is further tempered by workers' personal histories, including previous work experience, vocational training, and bodily injuries. Then, it examines how embodied knowledge is developed through daily routines, peer

interaction, and shared work processes. Central here is the accumulation of experience, alongside the continuous refinement of embodied knowledge. At the top of the pyramid, the thesis brings these strands together to examine how construction workers perceive and value their work, particularly in light of the persistent dirty work stigma they encounter from the wider public.

Figure 1: Research Structure



Source: Author's creation

This thesis has four objectives:

1. Document and analyze underground construction workers' daily practices and on-site roles.
2. Analyze how embodied knowledge and physical strategies develop through formal and informal training, routines, and tool and equipment use.
3. Examine workers' perceptions of professional identity in relation to occupational stigma.
4. Present narrative ethnographic accounts linking embodied knowledge, identity, and stigma.

To pursue these objectives, qualitative research, combining nonparticipant observation, partial shadowing, and ethnographic interviews, is employed. This alternative method enables a direct insight into the field and into the personal experiences and perspectives of the individuals. The empirical data are evaluated using the research style of ethnography.

1.4 Research Questions

This thesis is guided by three interconnected research questions. Each question addresses a distinct aspect of the workers' experiences. Taken as a whole, they form a cohesive framework for understanding the relationship between skill, identity, and societal recognition.

RQ 1: How do construction workers acquire and perform embodied knowledge?

This question explores how expertise is learned and enacted through daily routines, bodily techniques, peer exchange, and interaction with tools, materials, and environmental constraints. It underscores that construction knowledge is embodied, experienced, and adapted on-site, often implicitly, rather than existing solely as cognitive or procedural skill.

RQ 2: To what extent does formal training (or the lack thereof) influence workers' practical competence and learning-by-doing on construction sites?

The second question builds on RQ 1 by exploring the influence of formal training on practical competence. This question recognizes that while structured programs provide fundamental skills, much of the complex knowledge required on-site is acquired through experience, observation, and peer mentoring. Thus, it examines the dynamic relationship between formal education and informal, situated learning, highlighting that formal training interacts with, but does not replace, the embodied knowledge examined in RQ 1.

RQ 3: How do underground construction workers articulate their embodied expertise in the face of the stigma surrounding their work?

The third research question examines how underground construction workers articulate their embodied expertise in the face of stigma. It builds on RQ 1–2 by linking embodied knowledge, formal and informal learning, and reflective practice to workers' self-perception. RQ3 focuses on how workers draw on their bodily techniques, experience, and problem-solving skills to assert competence and counter the social stigma associated with "dirty work."

1.5 Thesis Structure

Chapter 1 introduces the research background, problems, motivation, and aims.

Chapter 2 introduces the theoretical frameworks used in this thesis.

Chapter 3 presents the methodology and methods.

Chapter 4 presents the empirical findings and their interpretation.

Chapter 5 synthesizes findings and revisits the research questions.

Chapter 6 concludes this thesis.

2. THEORETICAL FRAMEWORK

This chapter develops a theoretical framework for understanding the embodied knowledge of underground construction workers. It considers both informal workplace experience and formal vocational training as key components of the personal and educational trajectories through which this knowledge is cultivated. Together, these elements provide a foundation for examining how construction workers deploy their embodied expertise to navigate and respond to the social and occupational stigma associated with dirty work.

The first and second sections draw on Nick Crossley's (2007) body techniques and L  c Wacquant's (2004) study of embodied knowledge developed from body techniques. Crossley's work, an extension of Marcel Mauss' (1973) concept of body techniques, traces sociological aspects of embodied knowledge. Meanwhile, L  c Wacquant's (2004) phenomenologically grounded "carnal sociology" highlights the acquisition of skill through bodily practice and apprenticeship. Combining these theories helps us understand how learning about one's own body and physical ability, along with sensory perception, is crucial in executing tasks and performing work.

The third section draws from Tim Ingold's (2000) phenomenology of human interaction with tools, materials, and equipment. Ingold's (2000) deep understanding of the human ability to use, create, and produce tools or equipment with the resources available is highly compatible with the concept of body techniques, instead of the common Actor-Network-Theory, which does not emphasize physical activity and sensory development. Building on the focus of learning through practice, the fourth section examines how Clarke, Winch, and Brockmann (2013) show that vocational training systems support and formalize embodied learning processes, particularly in the German context.

The last section integrates the themes of embodiment, materiality, and vocational education to explore the moral and symbolic framing of construction work as "dirty work," a concept articulated by Ashforth and Kreiner (1999). It illustrates how the embodied skill of construction workers is essential to their sense of identity and self-worth, despite the fact that the work itself is frequently socially stigmatized.

2.1 Body Techniques: Embodiment – Embodied Knowledge

The traditional view of knowledge, rooted in Cartesian dualism, often treats knowledge as cognitive and discursive, something that separates the mind from the body and can be communicated or verbalized (Shilling, 2007). This view is challenged by contemporary research on tacit knowledge. The term “tacit knowledge” was first introduced by Polanyi (1958, 1966) to explain knowledge that is difficult to articulate and is developed through doing or sensing, rather than thinking alone. Such knowledge is often associated with informal learning or experience-based practice, as discussed by scholars such as Nonaka and Takeuchi (1995), Styhre (2009), and Wessels (2017, pp. 25-44).

Against Cartesian dualism, tacit knowledge is best understood by placing the body⁷ at the center of analysis. Our physical form, sensory abilities, and learned ways of using tools and engaging with the environment shape what we can do and how we perceive the world. In this context, the body serves as a medium through which we interact with space and materials, linking perception, practice, and experience in ongoing engagement with the environment (Stadelbacher, 2016, p. 65). The body is therefore not merely an instrument of action but a primary site where knowledge is both produced and enacted (Stadelbacher, 2016, p. 71). Attending to the body thus reveals both how social structures shape action and how individuals exercise agency (Shilling, 2016, p. 4).

Despite its centrality to human action, the body is often treated merely as an instrument that disappears in practice, even though it does more than perceive the world through the senses (Crossley, 2007, pp. 82, 84; Joas, 1992, p. 245; Shilling, 2016, p. 4). Consequently, it has received limited attention in social research, partly because of the methodological challenges involved in capturing embodied practices (Murphy et al., 2019, p. 429). Nevertheless, growing interest in the body as a subject of study is driven by a wide range of factors, including feminism, concerns about ecology and sustainability, an aging population, artificial intelligence, commodification, ethics, identity, safety, and project-based work (Shilling, 2016, pp. 9–10). Eriksson (2024, pp. 6, 10) further

⁷ Theoretical discussion about “having, doing, and being” a body, including the difference between *Leib* and *Körper*, is already discussed by many other authors. See: Stadelbacher (2016); Nettleton (2021).

observes that embodiment has become increasingly relevant because all daily and interactional tasks are performed through the body, making it central to professional practice.

To address the problem of the ‘absent body,’ this thesis employs Crossley’s (2007) response and an extension of Mauss’ (1973) concept of body techniques. Mauss (1973, pp. 70, 73–74) defines body techniques as a social product that differs across societies and is shaped by education, prestige, and other social factors. Thus, embodiment can be analyzed through its laws, norms, purposes, and meanings without losing the body as the central object of study (Mauss, 1973, pp. 71–72, 76–85; Murphy et al., 2019, p. 429). He gives examples of how Polynesians and older generations use different techniques for swimming and further provides examples of how different societies use various techniques to sleep, move, care, consume, or reproduce (Mauss, 1973, pp. 71–72, 80–85).

Related to this thesis are techniques of movement and activity. Mauss (1973, pp. 72–74, 77–78) observed that the body maintains an upright posture when walking, coordinating rhythm through breathing, and when running, the position of the feet and arms is as important as breathing for endurance. Although these movements may seem basic, applicable universally, and can be shared through training to achieve efficiency, it is the motion of the hands and elbows that reveals differences between the German and French armies (Mauss, 1973, p. 82), reinforcing his argument that bodily techniques are shaped by cultural and social norms. There are also techniques in climbing trees with a belt, descending downstairs with slippers or walking in heels, or swimming with equipment (Mauss, 1973, p. 82–84), showing that bodily techniques also engage with materials to a certain degree, although Mauss did not elaborate further. This under-theorized engagement between bodies and materials reveals a gap, which is addressed through Tim Ingold’s (2000) work on material engagement, developed in Section 2.3 in this thesis.

Crossley enriches Mauss’ concept by emphasizing that the world appears meaningful because humans perceive lived experience through their senses (Crossley, 2007, pp. 82–84). As a result, we often take our movements for granted because if we are aware of our movement, it can disrupt the fluidity of action, leading to physical

awkwardness or decreased coordination. He argues that the directions in which we move are constrained by anatomical limitations (Crossley, 2007, p. 85). This is illustrated in his example of amateur swimmers, who may learn only the basics yet develop improvisations in their techniques by relying on physical habit and instinctive movement but are limited by the capability of their organs (Crossley, 2007, pp. 85–86). Swimmers may lack a physicist’s theoretical understanding of buoyancy or hydrodynamics, but this does not mean they are without knowledge because their understanding exists in the form of technical skill and practical competence (Crossley, 2007, pp. 86–87). Through these body techniques, Crossley (2007, pp. 87–88) attempts to demonstrate that they are never just mechanical movements but carry abstract, socially inherited forms of knowledge that are transmitted through practice rather than explanation. Taken together, embodied knowledge constitutes a form of tacit expertise acquired through bodily experience and ongoing interactions with materials and the surrounding environment.

According to Murphy et al. (2019, pp. 429, 439–441), bodily techniques comprise three interconnected dimensions, namely the social, the physical, and the mindful, expanding the foundational perspective of Mauss (1973) and Crossley (2007). The *social* dimension highlights the pedagogical transmission of bodily knowledge. Basic techniques are generated through guided participation, in which experienced practitioners teach, correct, and demonstrate movements that beginners learn through observation and imitation. This emphasizes the relational and intergenerational character of bodily learning, in which knowledge is still forming and shaped by social norms and evaluation (Murphy et al., 2019, p. 434). The *physical* dimension emerges through sustained engagement with this fundamental knowledge, as individuals gradually develop more complex techniques. Many participants describe this as muscle memory, automatic reactions, or a tacit “feel for it” embedded in the body (Murphy et al., 2019, p. 428). The *mindful* dimension refers to the continual transformation of bodily techniques over time. Techniques evolve as practitioners adapt and refine them, demonstrating how embodied knowledge is shaped across generations, further cementing the social aspects of body techniques (Murphy et al., 2019, pp. 434, 438–440).

These insights into body techniques and knowledge can be extended to understand labor-intensive occupations such as construction work. Crossley's (2007) and Mauss' (1973) combined concept of body techniques can help explain how construction workers acquire and develop embodied expertise through practice. In construction, the body not only performs physical labor (Andueza et al., 2020, pp. 799-800), but also becomes shaped by an industry that values endurance, self-sufficiency, and a form of cultivated toughness (Sandberg et al., 2021, p. 76). Since construction work is closely tied with the intense use of heavy machinery, loud and dusty sites, workers' senses become heightened through adaptation. Even their calloused hands contribute to their tactile awareness (Sennett, 2009, p. 153; Dreyfus & Dreyfus, 1980, p. 12). Their engagement with the environment develops what Lensjø (2024, p. 337) describes as craft knowledge: a multisensory and fully embodied form of expertise that emerges through the coordinated use of their senses and movements. Some authors describe this multisensory experience as 'body memory,' emphasizing that once practices are sedimented, the body carries them out effortlessly, without needing to consciously remember earlier experiences (Fuchs, 2016, pp. 215, 222).

Despite the benefits of centering body techniques as a research subject, the concept of body techniques has several limitations. Crossley (2007, p. 87) notes that since individuals cannot articulate their techniques, researchers must actively interpret these practices, drawing on their own expertise to understand them fully. Furthermore, there is no guarantee that learned body techniques will be consistently applied by participants (Shilling, 2016, p. 5), making the social transmission of body techniques context-dependent. This means some movements may be accepted and taught in one group or region, whereas other techniques may be enforced institutionally, such as in schools or formal training settings.

Moreover, mastering these techniques is often tedious, repetitive, and time-consuming, which can be mentally and physically demanding for beginners (Murphy et al., 2019, p. 441). Biological and anatomical differences also affect how techniques are learned and performed, meaning that only certain individuals may achieve full mastery (Murphy et al., 2019, p. 429). Finally, Crossley acknowledges that the concept itself is

broad and somewhat vague, which can make it challenging to operationalize in research (Crossley, 2007, pp. 86–87).

2.2 Carnal Sociology: Practice – Training

While Crossley (2007) emphasizes the socially patterned and culturally transmitted aspects of bodily knowledge, Wacquant (2004) shifts the focus to the body as an active, sensing, and skilled site of social competence.

Drawing on his own experience as a sociologist turning into a boxer, Wacquant posits that all social action is founded by embodiment and that embodied competences are acquired by apprenticeship, which maintains habits and practice along with intelligence (Wacquant, 2005, p. 466). He describes how the boxers gradually shape themselves through repetitive training until bodily rhythms become attuned to the environment, where their body instinctively senses when a practice round begins or ends (Wacquant, 2004, pp. 14, 114). Through this process, the body learns to recognize, adjust, and replicate complex movements without deliberate thought (Wacquant, 2004, pp. 117–118).

Carnal sociology rests on three key claims (Wacquant & Vandebroek, 2023, pp. 136-138). The first, ontological, holds that social agents are embodied beings whose experiences, actions, and reflections are shaped by their social biography, history, and circumstances, and that social understanding is cultivated through the body itself, involving sensory engagement and the development of routines, motor skills, and visceral responses. The second, methodological, emphasizes that social science often overlooks the fact that people are sentient, mortal, and capable of suffering, instead privileging abstract, mentalist knowledge. According to carnal sociology, the foundation of all discursive and cognitive understanding is embodied, procedural knowledge, or "knowing how." The third, empirical, asserts that the development and use of embodied capacities can be observed and analyzed, allowing detailed accounts of embodied action similar to ethnomethodological discourse studies.

This carnal perspective turns the author's own bodily experience into an instrument to interpret data, with knowledge gathered not only by observation but also by the author's sensory engagement with the research situation (de Souza Bispo & Gherardi,

2019, p. 380). Contreras (2015, p. 28) asserts that carnal sociology offers an important dimension beyond what is possible in an observation-only study because the researcher becomes both an observer and a participant, getting insight into the sensory and physical knowledge, thus enriching sociological understanding.

Nevertheless, as Wacquant (2004, pp. 123–124) notes, carnal sociology also has limitations. First, the number of participants must be limited so that the trainer can focus on each individual, as large groups make it difficult to maintain attention. Second, there must be sufficient equipment for all participants. Finally, there must be enough trainers to provide guidance to participants.

Contreras (2015, p. 30) argues that carnal sociology exemplifies “extra-methodological thinking,” requiring researchers to participate directly in the activities being studied, which demands a significant amount of time, effort, and physical endurance and is often difficult to sustain, especially for inexperienced researchers. He further notes the researcher’s background, such as education, ethnicity, or profession, can still lead to inadequate analysis or distortion of certain unfamiliar aspects (Contreras, 2015, p. 28), potentially creating bias. He also warns that such self-referential approaches risk turning into autoethnographic self-indulgence, where the lives of the subjects of the study are overshadowed by the researcher's own experience (Contreras 2015, p. 30-31). Similarly, Seim (2021, p. 11) questions whether carnal observation, even though it can enrich fieldwork, automatically leads to better research outcomes.

2.3 Material Engagement and the Mind

While Crossley (2007) and Wacquant (2004) demonstrate how knowledge becomes embodied through bodily and social practice, underground infrastructure work cannot be done without further interactions and engagement with nonhuman actors, such as materials, tools, or machinery (Buser & Boyer, 2020, p. 2).

In construction, tools, scaffolding, and protective gear act as infrastructures of bodily discipline and skill, the “boring things” that quietly organize expertise and risk (Star, 2002, pp. 108–111). These material interactions make work possible while shaping how efficiently, safely, and precisely it is done. This argument raises a crucial

question: How do workers develop skilled relationships with the tools and materials that are essential to their craft?

Ingold (2000, pp. 186–187) extends this conversation by emphasizing that, in addition to bodily and social aspects of knowledge, humans are always born into environments already shaped and modified by their predecessors. This legacy equips them with specific abilities, senses, and orientations that are developed and transmitted through technological design and mechanical practice (Ingold, 2000, p. 186–187). Technological design stems from humans' mental capacities and embodied skill, whereas execution often becomes associated with the externalization of these capacities into mechanical processes (Ingold, pp. 289–290). This, in turn, raises an important question: How did pre-industrial humans survive and adapt in environments where machinery, as the product of technology, did not yet exist? (Ingold, pp. 289–290, 294–296).

Ingold responds to this issue by revisiting the classical distinction between *tekhné* and *logos* to explain how humans engage with materials. According to Ingold (2000, pp. 289, 294, 295), in its traditional sense, technology is understood through *tekhné* as a skill of craftsmanship, the art of making, or, in Aristotelian terms, the general capacity to produce intelligent things. This view emphasizes the importance of craftsmen's ability to envision forms and bring them to life while highlighting how skill is inseparable from bodily practice and continuous engagement with the environment (Ingold, 2000, pp. 294–296).

In contrast, the modern view of *logos* shifts the emphasis toward mechanization, standardization, and formalization. In this framework, making is reduced to a series of mechanical operations that can be codified, systematized, and detached from the craftsman's embodied engagement with materials (Ingold, 2000, pp. 294–296). Within this perspective, the human role is reduced to operating systems and following predetermined protocols, while design and execution are separated and skill becomes externalized from the maker's body (Ingold, 2000, p. 295).

Ingold (2000) develops this argument through the example of dwelling. Comparing a mollusc shell, a beaver's lodge, and a human house, he shows that while animal constructions follow ingrained biological or behavioral programs, human building involves conscious decision, imagination, choice, and projection (Ingold, 2000, p. 175;

Ingold, 2007, pp. 345–346). In construction, this is evident when crews plan and execute underground tunnels, where design, excavation sequencing, and execution are shaped by technical procedures and situational experience. This reasoning extends into the domain of toolmaking. Ingold (2000, p. 175) notes that, while animals may alter projects for their own purposes, tools are only created when they are initially imagined before becoming tangible, something animals cannot do.

He further distinguishes between *co-optive* and *constructive* modes of making, using a hammer as an example that is directly applicable to construction work. In the *co-optive* mode, a construction worker might choose a hard, flat object from their surroundings, such as a stone, to serve the purpose of driving a nail. Without any modification, the stone is mentally designated as a hammer and used as such (Ingold, 2000, p. 175). In contrast, *constructive* mode requires the stone to be physically modified according to a prior design to optimize its function (Ingold, 2000, pp. 175–176). Once created and modified, tools rarely remain limited to a single use. A hammer designed for driving nails can also be used to destroy small rocks, demolish a wall, or perform other tasks. Ingold relates this adaptability to the concept of exaptation, in which tools initially modified for one purpose may later be repurposed and further modified in new settings (Gould & Vrba, 1982, as cited in Ingold, 2000, p. 176).

Yet, Ingold’s concept appears limited in scope, as his persistent use of “he” overlooks the influence of gender, class, race, and other social factors that shape individual experience (Howes, 2022, pp. 450, 457). Moreover, while Ingold explains how sensory engagement fosters material awareness, he is hesitant to integrate the senses with ethnographic methods (Howes, 2022, pp. 447, 456), thereby privileging direct perception over an analysis of how cultural practices are shaped by broader social and political structures (Howes, 2022, pp. 456–457).

2.4 VET in Germany

This section introduces the German VET (Vocational Education and Training) system to contextualize how tacit and embodied knowledge is formally cultivated within vocational training. While Clarke’s research positions Germany in contrast to the UK, the aim here is not to pursue a comparative study. Rather, it functions only as a

reference point within Clarke’s analysis, which the author draws upon primarily to illuminate the organizational and pedagogical features of German VET that are relevant to this thesis.

In the industry, Steiger (1993, p. 538) notes that construction workers are often informally categorized as either “specialists” or “jacks-of-all-trades and masters-of-none.” Specialists are craftsmen with extensive experience in a particular domain, whereas jack-of-all-trades can carry out a wide range of tasks but lack deep expertise in any single area. This distinction provides a useful lens for understanding how different training systems shape workers’ skill profiles.

In Germany, the structure of the education and training system tends to reinforce the development of specialists in Steiger’s sense. The system separates academic and vocational pathways. Alongside traditional university education, Germany has established hybrid formats such as the *Duales Studium*, which combine academic study at a university or university of applied sciences with extended phases of company-based practical training and often involve contractual relationships with employers that lead to degree programs (BIBB, 2023).

The core of the German skill formation system, however, is the dual vocational training model (*Ausbildung* in German) at the upper-secondary level, which combines company-based training with part-time vocational schooling (*Berufsschule*) over a period of two to three years (BIBB, 2023). Upon successful completion of a final examination administered by chambers of industry and crafts, apprentices receive a nationally recognized vocational qualification but restrict movement across occupations, making early vocational choices significant for long-term career trajectories (BIBB, 2023; Schuster & Margarian, 2021, p. 3; Baethge & Wolter, 2015, pp. 97–99). This vocational training is negotiated collectively by the state, employers, and trade unions, producing nationally standardized curricula and qualifications. Such governance ensures vocational credentials are both technically relevant and socially recognized, supporting stable occupational identities and career paths (Deissinger et al., 2018, p. 47). Deissinger et al. (2018, p. 46) argue that Germany emphasizes developing labor power, training individuals to work competently and flexibly across different environments.

According to Haverkamp and Proeger (2020), vocational training (*Ausbildung*) in Germany is institutionally organized across different economic sectors, including skilled crafts and trades (*Handwerk*) and commercial and distributive trades (*Handel*). Vocational schooling is regulated at the federal state level and coordinated through the Standing Conference of the Ministers of Education and Cultural Affairs (*Kultusministerkonferenz*, KMK), while training standards and occupational profiles are jointly governed by federal authorities, employers' associations, and trade unions.

By contrast, the UK system is more fragmented, with multiple organizations, such as City & Guilds London and the Engineering Construction Industry Training Board, offering a variety of programs through public and private providers⁸, making training more diverse and decentralized⁹. This highlights how the German VET system provides a structured framework for acquiring practical and theoretical competencies.

Table 1. Construction operations (water qualifications VET)

Country			UK		Germany	
Length			1-2 years		3 years	
Main Element	Main type of activity	Particular activities	Core	Minor	Core	Minor
Practical Skills	Set up		V		V	
	Equipment, excavation		V		V	
		Functionality	V		V	
	Tools, machinery	Maintenance	V		V	
		Operation			V	
		Emission			V	
		Storage	V		V	
	Masonry				V	
	Scaffolding		V		V	
	Carpentry		V			V

⁸ See the UK training curriculum (City & Guilds, 2025, November 5), Construction skills qualification, and the German training curriculum (KMK, 2023), *Richtlinien für die Berufsausbildung Bau/Tiefbau mit erweiterten Lernfeldern*, for reference.

⁹ In the UK, ^9 vocational pathways are organized by task, regardless of setting. Germany's dual system, by contrast, draws precise lines between sectors, such as residential and commercial building, roadworks, and underground infrastructure, while placing comparatively less emphasis on standalone maintenance or repair qualifications.

	Concrete formwork	Formwork		V
		Asphalt		V
		Rocks		V
	Coating and covering components		V	V
		Drillholes		V
		Measuring		V
	Pipelines installation	Utility trenches	V	V
		Pipelines and house installation		V
		Line engineering		V
		Maintain and rehabilitation		V
		Sewer systems installation and renovation		V
		Water mains installation		V
		Pressure testing		V
		Restoration		V
		Reparation		V
		Excavation and pavement surfaces		V
		Jointing		V
		Functionality restoration	V	V
	Waste water	Waste water network reparation	V	V
		Manhole replacement	V	
		Hygiene measures	V	V
	Environmental damage prevention		V	V
	Cleaning			V
	Preservation		V	V
Non-manual competences	Planning and organisation	Planning and organisation	V	V
		Communication	V	
		Work coordination		V

		Efficiency in utilities	V
	Surveying		V
	Risk Assessment	V	V
	Quality Control		V
	Reporting to management		V
Knowledge	Industrial	Labour law and socio-economics	V
		Health & Safety	V
		Digitalisation	V
		Economics and Social	V
	General	Geometry	V
		Mathematics	V
		Physics	V
		Language	V

Sources: City & Guilds (2025, November 5), *6028 Network Construction Operation*; KMK (2023), *Richtlinien für die Berufsausbildung Bau/Tiefbau mit erweiterten Lernfeldern*; author's creation inspired by Clarke et al. (2013).

The table shows that both Germany and the UK prioritize practical and non-manual competencies, such as site setup, material handling, planning, and safety. The main difference lies in how these subjects are classified: what is core in one country may be minor or absent in the other. Germany's VET system integrates multiple tasks into a structured framework, whereas the UK separates work into discrete tasks such as operation, repair, and maintenance (Clarke et al., 2013). This distinction helps explain why, during the interview, German workers were confused by questions about maintenance, repair, and replacement, having been trained to perform all three as part of their role¹⁰.

Despite the structured and comprehensive nature of Germany's VET system, formal training alone cannot guarantee the transfer of tacit skills. On-the-job experience remains crucial, allowing workers to learn through observation, practice, and informal guidance from colleagues (Tutt et al. 2013, p. 134). Younger workers, while often less experienced, may bring new knowledge or skills that older workers lack, highlighting

¹⁰ The workers initially responded that "we do all of them, there is no difference." To clarify their responses, the questions were subsequently reframed to focus on budget-related aspects.

the ongoing need for retraining and upskilling (Jepson et al., 2018, p. 192). Career changers, or *Quereinsteiger* in German, expand the workforce by entering roles that demand fewer competencies, although this often means lower starting skill levels in positions such as construction assistant or helper. Construction companies, however, generally prefer applicants with established trade experience (Schuster & Margarian, 2021, p. 4).

2.5 Dirty Work

Star (2002, pp. 116–117) argues that infrastructures are not neutral backdrops but social and material arrangements that sustain both order and inequality. Despite Germany’s sophisticated knowledge systems and institutional frameworks (Thelen 2019; Clarke et al., 2013), construction workers continue to encounter a persistent social challenge that transcends their technical competence. The concept of 'dirty work,' first articulated by Hughes (1958), helps explain why occupations requiring significant embodied skill and formal training can be socially stigmatized at the same time.

Everett C. Hughes first formulates the term “dirty work” to describe occupations that are essential to our daily life yet are perceived by the public as “dirty” metaphorically or literally, due to their involvement with physical dirt or the public perception as morally or socially undesirable, such as prison guards or mortuary attendants (Hughes, 1958, pp. 49–52, 121–122; Watson, 1995, p. 213–214).

The first involves physical taint, when a line of work is directly or indirectly associated with bodily fluids, waste, dirt, or garbage (such as caretaker, mortician, or janitor) or when it exposes workers to hazardous conditions (such as construction worker, farmer, or miner). The second category, social taint, applies when a line of work serves stigmatized or marginalized populations (such as AIDS workers or prison guards) or when the role is perceived as subordinate to others (such as housemaids or butlers). The final category, moral taint, refers to a line of work which is considered morally questionable or sinful (such as psychics or pawnbrokers) or those involving morally ambiguous practices (such as lawyers, private investigators, or bill collectors) (Ashforth & Kreiner, 1999, pp. 414–415).

However, the boundaries between the physical, social, and moral dimensions are often blurry or even nonexistent, since many jobs appear to be tainted on multiple dimensions (Ashforth & Kreiner, 1999, p. 415). For example, lawyers may be perceived as socially and morally tainted, while exotic dancers are often judged on both social and moral grounds. This illustrates that the limits of dirty work are themselves a social construction, shaped by subjective judgments of purity and cleanliness, which in turn produce occupational hierarchies and prestige. Its common denominator is not the work's basic traits but the public's instinctive disgust or repulsion towards the job (Ashforth & Kreiner, 1999, p. 415).

In underground construction, workers routinely handle wastewater, soil, and sewage systems and perform physically demanding and hazardous tasks. As a result, the occupation is often stigmatized as dirty work, both literally because of its environmental exposure and socially because of the low security and low income, despite its technical complexity and critical public value (Adamson & Roper, 2019, p. 553; Deery et al., 2019, p. 633; Ness, 2009, p. 648). Furthermore, dirty work is also viewed as dishonorable and degrading (Morales & Lambert, 2013, p. 229). It raises broader questions about the hidden costs of maintenance labor. De Coss-Corzo (2021, p. 4) reflects on whether society merely maintains infrastructure or also sustains the injustices and inequalities experienced by the workers who perform this essential work.

However, research shows that workers in stigmatized or “dirty work” do not necessarily develop negative views of themselves or surrender to the stigma (Morales & Lambert, 2013, p. 228). Instead, they actively use a range of occupational ideologies as strategies to preserve a positive professional identity, protect their sense of dignity, and maintain credibility in the eyes of others (Adamson & Roper, 2019, p. 555). Building on this insight, the first strategy to counter the dirty work stigma is to *reframe* the work, mitigating negative views and adding positive value to stigmatized tasks. A prime example is lawyers: while representing a person accused of a crime, lawyers may view their role as a duty to safeguard the legal rights for all to a fair judicial process. To neutralize the stigma, they often reassure themselves they are “just doing their job” (Ashforth & Kreiner, 1999, pp. 421–422).

The second strategy is to *recalibrate* the stigma by developing alternative standards for the job's worth and recognizing that even a minor job is necessary to keep the system functioning (Ashforth & Kreiner, 1999, pp. 422–423). Construction work illustrates this well. Underground construction work may be largely invisible, but any failure in toilets or sewage systems immediately becomes apparent (Star, 1999, pp. 381–382). Similarly, a hospital janitor ensures cleanliness to prevent infections from spreading, making their work indispensable (Ashforth & Kreiner, 1999, p. 422–423).

The third strategy is to *refocus* the stigma, shifting attention from the stigmatized aspect of the work to its non-stigmatized elements. Lawyers, for instance, focus on winning the case rather than the moral implications of their work (Ashforth & Kreiner, 1999, p. 423). Such strategies are not only applied individually but also collectively, creating a sense of collective pride. These collective strategies function as what Ashforth and Kreiner call occupational social buffers, where workers reinterpret stigma as evidence of strength and resilience rather than deficiency (Ashforth et al., 2007, p. 160).

3. RESEARCH METHODOLOGY AND METHODS

3.1 Historical Background of Construction

Across much of the Global North, including Germany, deteriorating infrastructure has become an increasingly urgent issue, heightened by financial constraints and growing environmental pressures (Denis & Florentin, 2024, pp. 2–5). Infrastructure is further stressed by its inherent vulnerability to decay, erosion, vandalism, or deliberate sabotage (Graham & Thrift, 2007, p. 5), as well as by demographic changes, including the influx of displaced persons, which places new demands on municipalities and requires larger pipes, expanded sewer networks, and greater water capacity (Kaminsky & Faust, 2018).

Construction lies at the heart of this crisis. While the crisis is often framed as a technical or financial difficulty, it is also fundamentally a labor issue since investment plans cannot materialize without a stable and qualified workforce. Construction is frequently viewed as a functional and instrumental activity rather than a social or cultural one (Appel et al., 2018, pp. 3–4), which explains the reason why the research in construction remains limited. As a result, the everyday routines of construction workers, as well as the social contexts in which infrastructure is produced, have often been overlooked in academic research, even though both the industry and its workforce are fundamental to contemporary society (Sage & Vitry, 2018, p. 4). Pipes, roads, and cables may be called infrastructures, but without the people who maintain and repair them, these systems cannot function (Andueza et al., 2020). In this sense, infrastructure takes form through embodied human labor.

Historical neglect towards the construction industry shaped early research approaches and contributed to the methodological debates that emerged in the mid-1980s.¹¹ Research has often overlooked actual work processes, focusing instead on pre- and post-production phases (Pink et al., 2010, p. 648). This shift in focus coincided with

¹¹ These debates were dominated by quantitative approaches throughout the 1990s, despite the availability of diverse methods, leaving construction management without a unified theoretical framework (Oswald, 2024, pp. 53-54). Oswald asserts that construction management as a research domain often intersects with the natural and social sciences, yet early applications of classical ethnographic methods were scarce and inconsistent, a scarcity he attributes to the construction management community's hesitation to regard engineers as researchers because they are perceived as lacking clearly defined objectives and quantitative outcomes (Oswald, 2024, p. 54).

growing ethnographic interest in construction and infrastructure, encouraging the adoption of broader social-science perspectives in construction management, especially ethnography (Oswald, 2024, p. 56). As Oswald (2024, pp. 54–56) observes, construction studies depend heavily on semi-structured interviews. While these highlight workers' perspectives, they risk subjectivity and neglect the observation of on-site practices. From a practical perspective, construction sites were then primarily viewed as functional tools that facilitate careful planning and coordination of labor, materials, equipment, machinery, and storage, with the degree of planning varying according to the project's size and type (Neubert, 2023, p. 518). At the same time, sociological research examined construction sites as social and occupational spaces, highlighting their broader significance in shaping work culture, labor relations, and urban development (Neubert, 2023, p. 519).

3.2 Ethnography as a Methodological Response to Construction Research

Pink et al. (2010, p. 648) describe ethnography as an inductive approach that produces detailed accounts, considers the complexity of human experience, recognizes theoretical frameworks and the researcher's influence, and treats humans as both subject and object through engagement with people in everyday environments and cultural contexts, emerging from practical activity and focusing on how practices are performed and learned in context. Ethnography aims to understand people's perspectives, their relationship to their lives, and the ways they perceive and interpret the world around them (Spradley, 1979, p. 25).

Building on this understanding, ethnography allows researchers to explore how infrastructure both shapes and is shaped by social and political practices, revealing how it embodies political rules and structures daily life through material systems such as pipes, energy grids, and sanitation (Appel et al., 2018, pp. 4–5). Within infrastructure and construction research, Neubert (2023, p. 519) adds that ethnography that distinguishes between research conducted *on* construction sites and research conducted *about* them not only focuses on work culture, health, and safety but also recognizes construction sites as socially significant spaces that shape local communities and influence urban development.

There are two common approaches in ethnography. The first is the long-established tradition of classical long-term ethnography, which typically involves extended immersion of more than six months in the daily lives of the people being studied (Oswald & Dainty, 2020, p. 4; Pink et al., 2010, p. 648). In this approach, the author participates in daily activities, observes interactions and behaviors, writes fieldnotes, conducts interviews, and reflects on their own thoughts throughout the research process. This traditional method is widely valued for producing rich and detailed output, yet it is also time-consuming and cost-ineffective (Oswald, 2024; Pink et al., 2010, pp. 648–649). A further limitation is the difficulty of exploring relationships between people and things across different locations, especially when both are mobile (Pink et al., 2010, pp. 648–649).

Construction sites exemplify this limitation. They are typically short-term, temporary, and project-based, with higher levels of fragmentation than many other industries (Pathirage et al., 2006, pp. 1–2). In such dynamic environments, problem-solving often depends on specialized, context-specific knowledge, much of which is tacit, difficult to verbalize, and transmitted through practice rather than formal procedures (Pink et al., 2010, p. 650). Together, these characteristics make construction sites particularly challenging for traditional long-term ethnographic methods. This has contributed to the emergence of alternative approaches that combine video, photography, ethnographic interviewing, auto-ethnography, and action-based research, resulting in more flexible and adaptable ethnographic practices (Oswald & Dainty, 2020, pp. 3, 11, 17–19).

One of the contemporary, alternative approaches is known as short-term ethnography. Short-term ethnography is a contemporary research approach conducted over a period of less than six months, relies on collaborative and interactive techniques yet still produces equally rich insights¹² (Brett et al., 2022, pp. 361–362; Oswald & Dainty, 2020, pp. 4, 7; Pink et al., 2010, pp. 648–649). This approach acknowledges the practical limitations of long-term ethnography, including constraints of budget, space, and time, and therefore often uses video and photographic documentation to compensate (Brett et al., 2022, p. 361–362; Pink et al., 2010, p. 648–649). This approach is not only

¹² Despite the brief timeframe, other researchers argue that the intensity of engagement provides sufficient richness and depth to the data collected (Knoblauch, 2005).

valuable for highlighting the constraints of the construction industry but also for fostering a deeper, more empathetic understanding of the lived experiences of participants in both analysis and communication (Pink et al., 2013, p. 35).

As Oswald (2024, p. 57) notes, interest in ethnographic approaches accelerated in the 2010s, when scholars such as Sarah Pink, Dylan Tutt, and Andrew Dainty moved beyond classical ethnography into new methodological territories, employing audio, video, and other media to generate rich descriptions while retaining the thick data that remain central to ethnographic inquiry. The integration of visual and digital technologies is particularly well suited to the fast-paced and materially dense nature of construction sites. By replaying video and audio sequences, revisiting photographs, and triangulating these materials with fieldnotes and interviews, researchers can capture dimensions of work that may be overlooked in real time, such as fleeting gestures or micro-coordination between workers.

However, these methods also have limitations. Emerson et al. (1995, p. 9) note that audio and video recordings capture only a portion of ongoing activities, as what is recorded depends on the location, timing, and positioning of both the equipment and the researcher. The sustainability of short-term ethnography has also been questioned, as it often compels researchers to intrude into participants' lives in order to collect data within a restricted timeframe (Pink & Morgan, 2013, pp. 353, 358). It has even been labelled a 'quick and dirty' method (Hughes et al., 1995, as cited in Oswald & Dainty, 2020, pp. 7–8), casting doubt on its capacity to generate comprehensive or nuanced insights. Concerns over validity and general applicability arise because the data collected within such a short timeframe may be insufficient (Oswald & Dainty, 2020, pp. 20–23, 25).

Furthermore, bias often arises when researchers fail to critically reflect on how their presence and interactions shape participants' behavior (Oswald & Dainty, 2020, pp. 25–26). This lack of reflexivity is compounded when ethnographers actively participate in the setting, as their involvement can inadvertently disrupt social dynamics and undermine the authenticity of the observations (Oswald & Dainty, 2020, pp. 19, 25–26). In both cases, insufficient awareness of one's own affect risks distorting the very practices under study.

Although ethnography in construction work has certain limitations, the ethnography method still responds well to the challenge of construction work with it being of complex and temporary nature. Ethnography captures social realities of construction sites, providing valuable ways to access interactions and practices that are not immediately visible and clear (Pink et al., 2010, p. 658).

3.3 Research Methods

In this thesis, a qualitative research design was employed. The thesis combines three main components: nonparticipant observation, ethnographic interviewing, and partial shadowing. These approaches were chosen to explore both the practical and experiential dimensions of construction work without interfering with the workflow. Finally, an ethnographic writing style is adopted for presenting and interpreting the findings, ensuring coherence between the empirical material and its interpretation.

3.3.1 Nonparticipant Observation

Pfeiffer-Kloss (2018, p. 231) notes that temporary road signs or blocked roads expose construction sites to public curiosity, with adults and children alike drawn to peer behind barriers, captivated by the movement of machines and the gestures of workers. In the context of construction work, what can be observed from the outside often reveals only a fragment of the actual work process. These fleeting glimpses do not capture how work truly unfolds or how workers navigate their routines and skills *in situ*. While ethnographic interviews provide valuable insights into workers' perspectives, they cannot be taken as a sole source for understanding a culture, since the information is controlled by the informant (Agar & Hobbs, 1982, pp. 1–2). To address this gap, a combination of nonparticipant observation and partial shadowing (Section 3.3.2) was employed.

Nonparticipant observation involves observing without actively participating in the activities being studied (Ciesielska et al., 2018, p. 34). Williams (2008, p. 561) identified several reasons for selecting nonparticipant observation. First, the group may not be directly accessible to the researcher. Second, the setting may be hazardous or challenging to work in. Third, the study may prioritize the patterns and structures emerging

from actions rather than the individuals' unique experiences or interpretations of those behaviors.

While this approach does not allow for direct involvement or experiential participation, its minimal visibility and non-intrusive stance enable the researcher to observe natural workflows and interactions (Czarniawska, 2007, p. 10; Williams, 2008, p. 561). Since there is a significant difference between letting them talk about their actions and observing how they behave (Scheffer, 2002, p. 363), nonparticipant observation is therefore viewed as a complement to the interview, where participants seldom verbalize the reasons behind their actions and what their work practices look like.

Czarniawska (2007) distinguishes between participant and nonparticipant observation. In participant observation, the researcher takes on an active role within the organization, engaging in both action and observation. This dual involvement can lead to what is called "going native," which is a state of deep immersion in the field that blurs the boundaries between researcher and participant (Czarniawska, 2007, pp. 13, 55–56). Such immersion allows for richer understanding, yet it can also make it difficult to maintain analytical distance. It also demands considerable time, energy, and spatial presence, sometimes making genuine observation difficult (Czarniawska, 2007, pp. 13–14).

By contrast, nonparticipant observation allows the researcher to remain an outsider while closely monitoring routines, interactions, and material engagements (Czarniawska, 2007, p. 14). This approach can take several forms, including shadowing workers or stationary observation, and is particularly suited to contexts where interference might alter behaviors or create safety risks (Czarniawska, 2007, pp. 55–56). Through this method, the ethnographer aims to understand a culture not only from what people say but also from how they act and from the common objects and tools they use in everyday life (Spradley, 1979, p. 8).

3.3.2 (Partial) Shadowing

According to McDonald (2005, pp. 456–457), shadowing is a qualitative research method where the researcher closely observes an individual for a prolonged duration with the tasks being varied following the individual being studied. The researcher

accompanies the participants through their daily movements and asks questions throughout the process to elicit explanations, clarifications, or reflections, leading to a detailed description. Therefore, shadowing does not only unveil the ‘what’ aspect of a conduct but also the ‘why’ factor (Bartkowiak-Theron & Sappey, 2012, p. 17).

The core element to shadowing is “the level of analysis it produces” (McDonald, 2007, p. 457). Shadowing is especially valuable because it enables the researcher to accompany participants throughout their daily activities without direct interference, while closely observing how they act, interpret, and make sense of their surroundings from their own perspective (Bartkowiak-Theron & Sappey, 2012, p. 18). Shadowing supplements interview findings, which are often affected by the circumstances and environment in which the interview occurs (van Hulst & Ybema, 2020, p. 105). It allows ample opportunities for an in-depth and personal connection with individuals for them to explain certain situations (Gill et al., 2014, p. 70). It also creates an opportunity to explore research questions in regard to social relations (Gill et al., 2014, p. 70).

Both observations yielded in fieldnotes, which are collected and treated as data or findings and later analyzed (Emerson et al., 1995, pp. 15–16). The researcher’s reflections are separated into field journals, which separate the main observation from the researcher’s own experience and perspective (Emerson et al., 1995, pp. 15, 95).

3.3.3 Ethnographic Interviewing

Building on the ethnographic orientation of this paper, ethnographic interviewing was used as one of the methods to access workers' and management's perspectives. This thesis adopts Spradley’s (1979) concept of the ethnographic interview. According to Spradley, participants are not merely data resources but collaborators who taught the researcher about their way of life from their point of view (Spradley, 1979, p. 25).

The core element of Spradley’s (1979) ethnographic interview is the Developmental Research Sequence (DRS), which is employed to elicit knowledge and information from participants. There are three main types in DRS:

1. Descriptive questions: an introductory sample to collect general information and encourage informants to talk more (Spradley, 1979, p. 59, 83–84).

2. Structural questions: to discover how participants organize their knowledge by revealing folk domains, the term used for the domains to test hypotheses about cultural categories (Spradley, 1979, pp. 120–121, 131).
3. Contrast questions: to understand cultural meanings by comparing and verifying across objects and events (Spradley, 1979, pp. 161, 171–172).

In the context of construction, ethnographic interviewing was first used to guide field observation, offering insights into how participants perceive and describe their work from their perspectives before the main observation took place. During the observation phase, follow-up questions were asked when participants' actions or practices appeared to differ from what they had previously described in the interviews. This gave them a moment to reflect on their actions and articulate the reasoning behind their routines, decisions, and problem-solving strategies that often remain unspoken in everyday practice. Sample questions and implementation of this method are detailed in Section 3.6.

3.3.4 Suitability for the Research Project

Capturing embodied knowledge practices in construction requires methods that are flexible and sensitive to the pace and rhythm of work. Full participant observation, as described by Williams (2008), was not feasible due to safety regulations and a denied internship. To address these constraints, this research adopts a short-term ethnography approach. This method is particularly suitable for underground construction sites because it accommodates temporal and logistical limitations, including restricted access and budgetary constraints, yet still enables the study of embodied practices *in situ*.

Building on this methodological approach, a combination of nonparticipant observation, partial shadowing, and ethnographic interviewing was employed. Nonparticipant observation provided an initial orientation in the field, helped establish early contacts, and supported a snowball process for identifying gatekeepers and interview partners. It also allowed the author to witness interactions and routines that might not surface in interviews. When appropriate, the author could ask workers to clarify specific procedures or tasks that were not immediately understood.

Partial shadowing extended this perspective by following workers through their daily movements, offering insight into how embodied knowledge guided them through their daily activities. These methods enabled close study of work practices, especially body techniques and material interactions, while maintaining safety and minimizing interference with ongoing construction. They also offered occasional opportunities for the author to engage directly with equipment, providing a rare, carnally informed perspective on the work.

Ethnographic interviewing complements these by giving workers and management the opportunity to articulate their experiences, strategies, and interpretations of their work, perspectives that often remain implicit otherwise. In this way, interviews also contextualize observations, bridging the gap between practice and meaning. This method also reveals aspects of work that may not have been anticipated by the author, such as informal problem-solving practices, interpersonal dynamics, or personal reflections on organizational routines and constraints.

Combining these approaches as a hybrid allows the author to study three types of social relations in the field: workers with their peers and superiors, workers with their tools and materials, and workers with the public. Employing multiple methods produces a richer and more nuanced understanding of workplace practices (McDonald, 2005, p. 461).

3.4 Field Access and Research Setting

3.4.1 Field Access

The research began with the search for suitable subjects on the topic of underground infrastructure work. Fieldwork was essential, as construction sites function as social and practical exchange spaces where workers perform daily routines and socialize (Neubert, 2023, pp. 1, 8). Drawing on Wacquant's (2004, p. 14) observation that the boxing gym is where the pugilist "molds himself into shape," the construction site can likewise be understood as a space where workers mold their bodies, sharpen their senses, and embody practices. Construction companies specializing in water and sewer systems, pipeline construction, and roadworks emerged as appropriate sites of investigation. Two companies, located in City X and City Y, were recommended through the

author's personal network. Both were contacted via email, which included a short introduction, a research proposal, and a request for potential field access. While the company in City X did not respond, the company in City Y, MultiBau, replied positively.

MultiBau is a family-owned enterprise located in western Germany, growing up from an agricultural tradition with a small excavator business in the 1970s and continuing through family generations from the 1980s onwards. The company constitutes a medium-sized enterprise with approximately 190 employees. Its portfolio covers sewer, pipeline, roadworks¹³, and earthworks, as well as underground construction for both municipal and commercial infrastructures. Contracts are predominantly acquired through public tenders. MultiBau also offers internships and apprenticeships as part of the German dual training system, which makes the company an experienced vocational training provider and also a perfect candidate to be observed for vocational training. With its combination of underground construction expertise, innovative practices, and commitment to workforce development, MultiBau provides a relevant and illustrative case for this thesis.

Following this first contact, the author attended a meeting with the CEO of MultiBau in order to present the project in person. In this occasion, the request to conduct fieldwork through temporary affiliation with the company in the form of a short-term internship was made. This arrangement was intended to facilitate direct engagement with workers and to allow for participant observation under conditions acceptable to the company. However, since the author had no prior experience in construction, the internship proposal was rejected. Consequently, the author's participation was restricted to nonparticipant observation. The author fully respected the company's decision.

3.4.2 Research Setting

Construction sites vary in location, and worker assignments are determined by the weekly timetable. While workers may remain with the same crew for extended periods, they may also rotate between sites depending on operational requirements. A typical team usually consists of a foreman (who also works as a pipefitter or an excavator

¹³ Underground construction work sometimes overlaps with roadworks. At MultiBau, underground construction workers complete their tasks first, after which the roadworkers carry out all finishing work on the site, including paving and asphaltting.

operator), a main excavator operator, a pipefitter, and a helper, although in some cases, the composition is reduced to only a foreman and a pipefitter. In other cases, the team is expanded to include additional workers, depending on project size and specific operational goals.

At the writing of this thesis, the author visited six different locations in a West German province. The fieldwork encompassed three types of construction contexts:

- Two sites focused on pipe replacement and installation, one in a densely built residential neighborhood and another on a converted farm field serving as an access road to an industrial facility.
- A third site in a remote area involved earthworks and pipe replacement, emphasizing excavator coordination over groundworkers.

Construction sites are commonly perceived as sources of disturbances, characterized by noise, dirt, and dust (Neubert, 2023, p. 517). These conditions posed practical challenges for conducting fieldwork. In accordance with safety regulations, basic protective equipment was used at all times, including certified safety footwear (level 3), earplugs, and appropriate weather gear. Field visits were not scheduled according to a fixed plan but were arranged flexibly in relation to weather conditions, the availability of active construction sites, and the progress of ongoing construction phases.

3.5 Data Collection and Documentation

3.5.1 Data Collection Procedure

The empirical data for this master's thesis was collected through a combination of ethnographic field observations and semi-structured interviews with the CEO and workers of the underground construction company MultiBau in western Germany. The field phase extended over a period of five months¹⁴, from July to November 2025, and included repeated site visits across different locations. In total, a number of observation days were carried out, amounting to approximately 46 hours and 28 minutes of documented fieldwork. Each visit typically lasted between two and five hours and spanned different seasons, allowing for the observation of potential variations in construction

¹⁴ Initial observation was conducted in May 2025 while awaiting approval. The approval was subsequently received in late June 2025.

practices due to climatic and seasonal factors. A preliminary orientation visit lasted one hour, and one other visit was cut short due to unforeseen circumstances. Prior to each observation day, the foreman of the respective site was contacted to obtain consent. Observations were conducted from safe zones using a non-participatory, passive approach, remaining close enough to document the work without interfering.

In accordance with Spradley's (1980) three-phased model of participant observation, the fieldwork was structured in stages. The initial phase of descriptive observation served to develop a broad understanding of the work environment, the participants involved, and the rhythm of construction processes. Notes during this phase were deliberately open-ended, documenting the organization of the crews, the deployment of equipment and machinery, and the general atmosphere of the sites. The observations were guided by practical inquiries such as: what is the goal for today, do the workers know each other, or are they meeting for the first time through an assignment from the main office, among other practical questions.

The subsequent phase of focused observation narrowed the perspective towards aspects directly relevant to the research questions. These included, in particular, the bodily techniques of groundworkers, the handling of tools and heavy equipment, the interaction between humans and materials, and the forms of verbal and non-verbal communication among workers, as well as between workers and outsiders such as local residents or passers-by. Typical guiding questions for this stage include: what challenges this particular location poses, whether there is any problem with the machinery or tools, how workers coordinate their tasks when plans change or disruptions occur, and other related inquiries.

In the final phase of selective observation, attention was directed towards recurring patterns of analytical significance, with particular emphasis on the embodiment of skills, the coordination of teamwork, and the negotiation of occupational identity under the stigma of 'dirty work.' Since construction sites often attract the attention of neighbors, occasional conversations also extend beyond the workforce itself. When residents stopped to watch or comment, workers were asked whether they received complaints, and neighbors were asked which aspects of the work they found noteworthy. At this stage, questions became more interpretive, for example, how do you adapt your

techniques in tight spaces, how do you handle complaints, how do you feel when the residents recognize your work, among other interpretive questions.

3.5.2 Documentation Method

To facilitate systematic documentation, spatial sketches of the construction sites were produced, mapping the relative positions of workers, machinery, and tasks. These sketches provided a visual frame for later analysis. While interviews were conducted in German, all field notes and analytical writing were produced in English. Transcription, translation, and interpretation of the interview material were carried out by the author.

During observation, video recordings were taken for activities that demonstrated specific body techniques. Because these actions occurred quickly and irregularly, video recordings allowed the author to replay the sequences and confirm the explanations workers provided during the observation day or during interviews. The recordings also captured the eye and body movements of an excavator operator prior to executing a maneuver, enabling detailed analysis of how visual focus and bodily positioning informed machine control.

On the first day of observation, jottings were written manually with pen and notebook. However, this approach quickly proved problematic, as some workers displayed unease or altered their behavior when they noticed the act of writing¹⁵. In response, a new strategy was adopted: jottings were typed discreetly into a mobile phone to resemble casual texting, and voice memos were used to capture immediate impressions and sequences of events¹⁶. These digital notes and audio recordings were later transcribed and combined into detailed fieldnotes. Overall, mobile-phone-based notes and voice memos proved more effective than handwritten notes for capturing simultaneous workstreams.

¹⁵ This experience is also reported by Rawlinson & Farrell (2008). Hence, the fieldnotes in this thesis were often written after the observations, although present tense was used.

¹⁶ Emerson et al. (1995, p. 49) note that the use of voice memos requires considerable time and resources. In this thesis, however, they proved highly effective for quickly capturing observations, particularly on construction sites, where multiple activities often occur simultaneously.

To ensure data security, all files were regularly transferred from the mobile device to an encrypted external hard drive, with duplicates stored on a password-protected laptop. Access to the data was restricted to the author alone.

3.5.3 The Researcher's Role

The author's role was partially participatory and reflexive, maintaining an attentive but unobtrusive presence. Observation occurred from the periphery of work processes. In this way, the author functioned as a passive observer and temporary insider-outsider, acknowledged by the crew while retaining the distance necessary for naturalistic observation. Since safety regulations prevented entry into active trench zones, partial shadowing was employed from legally permitted positions. Some workers permitted the author to handle tools and equipment after hours. These interactions allowed the author to engage with aspects of carnal sociology, allowing limited firsthand experience of embodied skills and workers' material interactions with apparent ease.

3.6 Ethnographic Interviews: Implementation

In addition to field observations, semi-structured and open-ended ethnographic interviews were conducted with employees of MultiBau to complement observational data with first-hand accounts. Interviewees included groundworkers, excavator operators, foremen, and the company CEO.

In line with Spradley's (1979) Developmental Research Sequence, two interview guides were developed, one for fieldworkers and one for management, with questions being open-ended. The questions were grouped as follows:

1. Descriptive questions were used as warm-up questions to help participants feel comfortable and talk more openly. Questions for workers included: *how old are you, what did you do before your current job, how did you get into construction, what is your role, what is a typical day like for you*, and similar introductory questions. Questions for management included: *how did the company start, how many workers are employed, how has the company developed in recent years, what is the company philosophy*, and similar background questions.

2. Structural questions were used to learn how participants group knowledge and what topics they see as meaningful. Questions for workers included: *what qualifications did you bring into construction, are you formally trained in construction, how do you communicate with coworkers when it is very loud on site, how do you handle conflicts with coworkers*, and similar questions about work practices. Questions for management included: *how is weekly planning organized, how are teams formed, how are workers assigned to teams, what kinds of conflicts require management involvement*, and similar questions about site organization.
3. Contrast questions were used to understand how participants describe differences between things. Questions for workers included: *what is the difference between a formally trained worker and a career changer, if career changers exist in construction, then what is vocational training for*, and similar comparison questions. Questions for management included: *why does the company hire career changers, what methods are used to attract new construction workers*, and similar questions.

Potential participants were approached through snowballing or convenience sampling. They were first informed about the study and its purpose and invited to participate voluntarily. Interview appointments were scheduled according to participants' availability. A formal interview with the CEO was granted. Interviews with workers were conducted in person or through video call, depending on participants' preferences and schedules. Each interview lasted between 50 and 60 minutes, with follow-up interviews or exchanges via voice notes, yielding a total of 400 minutes of recorded material. In addition to the formal interviews, informal conversations during fieldwork were documented as fieldnotes. These interactions provided further clarification on work practices and complemented the formal interview material.

At the conclusion of each interview, participants were invited to provide additional remarks or clarifications. All interviews were audio-recorded with participants' consent and later transcribed verbatim¹⁷, with only minimal editing to improve

¹⁷ Some transcripts may also show minor timing inconsistencies, arising from recording interruptions such as technical issues, unexpected visitors, or workers' requests to remain off the record. When such problems occurred, it would be described as *(Internet Problem)* or *(Off the Record)*.

readability. Fillers such as *äh*, *uh*, or *umm* were omitted¹⁸ when they did not contribute to meaning (Spradley, 1979, pp. 63–64).

3.7 Ethical Considerations

Ethical considerations were addressed throughout. Workers were informed about the author's presence and role prior to observation. Videos and photos were taken with consent. Requests not to be photographed or recorded during observation were fully respected. Names, locations, and identifying details, including physical traits, were heavily altered¹⁹. For confidentiality reasons, pseudonyms are used throughout this thesis. In a few cases, a single participant is referenced with more than one pseudonym to ensure anonymity where specific workplace roles or characteristics could otherwise lead to identification (Fetterman, 2010, pp. 146–147). Furthermore, when participants requested that certain information remain off the record, no notes were taken, and such data were excluded from this thesis.

3.8 Analysis

The analytical process followed an interpretive and iterative approach that combined thematic and contextual reading of the empirical material. Following Agar and Hobbs (1982, pp. 5-7), the analysis aimed to achieve coherence on three levels: global, local, and thematic. Global coherence concerns the overall purpose or frame of a narrative. This helps reveal why a story is told and how it fits into the participant's worldview. Local coherence refers to the flow of meaning moment by moment within interaction or talk, and thematic coherence refers to recurring themes or ideas that appear across texts, both explicit and implicit.

Interview statements were not treated as isolated representations but interpreted in relation to observed behaviors, material settings, and interactional contexts. This

¹⁸ It was practically impossible to transcribe fillers consistently, especially in follow-up interviews that often took place as casual conversations on site. In these settings, participants were usually working, and frequent interruptions and background noise made the inclusion of every filler unrealistic and analytically unnecessary.

¹⁹ While Emerson et al. (1995, pp. 61–63) encourage vivid description of people and settings, this thesis includes such detail only when it is necessary to clarify situations or interactions relevant to the theoretical framework. For confidentiality, all other physical descriptions have been removed.

layered reading allowed for a movement between micro-level accounts and macro-level social meanings (Agar & Hobbs, 1982, pp. 5–7). Through repeated cross-reading of talk, action, and environment, analytical coherence emerged not from coding alone but from recognizing how workers’ embodied practices, linguistic expressions, and material surroundings mutually shaped one another. In this way, the analysis remained faithful to ethnographic logic: by connecting what people *say* to what they *do* and how they *inhabit* their working world.

3.9 Coding Steps and Writing Ethnography

The empirical material for this thesis, consisting of field notes, interview transcripts, photographs, videos, sketches, and voice memos, was analyzed using MAXQDA, drawing on the coding principles outlined by Corbin and Strauss (2015) and Emerson, Fretz, and Shaw’s (1995) ethnography guide.

The process began with creating open codes, during which key themes, significant events, and distinctive interactions were identified, allowing similarities and differences to emerge while preliminary concepts were developed (Corbin & Strauss, pp. 222–223, 238). Following Emerson et al. (1995), coding focused on patterns and categories that emerged from the data itself, rather than fitting observations into pre-established frameworks. Open codes such as “*VET Subject*,” “*Briefing*,” “*Self-Worth/Pride*,” and “*Role*” were developed by highlighting meaningful moments in the fieldnotes. However, as Charmaz and Mitchell (2007, p. 165) observed, while line-by-line reading is more effective in grounded theory, it may lead to the loss of anecdotes, scenarios, and descriptive sketches that are valuable in ethnographic research. Therefore, open codes created through contextual reading were essential given the dynamic nature of the field site, where workers’ tasks could shift depending on immediate needs.

After these patterns were identified, the data were refined to emphasize the aspects most relevant to the thesis’ focus (Bönisch-Brednich, 2018, p. 19). Memos were written recurrently after initial analytic drafting to identify patterns. However, this thesis employed memos to capture how social actions unfold in the everyday lives of participants, which is consistent with ethnographic writing, rather than using them to develop a theory as in grounded theory (Charmaz & Mitchell, 2007, p. 167).

By the time the researcher investigates the data, categories, networks, relationships, and connections are found, linked, and intersected, forming the second step known as axial coding (Corbin & Strauss, 2015, pp. 93, 165). This helps identify context from the data, which were then categorized and grouped into broader axial themes, for example, into “*Daily Work*”, “*Bodily Knowledge*”, “*Materiality*”, and other related themes.

After reviewing all coding notes and memos, the final step was to develop selective coding (Corbin & Strauss, 2015, pp. 94–95). In this stage, a central analytical category was identified to bring the axial themes together and clarify the main focus of the study. Selective coding serves to draw out a theme that connects with other emerging themes (Emerson et al., 1995, pp. 189–190). Since this thesis is ethnographic with grounded-theory elements, this step was used to identify the central ethnographic insight and build a thematic narrative that emerged across the categories, focusing on how workers dealt with real situations, practical decisions, and interactions in the field (Emerson et al., 1995, pp. 191–193, 198). The final analytical structure directly corresponds to the three research questions, while the analysis was informed by the intersecting theoretical perspectives previously written on Chapter 2.

According to Creswell (2007), ethnographic writing can take several stylistic forms. The realist mode adopts an objective, impersonal tone, representing cultural practices directly with minimal reflection on the research process. The confessional tale centers on the author’s experiences in the field, emphasizing the challenges and personal dimensions of inquiry. The impressionistic style combines both, offering a vivid, narrative-driven account that interlaces realist description with reflexive commentary (Creswell, 2007, pp. 192–193). This thesis adopts elements of both the realist and impressionistic styles, using detailed description and reflexive insight to depict everyday practices, material environments, and embodied forms of knowledge while maintaining analytic coherence²⁰.

²⁰ As Charmaz and Mitchell (2007, p. 170) note, ethnographic writing foregrounds the social lives of participants, while conceptual analysis plays a supporting role in the background.

3.10 Informants

The sampling in this thesis was guided by Spradley's (1979) Developmental Research Sequence method, although consistent implementation was constrained by limited access and the timeframe of this thesis. Following Spradley (1979, p. 25), an informant is a source of information who speaks the "native" language of the culture and provides information into the social world being observed. In the social science role, an informant may simultaneously function as subject, respondent, and actor, providing multiple perspectives on workplace practices (Spradley, 1979, p. 26).

Informants for this thesis were selected to provide a diverse view of underground construction work, covering a range of hierarchical levels, occupational roles, and technical responsibilities. Access to informants was shaped by company permissions, but the sample included representatives from management, technical staff, and operational workers:

- CEO: Alan, representing management perspectives.
- Dual role:
 - William (foreman and machine operator).
 - Caleb (foreman and machine operator).
 - Elliott (foreman and machine operator).
 - Nick (foreman and machine operator).
 - Sam (foreman and pipefitter).
- Pipefitters: Tyler, Evan
- Helpers: Ethan
- Operators: Vincent, Ian, Charles
- Temporary interns: Henry and Mario

This informant-based approach allowed the study to capture multiple perspectives across hierarchical levels and occupational roles. By focusing on informants rather than general participants, the thesis aligns with Spradley's ethnographic methodology and emphasizes the cultural knowledge shared by those actively engaged in the work environment.

4. INTERPRETATION OF EMPIRICAL FINDINGS

The concepts and analytical categories were developed inductively from the data collected for this master's thesis, and their interrelations were examined through iterative analysis. Because these dimensions are deeply embedded in daily site activities, the section headings combine observed forms of practice with the central conceptual concerns of the thesis. To ensure transparency and traceability, excerpts²¹ from fieldnotes and interviews²² are included throughout the chapter.

4.1 Planning and Daily Work

Work in underground construction follows a rhythm that is shaped by the roles of workers and the requirements of each site, while the working hours adjust seasonally. In the summer, the working hour starts at 06:30, while in the winter, it is at 07:00. The day typically begins at MultiBau's main office in (Town X), where workers gather, drink coffee, collect tools, or chat with colleagues who have already arrived. If their construction site is further away, they have to arrive earlier to travel there. Once the planned team is assembled, they travel together in the company van to the site, although some prefer to arrive with their own vehicles if the site is nearby. On arrival, the team begins setting up tools, excavators, and other equipment. Sam, a foreman and also an excavator operator, described:

(...) It usually starts with us arriving at the construction site in the morning, first having a cup of coffee, discussing the schedule [like] what's being done today, who's doing what. (...) That's why we have this morning's meeting beforehand, to discuss what we'll be doing today. [So, it is] clear, [why] I need the right tools for that (Interview Sam, Pos. 78–86).

Tyler, a pipefitter, explained:

No. Mostly (...), only when you start a new construction site. A rough briefing. This is where we start. The direction, the new sewer. All clear. Barriers. Then we start tearing out the asphalt (...) (Interview Tyler, Pos. 1205–1207).

Their accounts show that there are no fixed rituals that apply uniformly to all workers at MultiBau, yet repeated patterns reveal an informal rhythm that structures both work and social relations. For Sam's team, the morning coffee functions as a social ritual, a

²¹ Interview excerpts are cited using the format (Interview Name, Position number), and field observations follow the same convention (Fieldnote, line number).

²² When participants emphasize certain words or expressions during interviews, these are presented in italics to convey tone and emphasis.

practical briefing, and an essential time when the day is collectively planned and tasks are delegated, and it takes place daily (Interview Sam, Pos. 301–305). For other teams, such as Tyler’s, briefing is not seen as necessary, as coordination happens during working hours or is only held when it is the start of a new site to clarify technical details. This variation does not indicate differences in competence or experience. Rather, it reflects how coordination practices are situational and relational, shaped by team composition, site size, and shared work histories. Explicit briefing becomes particularly important when workers are unfamiliar with one another, when new members join a team, or on larger sites involving multiple crews, while tacit coordination is more common in stable teams whose members have worked together consistently over years.

Before projects begin, foremen coordinate with municipal officials or the main office to define site boundaries and work sequences. Elliott, a foreman and an excavator operator, described this process in more detail:

Yes, of course, we have a meeting with the construction manager and sometimes also with the client. Depending on [which projects] they are. We work a lot for the public sector, for municipalities or state institutions. And then we usually get a thorough site inspection, where we verbally discuss what activities need to be carried out. And of course, from the construction manager, who is usually familiar with the construction site and knows his way around. And then we discuss this together, [then] a sequence of how we will proceed on-site is established. Then, during the construction phase, site meetings are held every week, where the steps for the following week are planned (Interview Elliott, Pos. 60–68).

A new project involves three main actors: a client, which could be a municipality or a private company, MultiBau’s main office, which receives the contract or public tenders, and the technical team from MultiBau. Coordination between these actors is formalized at the beginning of each project through a technical meeting. During this meeting, clients’ requirements are discussed with the site manager, who oversees the budget, and the foreman, who assesses whether specific plans are technically feasible given ground conditions. At MultiBau, foremen remain actively involved on-site rather than working from the office. This indicates a hands-on management style, blending leadership with practical engagement in workflows. Throughout projects, municipal officials or construction managers often call or visit the site to inspect progress or address issues related to the plans (Fieldnote 4.7 & 2.10).

The CEO of MultiBau, Alan, situates these practices within a broader organizational and bureaucratic framework:

Yes, we mostly receive contracts through public tenders. A public client issues a tender, and we can then apply or request the tender documents. We receive the tender documents and prepare a bid based on them. Ultimately, the client, i.e., the local authority, such as the municipality, the regional association, or the district, makes the final decision. And yes, the client, i.e., the local authority, the municipality, the collective municipality, or the district, makes the final decision. They decide [if] there are damage classes for roads. Then, based on these damage classes and the road's function, they decide what will be repaired, what will be newly constructed, or what will be renewed (Interview Alan, Pos. 32–34).

Alan's account indicates the bureaucratic and procedural framework of this underground construction industry. Although MultiBau also works in the private sector, many of the contracts they received are through tenders. This emphasizes the competitive nature of construction work, where the preparation of bids and adherence to public tendering protocols are as essential as the technical execution on-site. What appears on the surface as an engineering process is in fact shaped by administrative and political decisions made outside workers' control, affecting both company operations and workers' employment stability.

While foremen are occupied with official visits, the crew continues their tasks seamlessly by preparing and setting up the necessary equipment, maintaining the rhythm of work without interruption. Ground preparation is a recurring element of daily work on underground sites, which takes place in all observed cases. Each day, work begins with the removal of safety fences that secure open trenches, and before the workers leave the site, these barriers are reinstalled to prevent accidents involving passersby. Larger tools, such as rammers and shovels, together with smaller tools like pliers and cutters, are brought to the work location as needed and, after use, are locked in a container in designated areas to prevent theft. The same grid box is transported to the work site on a pallet using a forklift for convenience. Sam further explained:

So, the most important thing is to set up the construction site. That means there has to be space for the construction trailer, for tool containers, for storing materials, be it bulk goods like sand, gravel, excavated material, or simply pipes that are being delivered, or structures. Everything has to be prepared. Of course, the foundations are also important, too. Then it continues with, first of all, what are we doing here? What do we need to do? Where do we need to open? How big do we need to open? What impact will it have on the surrounding area? Do we tear down the driveway in the high-rise? Then we have to check: Have the residents been informed? Are all the cars outside? Is there an emergency access road in case something happens? All of that has to be clarified in advance. First, there's a meeting with the clients and, depending on the project, also with utility companies, who then explain exactly what they want, how they envision it, [and] how it should all work. Yes, once it's clear what's going to be built, then it starts with setting

up barriers, restricting traffic as needed, or securing the construction site, and then the site survey begins (Interview Sam, Pos. 285–298).

Taken together, these procedures constitute a structured sequence of organizing work.

The foreman acts as both organizer and leader while also being responsible for planning and coordinating everything the team needs on-site, including machinery, tools, materials, and other equipment. Workers also provide a list of the tools and equipment they require for the day to the foreman. Operators typically receive machines that have already been prepared by the company's workshop, ensuring that equipment is standardized and ready for use (Interview William, Pos. 173–174). Coordination also extends beyond technical matters, as foremen may assign team members to inform nearby residents about potential disturbances from ongoing construction. This requires communication skills to convey the message clearly and respectfully to avoid misunderstanding.

Observing the varying number of workers and team compositions raised questions about how assignments were organized. William, a foreman and an excavator operator, explained:

Yes, daily. I mean, the people plan, like how many people I need, we do that every day. My site manager calls me in the morning. And then we discuss what I need for the next day. They ask how many trucks, how many people. And yeah, there isn't really weekly planning. There's a rough plan, of course. They give me a rough idea of the... But otherwise, we don't plan. We work from day to day. (...) You don't always get the people you want. Like Tyler and then Charles, those are my regular guys who are always with me. And if I'm doing road construction, for example, and I'd like to have Carl, then they try to get him involved as much as possible. It's not always possible, but they try to make sure that the people who get along well work together (Interview William, Pos. 151–156, 160–165).

William's account illustrates that workers are assigned primarily according to specialized trade skills. Although the company maintains a general planning framework and foremen have fixed teams they work with consistently, foremen are still consulted daily by the site manager. Information about tasks, deadlines, and goals is discussed before the manager relays it to the dispatcher, who decides which workers are assigned to which tasks and sites for the next day. Foremen can sometimes express preferences for another worker as an additional crew or a temporary replacement if certain tasks do not fit the abilities of their fixed team members, but these requests are not always accommodated. For example, William's fixed team consists of Charles and Ethan, but for sites requiring asphaltting or paving, he would like Carl to be assigned to his team because of his roadwork expertise.

This reflects Steiger's (1993) observation that construction workers in Germany develop deep competence within specific branches rather than being generalist laborers. This trade-based specialization explains why a team member may belong permanently to one crew but can be temporarily shifted to another when their specific skills are needed elsewhere. Because of this specialization, distinctions between maintenance, repair, and new installation are operationally less meaningful, and questions about these task types are better framed in terms of budgeting rather than daily execution. When asked about the influence of task type and budgeting, he added:

No, there's really no difference. Sometimes, it simply isn't worth-it to repair it. Sometimes installing a new system is cheaper. In our town, a fire station is being renovated. The renovation is more expensive than building a new fire station. That's why the renovation plan has been scrapped, and a new fire station is being built instead. It's often the case that a repair is sometimes more expensive than building a new one (Interview William, Pos. 353–358).

Decisions between repairing existing systems and installing new ones are therefore primarily matters of economic calculation. Within this broader framework of specialization and cost efficiency, the deployment of workers follows the same logic. William's remark also highlights the importance of team cohesion and interpersonal compatibility in coordinating hazardous tasks and that technical competence alone does not guarantee optimal team functioning. This does not suggest that the company lacks planning but rather highlights the necessity of daily assessment within the boundaries of the overall schedule and deadlines (Interview Elliott, Pos. 21–27; Interview Sam, Pos. 155–157; Interview William, Pos. 151–156).

Although some workers possess the right skills, they may not collaborate well with certain colleagues, thus affecting team planning (Interview William, Pos. 160–165). These interpersonal dynamics, common in many high-pressure, team-based environments, are managed informally by the company, which seeks to assign workers who function well together. It is possible that MultiBau attempts to rotate workers across different teams so that familiarity develops and isolated groups do not form. However, this intention does not always succeed in practice. Personality differences, established working rhythms, and varying levels of mutual trust mean that only certain combinations work more smoothly than others. This demonstrates that underground construction is also organized through the social blending of teams, balancing expertise and interpersonal compatibility.

4.2 Work Challenge

Work in underground construction is marked not only by routine coordination but also by constant challenges. As Sam notes, every site comes with its own set of conditions:

(...) It's always different for each construction site because you always have different requirements. For example, there are sewers that you lay within towns. Then you have house connections, a relatively large number of shafts [or manholes], changes in direction, different materials, and there are also so-called collector sewers. [With those] you simply lay the same sewer cross-country for three kilometers, with a manhole every hundred meters or so. It's relative, it's different at every construction site. There are *no* two construction sites that are *exactly* the same (Interview Sam, Pos. 142–147).

While training may provide a conceptual foundation, the reality of construction work involves continuous adaptation to unpredictable challenges on-site. As Sam emphasizes, even when projects share structural similarities, no two sites present identical conditions since each location offers a distinct combination of soil textures, existing pipes, groundwater levels, spatial limitations, and technical requirements.

On an observation day, Elliott was working on a terracing project. His site was located along the river, with an open field on the left and a residential area on the right, separated by a narrow bridge. Focused on his task, Elliott accidentally damaged a buried pipe with his excavator, a pipe he had recently reviewed in the site plan. He explained the incident:

(...) The thing is, the riverbank here isn't even my main site. The real work is up on that big excavated plot. That's where all the containers are, our tools, materials, toilets, everything. But I can't get back there yet. I hit a pipe with the excavator while checking the drainage along the river, so now I've got to fix it first. I'm so mad at myself for forgetting that stupid pipe was even there. I had just read the plan the day before! (Fieldnote 3.9, Pos. 20–24).

Elliott's dual role as foreman and excavator operator requires him to balance planning responsibilities with continuous engagement in task execution. While overseeing workflow as a foreman, his operator role demanded sustained attention to excavating stones and shaping the riverbank terrace, during which the buried pipe beneath the surface momentarily faded from his awareness. Fixing the pipe then became the immediate priority, illustrating how divided attention and overlapping responsibilities can redirect focus and disrupt the workflow for the entire team.

During another observation day, workers' experience with surprises became evident in how they respond to unexpected situations. Tyler, who often works in residential areas, is more accustomed to encountering unexpected surprises. He showed a section of the site where there was almost no room for the new pipe because the hole leading to the house was already crowded with cables and older lines:

You see here? Absolutely no space. This is very common in neighborhoods, especially with older pipes. How can I fit this pipe from the main system to this house when it's this tight? I can't just push it in. I have to work some magic to make it happen.

Interviewer: How? The new pipe looks bigger than the old one.

Tyler: No worries. I just gotta dig some more. It should be easy since the hole created by the old pipe is there. I need to add a bit more space.

He begins digging another narrow section toward the house, carefully widening it to create enough room for the new pipe (Fieldnote 4.7, Pos. 200–207).

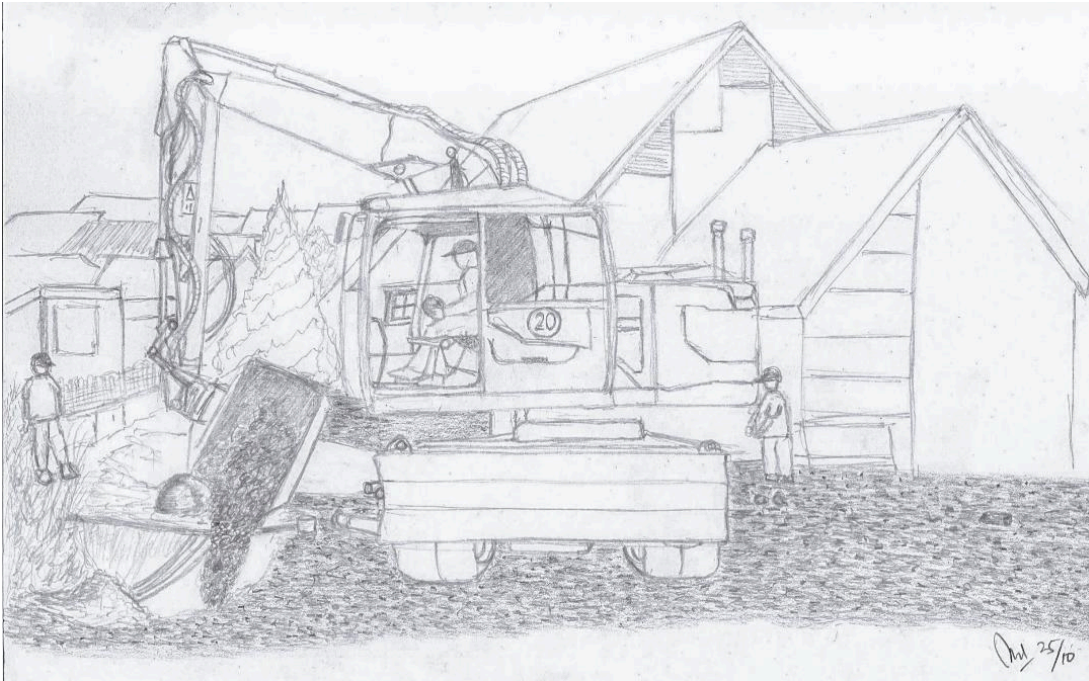
Tyler does not interpret such situations as surprises. For him, it would be more surprising if the ground were smooth and predictable. Drawing on years of practice, Tyler applies inventive, improvisational problem-solving skills that combine technical knowledge and quick judgment, enabling him to determine where to dig and how deep without damaging the existing pipes and cables. Charles, an excavator operator, also added that it was precisely these unexpected challenges that make creative thinking and problem solving essential on every site (Interview William, Pos. 530–534).

On another occasion, Tyler cut through a main water line late on a Friday afternoon. Thus, he had to resolve the situation quickly:

(...) The crew cannot leave the residents without water over the weekend, so he decides to install an emergency water pipe to restore the connection. For a brief moment, he pauses, staring at the open cut, as if visualizing the sequence of steps ahead. Then, with a quick air hand motion, he runs across the road to check the main valve, while Charles moves the excavator aside while Ethan gathers the tools and places them neatly into the grid frame. Within minutes, Tyler is back, moving quickly around the cut pipe. He peels and cuts the emergency line with the same tool he had shown me earlier, reconnects it, and opens the lever for the neighbor. The entire operation takes no more than ten minutes (Fieldnote 4.7, Pos. 274–281).

Unlike Elliott, whose incident occurred partly because his attention was divided between his role as foreman and operator, Tyler's lapse emerged from complete embodied absorption in the task, which made him momentarily forget that it was Friday, a day when the crew normally finishes at 15:00 instead of 17:00. Read alongside Wacquant's (2004, pp. 14, 114) account of boxers' embodied sense of time, these cases reveal a paradox of carnal timing. While bodily rhythms typically regulate practice, intense task

absorption or disrupted role configurations can temporarily override the body's internal clock.



MultiBau workers in the neighborhood area. Pencil sketch by Vemmy Pratiwi, 2025.

One of the most persistent difficulties lies in the discrepancy between technical plans and the actual conditions of the ground. Pipes and cables may have been buried decades earlier, at a time when regulations and standards were different. Although technical drawings and site plans serve as essential guides, workers ultimately face the reality of the terrain, which is often unpredictable and resistant to complete control. Even within the same location, underground conditions can vary considerably along the stretch of the site, creating challenges that cannot be fully anticipated through calculations or official plans alone²³. As Evan²⁴ explained:

Nick²⁵ thinks he's not at the right spot. He's checking that his excavation is aligned with the plan, and now he's calling the main office. Sometimes, things like this happen. Either there's a surprise underground that's not on the plan, or the office made a mistake in the measurements. We just execute what the office tells us. Sure, sometimes the operator is at fault or the GPS isn't correctly mounted. But sometimes, the ground itself is the reality, and that reality never shows up on any plan. It is what it is, but you have to communicate with the office every time something like this happens (Fieldnote 15.9, Pos. 110–116).

²³ Parallel to what Sam noted about the absence of any two identical construction sites.

²⁴ Evan is a pipefitter. However, he was not the main pipefitter but acted as a supporter to Hans, who was the primary pipefitter at the observed site.

²⁵ Another foreman who is also an excavator operator.

During this observation, the excavator operator reset the GPS and recalibrated the laser to make sure everything was properly set up, all while communicating with the main office about the unexpected conditions. There may also be discrepancies between the measurements provided by the main office and those from the client. When plans fail to match reality, workers do not respond by assigning blame but by improvising solutions to keep the project moving forward. Their calm responses reflect a shared understanding that unpredictability is an inherent part of the job.

Furthermore, the perception of what constitutes a challenging construction site varies noticeably according to workers' roles and responsibilities. When asked during interviews about their most difficult projects, their answers reflected how differently they experience and interpret their work environments. Tyler recalled a worker's settlement project that stood out for its extreme narrowness:

(...) A workers' settlement, extremely narrow. Everything was very cramped, and many companies simply refused to build new canals and water pipelines [there], because it was extremely difficult and tight. We've never seen anything so cramped before or since. And we've never had anything that narrow before or since. That was the construction site in (Town), 200 meters long, uphill, and everything [was] extremely tight and complicated (Interview Tyler, Pos. 176–181).

Meanwhile, William recalled an urban flat project for its continuous job, which challenged him mentally due to its continuous demands on memory and coordination:

The most challenging construction site? A city near XX. Because there's so much [going on]. Huge construction site, starting in so many different corners, then stopping again. Starting in another corner, then stopping again. You have to keep a lot in your head. You always have to know and remember where, what, and (...) how. And that's the thing, and you're tired in the evenings. Starting here, stopping there, starting here, stopping there (Interview William, Pos. 233–236).

For Tyler, a construction site located in a residential area posed an exceptional spatial challenge. The limited space required him to work around the dense network of cables and pipes, manage the steep gradients for shoring, and continually improvise within the confined area without harming the existing structures, as a single error could have impacted the whole compound. His exhaustion stemmed from navigating these physical constraints, which required not only technical precision but also inventive problem-solving²⁶.

²⁶ Tyler preferred that his specific examples of inventive problem-solving not be published.

William, by contrast, reflected on building a flat within an urban development project as the most challenging experience. Due to the sheer scale of the project, several companies were also involved. His challenge was not the confined movement of the site, as in Tyler's case, but the mental strain of keeping everything in order. He had to track plans, monitor progress across different corners, and ensure that each part connected smoothly with the next, while also staying in constant communication with other subcontractors working nearby to make sure the groundwork was finished in time for the above-ground team to begin. The exhaustion he described stemmed less from physical exertion but rather from the ongoing need to coordinate and keep pace with the shifting rhythm of work²⁷.

Building on this discussion, it can be seen that construction work is far from being mentally easy, contrary to common perceptions. Sam further explains:

(...) It's a dangerous job. And if you're only half-heartedly engaged, it can lead to accidents. You also have to follow technical rules, because water has a way of always flowing downhill. These are basic things you have to understand. And since civil engineering is an underground trade, precise and conscientious work is essential. If mistakes are discovered after the road is built, it can cause enormous damage. Therefore, I would say that one must be not only physically present but also mentally alert at all times (Interview Sam, Pos. 59–68).

Sam's account supports those of William and Tyler, challenging the stereotype that construction work is purely physical and that its workers are therefore uneducated or the work itself menial. His statement emphasizes that physical strength alone is insufficient, as workers must remain constantly alert and attentive to both their tasks and their surroundings while also applying creative problem-solving skills. Machine operators similarly require a high degree of concentration to avoid damaging underground cables or endangering colleagues working nearby with the excavator's extension arm (Fieldnote 6.10, Pos. 12–16). Sam highlights the consequences of lapses in focus as causing enormous damage, potentially requiring processes to be redone, resulting in financial loss for the company and dissatisfaction for all parties involved.

Working under tight deadlines while dealing with the unpredictable nature of the ground can easily create moments of tension among coworkers. Yet such tensions rarely escalate into physical altercations. Most often, conflicts are mediated by other workers

²⁷ William's dual role reflected a similar experience to Elliott's, managing the site while also performing excavation work.

or resolved within minutes through self-regulation. Workers do not have the luxury of stepping away from each other for hours, let alone days or weeks, to cool down. Work must continue according to schedule, and the most effective way to settle disagreements is through direct communication. As Elliott joked, the goal is always to talk things out “without bloodshed” (Interview Elliott, Pos. 94–95).

In most cases, workers handle conflicts internally without management involvement. Intervention from upper management occurs only when a disagreement cannot be resolved within the team or when a particular worker is consistently difficult to collaborate with (Interview Alan, Pos. 286–290). In rare cases, a foreman may report the issue to management, and the worker may be reassigned to another crew to prevent further tension (Interview Elliott, Pos. 101–104; Interview William, Pos. 209–212).

However, one type of conflict is entirely intolerable: any situation that puts someone’s safety at risk. Individual pride or disregard for procedure has no place on-site, as Sam explains:

(...) And if I notice he's doing whatever he wants, that's it, [it is] *immediately* over, *instant site stop*. Then I talk to the excavator operator and make it clear that it's not acceptable. The man standing in front of the excavator gives the orders, and the man sitting in the excavator only carries out what he's shown. Otherwise, it's just machines. [With] one wrong gesture by the operator, [it] is all it takes and I am not going home that evening. Safety comes first, and if it still doesn't work, then you simply have to go to the foreman, or if you're the foreman yourself, go to the site manager and say, “This isn't acceptable, the [operator] has to get off the machine, we need a replacement, or *that's it*. So, there's *no room* for discussion. It's simply about safety. (...) We all have families at home, families who want to see us (...), that's why (Interview Sam, Pos. 413–425).

Sam’s narrative illustrates how the work environment demands emotional control and regard for safety. When someone fails to follow these rules, work must stop, as continuing under unsafe conditions poses unacceptable risk. No worker wants to perform in an environment where colleagues cannot be trusted to act safely, making safety the highest priority on site. Workers learn that disagreements are best resolved by staying calm, composed, and communicative while maintaining teamwork. In the high-pressure, confined setting of underground construction, cooperation is not only necessary for progress but essential for survival.

Despite the physical and mental challenges of the job, those who choose to work in construction report enjoying their work. They focus on other aspects of construction, such as taking pleasure in working outdoors, rather than being confined to an office

cubicle or not having to work at the weekends (Interview Aaron, Pos. 330–331, 408–417; Interview Tyler, Pos. 38–41; Interview William, Pos. 67–68, 242).

4.3 Body Techniques

The construction industry thrives on the synergy between humans and tools or machines. Beyond the dust and noises, it was the movement of the workers at the site that drew my attention. The setting determines how freely workers and machines can move. In spacious areas, excavators and heavy equipment operate with ease, whereas in confined neighborhoods, every movement must be carefully measured. However, large, open spaces can create a false sense of security, which may lead workers to become less attentive to their environment.

During one morning observation, Tyler's movements in a trench illustrate these bodily techniques as he worked in a densely built neighborhood. He dug several meters below ground with Ethan²⁸ handing him tools. His movements were steady and rhythmic. He stabbed, twisted, and lifted with a consistent tempo. His back remained straight, his legs shifted slightly to balance the weight, and he used his left knee as a hinge. The soil was heavy, and his forehead glistened with sweat. He paused between strokes, exhaled, and continued, balancing exertion and control. His movements were fluid, as if he knew when to stop and when to continue, demonstrating an embodied sense of pacing that conserved energy for the rest of the day (Fieldnote 4.7, Pos. 209–216).

In another observation, Evan demonstrated a different technique. He bent his back only slightly when shoveling and relied on his knees and legs to distribute weight. He explained:

Evan: Yeah, because I don't want to break my back. It's like, when you lift something heavy from the ground, you shouldn't bend your back. You bend your knees and legs instead, using them as leverage to distribute the weight. It's the same principle here. But before I start anything, the first thing I do is find stable footing if I can. If not, I dig out a small patch of ground first, just enough so I can stand securely before I continue. Then I use my knee as leverage for the shovel instead of bending and putting all the pressure on my back. It's not good to use your spine as a lever. This is why I also only use shovels with a long shaft. It'd be impossible to use my knee as a lever if the shaft were too short. (...) I can't remember who taught me. [It was] a long time ago. Since I was a teenager, I've used it whenever I needed to.

²⁸ Ethan works as a site assistant or helper. Although he is formally trained in roadwork, he requested this role due to his limited experience with pipefitting.

Interviewer: But doesn't that hurt your knee instead? Aren't you just trading your back for your knee?

Evan: You've got two knees. You just have to switch sides [and] change your stance. But you only have one back. I don't want to end up with chronic back problems. My back has started to hurt lately too, so I'm planning to join the company's new back-training program as soon as registration opens (Fieldnote 2.10, Pos. 87–94, 96–103).

Evan's account reveals the subtle reasoning embedded in physical labor and an ethos of bodily knowledge. Working nine hours a day, workers rely on proper body techniques to maintain strength, protect their joints, and avoid premature wear, and consequently develop strategies to minimize strain and adapt these techniques to their own bodies. Evan's gestures in standing, distributing his weight, and choosing tools were initially advised by someone he could no longer recall. Rather than following this advice blindly, he tested it, and through this process, he learned his body's capacities, such as how much weight he could carry with the shovel or how long he could shovel continuously on either side of his body. Using his knees as leverage and switching stances allows temporary relief to either side of the body, preventing permanent strain, which he considers far preferable to risking permanent damage to his back if he were to bend and rely on it. After finding it effective, he gradually refined these techniques over years of practice.



Illustration of a worker's digging technique using a shovel. Pencil sketch by Vemmy Pratiwi, 2025.

The body techniques developed by Tyler and Evan also cultivate a heightened sensory awareness, sharpening their instinctive responses, allowing them to anticipate what is needed without hesitation or error and to work more efficiently. This knowledge also extends to foremen and operators like Sam:

It's usually a gut feeling. If you look at your work and have the feeling [like], "Uh, yeah, I'm not sure about this," then I'd better stop the construction project [briefly] for, say, a five-minute break here, [then] I have to check this again, just to be on the safe side because, as I said, in the end, it's buried underground, and then you won't be able to get to it anymore. Then it'll just be a huge pile of work and cost an *inordinate* amount of money. So, it's better to just be on the safe side so you can go home with a good feeling, knowing that nothing can really go wrong here (Interview Sam, Pos. 395–401).

Sam's description of gut feeling demonstrates this knowledge in action, as his instinctive sense of when something is off guides him to pause and reassess his work. This knowledge allows him to sense when something does not feel right or may have serious practical and financial consequences. This is further evident in his description of fitting pipes:

If you're using the right part. Yes, well, as I said, there are quite a few [things to consider], especially with the insertion depth of certain pipes. You just develop a feel for it, when you know, "I've done it now, pushed 10 cm of the pipe into the other one, that's it, that's where it's tight." Or every pipe has [some] play in the socket, so you don't pull it too far, like, [rather], push it too far to the side. That's simply a matter of experience, which you gain but also is [shown or demonstrated] to you, which is very difficult to measure (Interview Sam, Pos. 404–409).

Sam's narrative reveals how one can sense differences without relying on a tape measure and develops a feel for when a pipe is inserted deeply enough or pushed too far to the side. This moment illustrates that workers do not follow instructions mechanically. Instead, they constantly interpret tactile and visual feedback to detect when something feels off. This awareness allows them to anticipate potential errors before they escalate, reflecting practical on-site wisdom.

Tyler shared a similar kind of awareness:

(...) Many things, in my case, as far as I know, would feel as if they're unusual, [like] I hear eerie voices. Because I've had visual problems since I was a child, my hearing probably automatically developed differently. I often hear when something starts to go wrong. I hear a lot of things before they actually happen. I can then shout "Stop!" because I've heard that something is breaking while the excavator is moving or keeps on moving (Interview Tyler, Pos. 841–846).

Tyler's case shows that embodied knowledge is unevenly distributed, shaped by each worker's unique bodily history. During this interview, he reveals that he has a visual impairment and relies on a high prescription. To compensate, he has sharpened his hearing

and bodily sensation, developing acute spatial awareness that enables him to detect micro-signals, such as changes in tone, which precede visible danger.

However, learning body techniques requires openness and a willingness to change existing habits. This became clear during an observation with Henry, a young intern at MultiBau. Tyler demonstrated and explained his technique to Henry, yet Henry repeatedly returned to his usual habit of bending his back. Tyler pointed out that the technique he was showing would reduce strain, while Henry insisted that his own method allowed him to work faster. Tyler cautioned him that although the strain might not be noticeable now, in five years such a technique would harm his back (Fieldnote 31.10, Pos. 22–28). Without Henry realizing it, Tyler had just shared a piece of tacit knowledge shaped by decades of experience. His emphasis on correct lifting and digging techniques reflects the bodily consequences of getting them wrong. Whether to prevent past back strain or to maintain long-term health, these techniques now enable him to continue heavy labor safely and efficiently in his early 60s.

During an observation on a day involving deep excavation and shoring, the site was unusually quiet. All excavators were turned off and not running on idle. Closer to the trench. Evan, a pipefitter, was working several meters below, fitting a short section of a pipe. Henry handed him a rammer and then positioned himself behind Evan. From different points around the trench, workers watched him closely, each monitoring his safety as he began compacting the soil. Ian, an excavator operator, watched from one side while Caleb observed from the other. The pipe lay about five meters deep, and Evan moved with deliberate concentration, checking the alignment of the fittings before signaling for more soil. Ian responded by letting a controlled amount fall into the trench, and Evan spread it evenly around the pipe. When he started the rammer again, the vibration caused loose rocks behind him to shift. Ian called out a warning for Evan to be careful because the rocks were moving. Evan briefly turned, acknowledging that the vibration was making them unstable, before continuing the task. Ian kept his eyes on him, maintaining steady attention as Evan worked. Evan later explained the reason the workers focused their attention on him:

(...) I trust my men. They really look after the groundworkers. The ground never collapses without warning. It starts with a small crack. When that happens, they must shout so I can get out. My earplugs and the rammer make it hard to hear, so they must

scream really loudly. (...) It is [really dangerous]. Accidents can happen any time, we have to always be prepared and do our best to avoid them. What I hate the most is when an operator says the shoring will secure me anyway. I hate it. There is never complete security. The ground can still collapse from the front or the back. They must understand that. That is why the men must keep their eyes on us. They cannot just stare mindlessly or scroll on their TikTok or listen to the radio, whatever. They must watch us, the little men down here, and be alert for any cracks. And I always warn them if I am about to do something risky, so they know to watch carefully and put the phone away. If they don't, I refuse to go down there (Fieldnote 6.11, Pos. 33–36, 38–45).

Evan's account reveals how safety on construction sites depends on cooperative interdependence. His frustration with operators who place excessive trust in shoring systems underscores the limits of technical safety since reliance on equipment alone provides a false sense of security. His request that operators put down their phones and remain alert reveals the power imbalance on the site, with those operating large machines working from a position of relative safety, while those in the trench face the physical effects of others' inattention. Because noise and distance make verbal communication difficult, operators must actively monitor the ground to detect early signs of collapse and shout warnings to alert those below. His refusal to enter the pit when operators dismiss his safety concerns represents a form of boundary-setting. This dependence on visual and auditory cues makes sensory awareness a moral obligation, as the lives of trench workers hinge on the operators' attentiveness.

Although technological devices offer new ways to relay information, they have clear limitations: radio devices have restricted range, provide little privacy, and require the user to hold down a button to speak, while mobile phones can interfere with machinery or lose signal underground. When technology fails or becomes impractical, workers rely on hand signals to communicate non-verbally, as illustrated during an observation:

Meanwhile, William climbs back into his excavator, and I watch Tyler giving him hand signals²⁹. William begins sifting the fine sand again, while Tyler continuously directs him, particularly during material dumping and ground flattening, to ensure correct placement and avoid damaging the pipes below. Tyler's hand signals guide both William and Charles, enabling them to position materials with precision. It is almost as if Tyler's gestures function like a joystick for the operators, translating intention into

²⁹ This illustration also shows a similar pattern on another observation day: The American "come here" gesture calls for more sand in his direction, then he points at a specific spot on the ground. He makes a slow, waving motion with his hand, a signal for Charles to slowly sift the sands on the ground. It is fascinating to see how carefully Charles pours the fine sand. The movement reminds me of someone slowly sifting flour into a mixing bowl. Tyler rolls his fingers upward in a circular motion, then suddenly raises his palm in a stop sign, the kind that says "do not touch." Charles halts immediately. Tyler points left, and Charles shifts position, adjusting the excavator bucket to release sand there instead (Fieldnote 4.7, Pos. 87–94).

action. Without this system of signals and mutual understanding, the workers would have to rely on a lot of shouting to communicate (Fieldnote 22.7, Pos. 67–74). Tyler’s simple hand signals translate complex intentions into actionable instructions, allowing excavator operators like William or Charles to align his actions precisely. The joystick analogy highlights how Tyler’s gestures effectively turn the operator, like William or Charles, into a kind of human controller, making the excavator respond as though it were an extension of Tyler’s own hand. The slow, deliberate sifting of sand reveals the workers’ care and attention to detail, protecting the pipes below and ensuring high-quality work. Out of curiosity, I asked what these signals meant³⁰. Evan explained:

This (demonstrating the rubbing motion) means pour the sand slowly. Or carefully. Both. Someone once told me to do it slowly, because the operator can’t see if I do it too fast. He also can’t see clearly if I signal against something white, so I usually do it in front of my body, since we all wear colorful clothes. And when I do this (rolling both arms in front of his body), it means mixing, so he’ll use the mixing bucket. I like to roll left or right instead of pointing, because the operators see it more easily that way (Fieldnote 2.10, Pos. 125-130).

Hand signals are easy to learn and generally share a common meaning. Trained workers learned these during their apprenticeship, while career changers learn them informally from peers (Interview William, Pos. 191–281). Through daily collaboration, workers develop a shared understanding that makes spoken communication largely unnecessary. Yet these gestures also follow subtle, implicit rules. For instance, workers avoid signaling against a white background and refrain from moving too quickly, because operators who sit high in the excavator cabin may struggle to see the movement clearly. This adjustment shows how hand signals are adapted to the operator’s limited sightlines of excavation work.

Operators also develop highly refined techniques for scanning the ground and surrounding space. Throughout observation, William, Elliott, and especially Caleb constantly shifted their focus to the areas in front of, above, and below their sightlines, as the excavator’s large, tall extension arm could easily damage overhead cables. Before turning the cabin, they would rotate their bodies fully to close blind spots and ensure that no one was behind them. This repeated scanning becomes an automatic,

³⁰ Across multiple observations at different sites, the hand signals were largely consistent, with only minor variations. Consequently, the specific individual consulted to explain them did not significantly affect the interpretation.

experience-cultivated response, incorporating an anticipatory sense of risk and spatial consequence, particularly in residential areas.

Another everyday aspect of work became equally striking during fieldwork: physical movement and mobility across the site. When people think of construction work, they usually imagine digging, shoveling, lifting, and similar tasks. What is less visible is how much walking the job actually requires. When I followed Evan, Ethan³¹ or any other groundworkers³², they spent much of their time walking back and forth to collect tools and equipment from the grid box, which was tucked into a corner so as not to interfere with the excavator and the rammer. Most of their sites were in residential areas with limited space, so movement was contained, and, even in rain, the ground stayed firm enough to walk without much difficulty.

However, walking on the day I observed Elliott's site was challenging, especially along the riverbank on a rainy day. He moved constantly and confidently across uneven, muddy ground. Almost like a deer, his stride was light and sure, despite being in his sixties. In contrast, I struggled with each step as my boots sank ankle-deep into the swelling clay. I had to test every foothold on slick rocks to avoid slipping into the strong current. As Elliott called a coworker over, they moved effortlessly across the river between the pipe and the drain, hopping from the bridge as if it were a simple step.

Observing them made me acutely aware of my own slower, less steady movements (Fieldnote 3.9, Pos. 56–60). Elliott's movement was for efficiency, the faster he walked, the more he could finish for the day. Meanwhile, I was looking for something to save and avoid danger. Across all sites, the workers' movements appeared unremarkable, revealing how seamlessly they combined physical stamina and perseverance.

The effortlessness was striking, especially when lifting or moving objects. Although I knew that many pieces of equipment were heavy, I had no real sense of just how taxing they would be until I attempted it myself. When another opportunity arose to engage with Wacquant's concept of the carnal, I seized it.

³¹ Although his primary role was to support the main pipefitter, he also assisted the excavator operators. At times, this meant he could not be relied upon to provide Tyler with tools, which was why Tyler often had to walk around the site to collect what he needed himself.

³² The first-person perspective is used to reflect the partial-shadowing approach employed in this thesis. I followed workers on the periphery of the site, observing their movements and interactions.

Tyler: Here, try lifting the foot of the barricade. Bend your legs at the knees and never lift by using the strength of your back. Use your legs.

I look at it thinking, it is just mixed metal and rubber, so it should not be heavy. I grab the footing on each side. I make sure my back is straight but my legs bent, as if I am about to squat. Then I brace myself before I start to lift the footing by using my legs. I am surprised when it is much heavier than expected. I adjust my hand, grabbing it tighter and lifting the footing up again. I then straighten my legs and my back and start walking towards the grid box. I keep on pausing and dropping the footing on the ground and then starting again a few times before I finally give up, only a shy five meters from the grid box. Tyler just smiles knowingly.

Interviewer: It's really heavy. I thought that'd be easy and light because it seems so. How much does it weigh?

Tyler: Well, the footing is around 30-40 kilos.

He shows me the proper way to lift something heavy by doing a half squat, using my legs and not my back to lift the goods. I knew the theory, but with such weight, putting it into practice is another story. I keep trying and finally manage to lift it, but walking it to the grid frame is impossible.

Tyler: Try one of the fences.

I am thinking to myself: well, this one should be easier. It is made out of plastic, right? Wrong! Mario³³ easily lifts and carries a fence to place around the hole. He positions it under his left armpit while his right hand supports the front handle. I try to copy his technique, gripping the fence with my left hand, placing it under my left armpit, and positioning my right hand diagonally below the handle, but it barely moves. Tyler encourages me to try again. The fence is thick, and I brace myself before finally managing to carry it and place it next to Mario's (Fieldnote 22.7, Pos. 167–191).

This experience illustrated the gap between knowing and doing. When Tyler taught me to lift using my legs instead of my back, it became clear that knowing a safe technique and executing it with a forty-kilogram footing were very different, as I relied on my lack of bodily experience to execute the task. For me, performing these techniques was physically demanding, even though they appeared mundane at first glance, thus revealing that embodied knowledge could only be mastered through countless adjustments and repeated practice. For experienced workers, these movements were the product of years of trial, error, and correction, eventually becoming second nature.

At a different site, I had another opportunity to engage in hands-on work when Evan handed me a thick cable lying on the back of the truck that needed to be detangled:

Evan: Here, try to unroll this cable and pull it down to the ground. Or just grab the end there.

Interviewer: Any tips or tricks or techniques I should know?

Evan: No, just try.

I reach for the thick, limp cable, surprised by its weight. It's at least a 12-meter roll. I pull it down and begin to detangle it, rolling the end into a coil. It's just a thick hair, I

³³ Mario was an apprentice. It was his last week at the company during the observation.

keep telling myself as I walk up and down the tangled cable, trying to free it. After a few minutes, my arms ache, and I pause to catch my breath. I manage to detangle only part of it (Fieldnote 2.10, Pos. 154–162).

Tyler's guidance further underscores the informal pedagogy on-site, where experienced workers also actively demonstrate, correct, and share their knowledge with apprentices and novices like Henry or myself. At first glance, pulling a cable from a truck may appear mundane, yet doing so efficiently requires continuous grip and pace adjustment to avoid placing excessive strain on the arms and back while continuously monitoring the cable's orientation to minimize effort and prevent entanglement with hand-eye coordination. Such knowledge, however, can only be acquired through attentiveness, active participation, and an openness to feedback.

4.4 Mixed Role of Training and Experience

The construction industry is notably inclusive, welcoming workers from a wide range of educational and professional backgrounds. Workers arrive through diverse pathways, bringing varying combinations of theoretical knowledge and practical experience. At MultiBau, employees are comprised of formally trained workers and career changers³⁴, many of whom entered the field coincidentally. Because of this diversity, *learning by doing* is central to the occupation, as confirmed in interviews with workers (Interview Tyler, Pos. 663–671, 730–738; Interview William, Pos. 95–102). This contributes to a widespread belief that anyone can work in construction as long as they are physically fit. However, Sam disagrees:

(...) I wouldn't say a [construction job is for] everyone. You really have to want the job. Because it's physically hard, (...) you have to be on top of your head because you're working with machines that weigh tons (Interview Sam, Pos. 59–61, 67–68).

Formally trained in construction, Sam underscores that physical strength is only one dimension. Workers must also be mentally prepared: attentive, alert, and capable of maintaining focus in environments where distraction can have severe consequences. His perspective is rooted in deep familiarity with the trade. Sam consciously chose construction, having grown up immersed in the field:

I applied to be a roadworker because it runs in my family. My grandfather was a shaft master³⁵ at another company. My father was a roadworker. And it was relatively clear to

³⁴ During the observation, interns such as Mario and Henry occasionally joined the workers, rotating through various tasks to gain experience (Fieldnote 22.7; Fieldnote 6.11).

³⁵ This term is used to reflect differences in translation. The German term he used was *Schachtmeister*.

me that my path would lead me into the construction industry (Interview Sam, Pos. 30–32).

Growing up around construction work, Sam internalized the rhythms, values, and norms of the trade from an early age, creating a sense of inevitability about his career path. His case illustrates how early introduction through family or community connections can shape workers' entry into the field.

Similar to Sam's, William's career in construction also follows a linear pathway. He initially intended to train as an automotive mechatronics technician but decided to try construction instead, a decision he describes as enjoyable and has not regretted to this day (Interview William, Pos. 65–68, 74). After completing a three-year apprenticeship and several years of work as a skilled worker, he obtained further certifications that enabled him to advance to the position of foreman (Interview William, Pos. 646–647).

However, not all workers follow such structured routes. Career changers are common, often entering the field through circumstance. Aaron, for example, previously worked in a bakery and entered construction largely by coincidence. After resigning, a family member suggested he try driving a truck and operating an excavator, eventually leading him to a position at MultiBau (Interview Aaron, Pos. 28–30). Tyler, Elliott, Evan also described their entrance into the industry as a coincidence.

This diversity of entry points raises questions about the role of formal training in what workers actually need and apply in daily routines, particularly when much knowledge is acquired through practice and peer learning. Aaron's experience reveals the limits of learning by doing alone:

Learning by Doing is all well and good, but it doesn't always work. There are things where, after ten years, I call someone who's still in training, [and] they can help me with things I don't know. (...) Like when I'm working on a landfill, one truck after another comes along [and] dumps their load right there, and my shed is too small to get it all out. But even then, there are ways to do things differently. That's what learning by doing is all about. Or you have to learn from others. If someone else does something better, I watch and then try to do it that way too (Interview Aaron, Pos. 42–44, 112–115).

Aaron's reflection illustrates that while practical experience is vital, it is insufficient.

Even after ten years, guidance from others who possess theoretical knowledge is sometimes necessary. Theory provides a framework to interpret observed practices and adopt more effective or safer methods. Sam further emphasized the importance of vocational training:

Completing an apprenticeship is definitely worthwhile, because you simply understand the technical aspects better at school, and the topic of civil engineering is specifically addressed. In the construction industry, the first year of training is a foundation year. You work through various construction trades, be it bricklayer, tiler, or roofer, all of which are covered at the Chamber of Skilled Crafts. And this was specifically designed so that if you're dissatisfied with your career choices or say, "Sewage construction isn't for me, I'd rather be a bricklayer," you can switch to a bricklaying company after the first year and start directly on the second year. That's why I think an apprenticeship is very important, so that you're really sure about what you're *doing*, because it's a very demanding and tough job, and it's not for everyone (Interview Sam, Pos. 38–48).

For Sam, vocational training is not just a formality but serves as both a process of orientation and a filtering mechanism. At MultiBau, a three-week internship (*Praktikum*) offers an initial introduction to construction work. Interns typically accompany experienced workers and are allowed to try out selected tasks and equipment. Those who find the work appealing may then enter a formal apprenticeship. During the apprenticeship, new workers are exposed to the diversity of construction work in greater depth, allowing them to identify a niche that aligns with their abilities and interests while gradually developing the physical and mental resilience required on-site. Yet even within the apprenticeship, a structured exit option remains for those who determine that construction is not the right fit, reinforcing Sam's earlier point that the work is not suitable for everyone.

During formal training, or *Ausbildung* in German, workers acquire both hard and soft skills: technical subjects such as mathematics, geometry, technical drawings, and calculations, alongside communication strategies, hand signals, and other interpersonal competencies (Interview Sam, Pos. 23–24, 173–175; Interview William, Pos. 108–109). These are useful cognitive tools important for daily work, supporting tasks such as resolving conflicts with colleagues and communicating with residents, as previously mentioned. William further emphasized this point:

It's very important because the further training afterwards builds on the apprenticeship. So, the theory, you lack that if you're a career changer. Practical knowledge can be taught. But the theory is more difficult. Of course, you'll get better at it through an apprenticeship. So, a training framework is definitely important. But you can also go far as a career changer. My construction manager, for example, Jimmy, used to be a baker. And then he became a truck driver at MultiBau and then became a foreman, and now he's a construction manager. Without school. So, it's okay (...) If you're trained, it goes faster (Interview William, Pos. 95–102, 105).

William's narrative supports Sam's and Aaron's and emphasizes that while practical skills can be learned on the job, theoretical knowledge provides a structured framework

that accelerates learning, enhances problem-solving, and clarifies why certain procedures are carried out in specific ways. His example of Jimmy, who moved from bakery work to construction management without formal training, illustrates that career changers can succeed, even though their pathways are typically less linear, longer, and involve more trial and error.

MultiBau also offers opportunities for workers to advance to higher positions, such as foreman or construction manager. Here, questions about what counts as real expertise become particularly salient. While many ground workers are content working on-site rather than in offices handling paperwork, there is a strong consensus that managerial roles are best suited to those who have spent years in the physical, embodied realities of the job. As William and Tyler explained in a conversation³⁶, those who come into management straight from university are often viewed skeptically.

William: There are also people who study and go straight to being construction managers. They're *the worst*. They really are the worst.

Tyler: They often have absolutely *no idea* about the actual practice.

William: Yes. They only have theories. That's difficult. And that's why I say you can't always work according to regulations. And not everything is always 100% safe either (Interview William, Pos. 668–673).

This skepticism is not simply about credentials or academic knowledge. William's account is pointing to a fundamental tension: construction sites demand pragmatic judgment that cannot always align with formal standards. As discussed earlier in relation to planning, technical drawings and regulations present an idealized version of the work that assumes stable conditions and perfect implementability. When managers rely only on these models, they may demand procedures that appear feasible in theory but are not possible or are unsafe once confronted with actual ground conditions. What workers object to is not formal education but the absence of practical experience needed to assess when and how regulations can be applied.

This is where management's role in training and hiring becomes crucial. Alan, the CEO of MultiBau, explained that formal structures of training shape how workers

³⁶ Since the interview with William took place on-site during lunchtime, other workers who were sitting in the container overheard the conversation and joined in. In this case, Tyler contributed his perspective, reinforcing William's observations about the gap between theoretical knowledge and practical experience.

enter and navigate the profession, while hiring decisions balance the value of formal credentials with the recognition that many workers come from other trades:

(...) We always make sure, especially with young people, that they have completed vocational training. We don't hire *anyone* without vocational training. And as I said, we also get applications from civil engineers or construction equipment operators who have completed apprenticeships. But we also get applications from roofers, for example, or carpenters or bricklayers, who are, well, not exactly career changers, but at least career changers in underground construction. They then receive further internal training here. But we make sure that they have completed an apprenticeship. And if it's a construction apprenticeship, like a bricklayer or something like that, these people integrate very quickly and easily. They quickly learn what underground construction is all about (Interview Alan, Pos. 213–221).

Alan also highlighted the importance of formal training for both technical and theoretical foundations:

(...) They also learn things like plastering, bricklaying, or basic woodworking skills. That's definitely useful on the construction site when you have to plaster a wall or something like that. And it's also about learning certain theoretical fundamentals, which are simply important. You have to remember that on-site training, learning by doing, *takes time*. It *takes time* for the *foreman*, too. It's quite different when you get a trained road builder on the site who doesn't need to be taught everything from scratch and already has those basics. Sure, they get the finishing touches and some things from their colleagues or foreman. But if foremen are expected to provide complete on-site training, they can't manage that, (...) they're not trained for that. I mean, that's what vocational schools and inter-company training at the Chamber of Skilled Crafts are for, where people who are didactically and pedagogically qualified to teach people these things (Interview Alan, Pos. 225–238).

Together, these insights highlight that formal vocational training establishes a shared foundation of technical knowledge, theoretical principles, and transferable skills, equipping newcomers with essential competencies while reducing the instructional burden on foremen. Management thus retains responsibility for ensuring that all new workers meet minimum standards, while foremen support learning within the limits of their pedagogical expertise. Career changers from related trades can leverage prior experience to integrate more quickly, whereas those without previous experience typically start as helpers, acquiring foundational skills on the job. In this way, formal training and practical experience complement each other to prepare workers for the demands of underground construction.

4.5 Material Interactions

Building on the discussion of bodily techniques and experiential learning, it becomes evident that construction workers are also influenced by the materials, tools,

machinery, and equipment they use. In underground construction, materials³⁷ often require careful handling. Some, particularly concrete pipes, become porous or brittle when exposed to cold conditions, making them especially vulnerable during installation (Interview William, Pos. 254–255). When Elliott had to drain the area surrounding a drainage to stop the flow of the water to the pipe he intended to fix, he drove onto a mound of brown sand, scooping and sifting it carefully to form another protective ring around the channel. Mid-task, he suddenly burst into laughter, the irritation momentarily turned into amusement as he explained:

Elliott: Do you see that? This material is really funny.

Interviewer: The brown sand?

Elliott: Yes, yes. It is called bentonite (swelling clay). I use it now so it will swell and keep the drainage from water. The funny thing is, in German, we call it *Heilerde*. You know, *heilen* means to cure and *Erde* is the Earth or soil. I was just thinking, ha! I am curing the drainage from illness now! (Fieldnote 3.9, Pos. 42–45).

Elliott's handling of the clay illustrates *tekhné* as skillful judgment in action and as expertise in reading materials and responding creatively. By drawing on the swelling properties of bentonite, he adapts the material to an immediate problem. His intervention moves between *co-optive* and *constructive* use, as the material is repurposed for drainage control while being actively shaped to fit the situation. His humorous remark reflects familiarity with the material and a confidence that comes from knowing how it will behave in practice.

During another observation, two types of sand were used: one coarse and rough, the other fine and soft. Tyler explained:

We have to bury all the pipes, but they can't just go straight into the ground. If we did that, the rocks and gravel would damage them. The fine white sand works like a blanket, creating protective layers around the pipes before we cover them with coarse material. Once the gravel and stones are buried, we compact the ground (Fieldnote 4.7, Pos. 81–85).

While Elliott creatively repurposes bentonite to solve an unexpected problem, Tyler uses materials according to their intended functions, applying fine sand, gravel, and compacted soil in ways that align with standard construction practice.

Beyond the use of traditional materials, underground construction is continually shaped by technological change. As a company, MultiBau regularly updates its

³⁷ During fieldwork, the materials most frequently encountered included concrete, plastic, quarried stone, plastic and concrete pipes, sand, and soil. The term *materials* is used here to refer to these substances.

machinery and construction technologies and seeks to remain current with developments in the industry by attending major industry trade fairs and maintaining close networks with construction material producers, equipment manufacturers, and machine dealers (Interview Alan, Pos. 397–403). Contemporary versions of excavators, forklifts, and wheel loaders increasingly integrate automation, GPS systems, and sensor-based technologies that enhance precision and efficiency. Alan explained the detail of technological investment at MultiBau:

(...) There are different amounts for tools, machines, and equipment, and that varies from year to year. We invest, let's say, around 2,500,000 euros in our machines and equipment. Sometimes it's more, sometimes less, but we do invest a relatively large amount. Our benchmark is always about eight percent of revenue. That usually puts us at around two and a half to three million euros. This year, we'll probably invest something like 2.6 million euros. But that's *without* tools, that's just for machines and equipment. Tools certainly add another 100,000 to 150,000 euros a year. How often they need to be replaced depends on the type of equipment. Excavators are typically replaced every eight or nine years. Cars have a slightly shorter lifespan [while] tools sometimes *considerably* shorter. But it always depends a bit on the specific tool (Interview with Alan, Pos. 326–336).

Alan's explanation highlights the scale of investment required to maintain construction operations. Allocating eight percent of sales to equipment investment represents a major financial commitment, especially since these costs are not one-time upgrades but recur when machines and tools reach the end of their lifespan. To support this, MultiBau provides regular training sessions in which workers exchange experiences, share practical solutions, and collectively troubleshoot technical issues related to machinery and digital systems (Interview Alan, Pos. 372–375). These sessions are less formal classroom settings and more collaborative spaces, or collective learning, where knowledge circulates horizontally among workers and vertically between management and crews. Moreover, municipal requirements increasingly include mandated digital documentation and the uploading of work processes in real time (Interview Elliott, Pos. 193–197), further integrating technological and procedural skills into everyday work routines. Taken together, this shows how materials and technologies reshape the skill set demands of the occupation, increasingly pushing workers to participate in the knowledge economy³⁸.

Innovation also permeates smaller, hand-held tools whose design increasingly reflects ergonomic and task-specific considerations. Compact water pumps or shovels

³⁸ Knowledge economy is discussed thoroughly by Dasgupta & David (1994).

with differentiated handle length, materials, and blade shapes are examples of tools whose form is refined to ease bodily strain and improve efficiency. Nevertheless, because such equipment is costly, construction companies often use each piece of equipment to its full capacity (Kehl et al., 2022, pp. 164–169). Workers recognize and appreciate the company's substantial investments in equipment, understanding that these resources are intended both to reduce physical wear and to improve the speed and overall performance of the crew:

(...) Physical strength is indeed a basic requirement. My company, in particular, invests *enormous* sums in all kinds of equipment that makes strenuous physical work *significantly easier*. For example, this so-called tilt rotator excavator arm, including the control system with quick coupler, costs as much as the entire excavator (Interview Tyler, pos. 683–687).

Tyler's account confirms that while physical strength remains a prerequisite, technological investment directly reflects a dual logic, which is economic efficiency and worker welfare. From the workers' perspective, such equipment recognizes their physical limits and the company's willingness to ease their burden, while from a managerial perspective, they simply enhance productivity and minimize downtime.

Although technological advancement offers substantial benefits, it cannot fully replace human labor, as Sam explained:

Well, the work is definitely getting physically easier. Because machine technology is constantly improving. Nowadays, you can turn and swivel excavator buckets on the spot. You don't have to do nearly as much manual work anymore. But those corners will remain, and machine technology will never reach them because it's simply not technically feasible. And yes, I think the trend will continue, with the workload being further reduced for outdoor workers. But complete relief, with them [human workers] being completely replaced by a machine, is something I consider impossible (Interview Sam, Pos. 662–668).

Sam's explanation illustrates that while technological advancement can ease the physical burden of construction work, it cannot fully replicate embodied perception. Current machines cannot detect subtle variations in the soil or anticipate unexpected irregularities, and their responses follow a string of commands that cannot account for surprises on the site. Workers thus remain indispensable interpreters between material resistance and mechanical precision.

This is illustrated by Evan, a pipefitter, who stopped Caleb from digging further with his excavator. I asked him why, since the trench could have been completed more quickly with the excavator. Evan explained:

No way. If Caleb dug here with the excavator, he could hit the cable. There'd be a blow, and neither of us would be standing here. Well, maybe not completely. I'd be gone, for sure. He'd still be here because his excavator protects him. Or if he hits some rocks or something, then it will be *my* mess to clean up, and I am tired of cleaning up someone else's mess. That's why, before all that happens, I'd rather dig this manually. And look at this tape. It shouldn't be buried this deep. The workers from the last company didn't care. The tape is supposed to be closer to the surface as a warning. What's the point of warning tape if it's buried right alongside the cable? (Fieldnote 2.10, Pos. 66–73).

Innovations in the construction industry have reduced the amount of physical strain, but large machines can only handle bulk operations. They cannot reach every crevice, leaving manual workers to clean and finish in areas that require precision and sensitivity.

Evan's choice to dig manually, rather than rely solely on machinery, demonstrates the limits of technological intervention. His decision to dig manually may appear counterintuitive but also demonstrates practiced awareness of consequence. On one hand, he avoided the danger of the excavator's bucket striking a live cable and prevented a mess he would otherwise have to clean. On the other hand, he exposed himself to risks that machines and innovation had sought to minimize.

He then clarified the reasoning behind his decision and elaborated on how he reads the ground:

I can feel it with my shovel (he grazes the tip of the blade against a stone in front of him). See, stone is hard and rough, you can feel the pores. And here, plastic. (He scrapes his shovel against the yellow band he has half-exposed beneath the pad-mounted transformer). Plastic is smooth. But the power line is even softer than this plastic. You can also hear it. Stones and rocks are hard; you hear the noise when you hit them. Cables? Almost no sound at all. That's why I also switched shovels with different heads, if you noticed. Flat heads are better to feel the difference. A sharp head is for stabbing. Well, I mean, stabbing uses the thin ones, but you know what I mean. That's why you never stab the ground blindly. One wrong blow, and you're gone (Fieldnote 2.10, Pos. 77–85).

Evan relies on touch, sound, and sight and integrates these sensory cues to read the ground. He presses lightly at first, testing resistance before deciding how deep to dig, while at the same time, he feels and distinguishes soil, sand, gravel, and buried man-made objects with the tip of his shovel. Each contact sends faint vibrations through the handle, and his hearing works alongside his touch, allowing him to sense variations of noise that vision alone cannot convey. He interprets by feel and sound: a soft tone through loose soil, a rough ring from stone, and a sharper resonance from metal. Over time, these cues have become instinctive.

This sensory awareness is not limited to groundworkers. For wheel loader drivers, truck drivers, and excavator operators, it extends to a comprehensive understanding of both machine and environment. They are responsible not only for moving materials but also for maintaining the equipment and detecting signs of damage through subtle cues such as unusual engine noises or slight shifts in alignment (Interview Aaron, Pos. 174–177). During an observation at a riverbank earthwork, Vincent, Elliott’s coworker and the day’s excavator operator, was tasked with delivering brown sand in his dumper at five- to ten-minute intervals. He had to navigate the river’s muddy, uneven terrain, with the dumper’s wheels sliding slightly on the incline.

About five minutes later, Vincent arrives with a load of brown sand in his dumper. The machine looks big, but compared to Elliott’s excavator, it seems almost small. Vincent has to maneuver across the river’s muddy, uneven ground, the wheels sliding slightly on the incline. The slope is steep, around 35 degrees, and he has to take it sideways, with potholes scattered in front of him. He drives cautiously, inching forward, hesitant. Elliott, still in his cab, honks sharply and gestures with his hand, the motion similar to the American sign for “come here.” Vincent pauses, still unsure. I see Elliott jots something down, then moments later he’s calling Vincent on the phone. They exchange a few words before Elliott loses patience, climbing partly out of his excavator cab and shouting across the site.

Elliott (screaming): Just drive!

Vincent finally eases the dumper forward. The front wheel sinks into the mud, rolling into a pothole. He stops, shifts into reverse, then slowly pushes forward again, testing the ground as if to make sure the machine will not get stuck. After a few cautious attempts, he gains traction and confidence. He accelerates slightly, steering across the slope until he reaches Elliott. Vincent tips the dumper and unloads the sand. Almost instantly, Elliott drives his excavator bucket into the pile, scoops a load, and swings it onto the riverbank (Fieldnote 5.9, Pos. 33–48).

This scene illustrates how machine operation on construction sites is tied to the terrain and the operator’s familiarity with it. Vincent’s initial hesitation at the muddy, uneven slope reveals how operators also read the ground through the machine through the feedback of the machine. With each cautious move, he senses how the tires press into the mud, how the weight shifts, and how much the surface of the soil can hold before it starts to slide. At the same time, Elliott’s intervention emphasizes a push toward confidence and trust in both the machine’s capability and the ground’s stability. As Vincent repeated the maneuver, his hesitation was replaced by confidence, making his movements smoother, and once he reached Elliott, both machines moved in synchrony, with Vincent feeding Elliott materials and coming back in intervals.

During another observation day at the same site, the multifunctionality of the excavator arm became evident. Vincent was seen hanging a pump on the arm while Elliott operated it to lift the pump higher, allowing them to drain water to the opposite riverbank (Fieldnote 3.9, Pos. 138–143). Meanwhile, William used his excavator arm to transport a rammer, delivering it to groundworkers five meters deep in the trench (Fieldnote 31.10, Pos.15–19). In this way, the excavator arm acted like a taxi for other tools, demonstrating its versatility beyond standard excavation tasks.

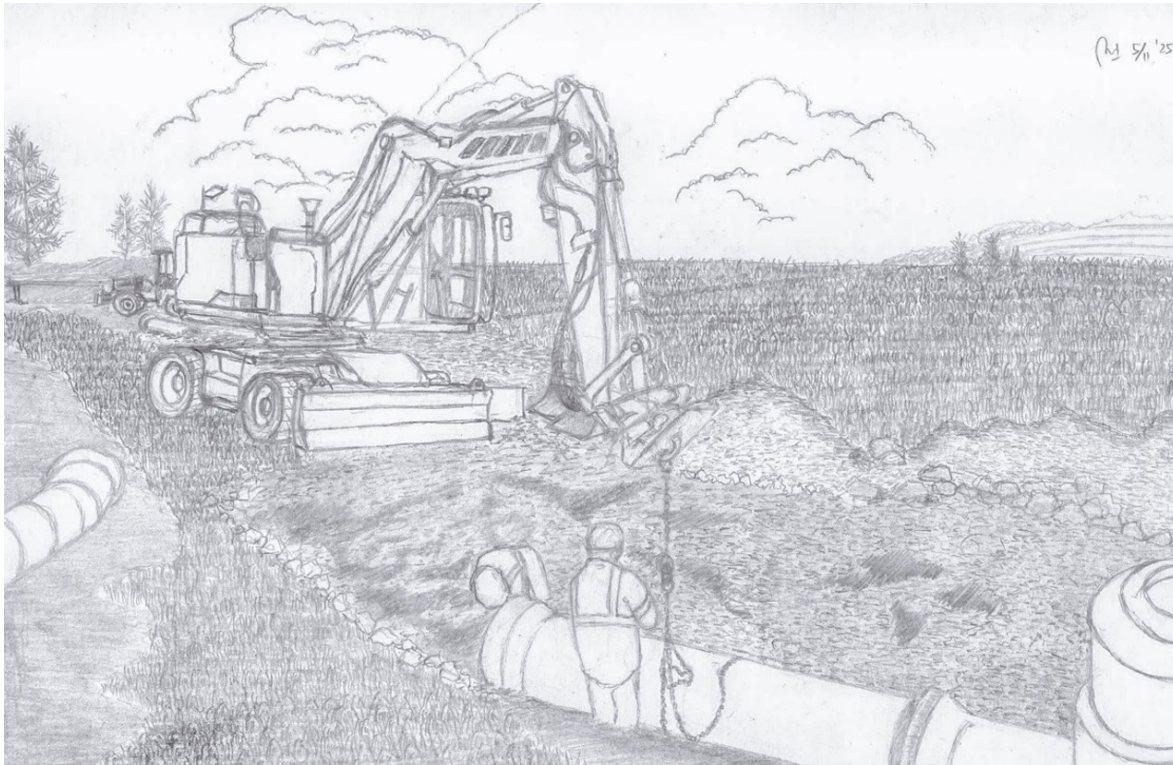


Illustration of a site in a non-residential area. Pencil sketch by Vemmy Pratiwi, 2025.

While skilled handling is essential, the design and quality of the tools, equipment, or machinery themselves directly shape how efficiently and safely work can be carried out. During observations, the author noted that workers employed different types of shovels depending on the specific task. Square-nosed shovels were primarily used to carry heavier loads, whereas round-nosed shovels were more versatile and commonly used for general digging. Additionally, trenching shovels were utilized to twist and penetrate hard-to-reach or compacted ground. Tyler explained how variations in shape and design affect the effectiveness of workers' movements:

I saw it immediately. In fact, I saw this thing and it struck me right away. Everything about this tool is different from what you're used to. A completely different physics.

The handle, for example, is simply a steel pipe. Yes, you can easily break that. Then the shape of the handle is also special. Above all, you need less force. It's easier to work with (Interview Tyler, Pos. 940–944).

Tyler's account demonstrates the intimate relationship between workers and their tools, showing how even minor design differences shape the bodily experience of work. Subtle changes in weight, grip, or angle require adjustment in force and posture. Tools with ergonomic design enhance effectiveness and reduce physical strain, allowing the body to move more naturally and respond more intuitively. As a pipefitter, Tyler may not articulate the physics behind the shovel's design, but he can describe how its shape improves precision when breaking rocks or penetrating soil. Many workers admire Multi-Bau's commitment to using the newest, most advanced tools and machinery, yet those who have worked at other construction companies often express the view that German companies lag behind in research and development for construction tools (Interview Tyler, Pos. 903–912; Interview William, Pos. 263–267).

Although innovation in machinery and tools helps workers, some find downsides to these developments. Even automated machines require human supervision to ensure proper function. Workers must be cautious in their dependence on machinery that defines modern sites. Tyler illustrates this clearly:

(...) An excavator bucket detaches from a so-called quick coupler, which shouldn't really happen, but can happen. There have been several situations where life has hung by a thread. There were only a few centimeters in the way. In the case of this excavator bucket, uh, there was some strange malfunction with the quick coupler on the excavator. It displayed a message on a screen inside the machine that the quick coupler was closed. But it wasn't. And the operator confirmed with "okay", extended his arm out, and the bucket simply fell off. And then it rushed past me from a height of three to four meters, just a hair's breadth away, onto the ground. If it's a few centimeters closer, you're absolutely dead. That's why I knew it was coming before it even happened. I know why I always tell every operator to check the quick coupler, use their eyes, and not just rely on a screen, because it can be deceiving (Interview Tyler, Pos. 311–320).

Tyler's account exposes the fragility of human trust in technology and the potential for fatal errors, a concern that is echoed in Evan's skepticism toward relying solely on shoring systems. This incident complicates narratives about technological systems, which are supposed to enhance efficiency and make construction sites safer but instead, introduce new forms of vulnerability and more complex danger. Tyler's insistence on personally checking the coupler illustrates how common sense, experiential knowledge,

and sensory awareness remain indispensable, even in highly mechanized environments³⁹. Another downside to technology is explained by Aaron, a truck driver:

GPS is very important because we have many machines with controls. We need GPS and telephones. I'd say it's an 80% disadvantage, a 20% advantage. (...) In the past, people worked without phones, so they had peace and quiet at work. Today, the phone rings [every] half an hour [because] someone wants something and says, "Do this, do this, do this, do this." That didn't happen before. You could just do your work in peace. And then, well, there are also a lot of people who spend their whole day on the phone instead of working (Interview Aaron, Pos. 203–204, 206–210).

Aaron's account illustrates how constant, instant communication can disrupt work rhythm and focus. While GPS helps him navigate efficiently to new sites, it also creates an expectation to respond immediately to multiple requests, even before ongoing tasks are finished. Beyond practical disruption, his remarks suggest that mobile phones foster a reflexive habit to check and respond at any idle moment, interrupting sustained attention⁴⁰ and reducing the flow of work. Thus, workers must balance the benefits of technological aids with the need for uninterrupted attention to their environment and colleagues.

Since technology in construction is becoming increasingly sophisticated, the question arises whether workers fear being replaced by robots or automated machinery. Aaron addressed this concern:

Let's put it this way: there are already attempts to let trucks drive themselves automatically. Or excavators (...). But that doesn't work in my line of work. Trucks drive from here to (city) twice a day. That's automated. I don't object to that, but with my work, there are always surprises. When I'm digging my trench, suddenly there's a telephone cable where it shouldn't be or a water pipe where it doesn't belong. That's just how it is. And no robot or anything like that can detect that (Interview Aaron, Pos. 351–357).

As a truck driver and machine operator, Aaron sees technology as a complement to his work rather than a threat. He emphasizes that no robot could replace the ability to react immediately or make quick decisions when confronted with unexpected conditions underground. Management shared this perspective:

There are already some partial automations through the automation of excavator controls. We've been involved in that for a long time and have equipped a double-digit number of machines (...) that actually have a semi-automatic excavator control system. We were also a development partner of a construction equipment manufacturer. But I

³⁹ It mirrors moments such as Evan's insistence on careful attention while working inside a pit supported by a shoring system.

⁴⁰ This concern resonates closely with Evan's earlier observations, noting that constant phone use can reduce workers' sensory awareness on-site. When employees are distracted by scrolling or checking messages, they may fail to notice hazards.

don't believe that a construction site workflow could truly be automated in the next 10 to 20 years. There are already pilot projects, but they're somewhere in the Nevada desert. And even those only work partially. I can't imagine it working in deep excavation. (...) That's certainly true if you have a very large area where perhaps a large industrial building or something similar is being built. In 20 years, the bulldozer and the roller will be running autonomously. I can imagine that. And that will happen. But in canal or pipeline construction, I don't think so (Interview Alan, Pos. 406–419).

Although MultiBau already uses partially automated machines, full automation is not considered feasible in the near future. Both Alan and Aaron point to the complexity of Germany's underground sewer and water systems. New technologies may work for newly built infrastructures designed with digital mapping in mind, but existing systems are far more unpredictable. Alan explained that the pilot project in Nevada was successful because it operated in a highly controlled and simplified environment. In contrast, sewer and water networks in German municipalities are characterized by ground surprises resulting from expansion, repair, and modification over decades under differing regulations, which cannot be anticipated digitally. At best, future technology in this context will produce more advanced semi-automated machinery that still requires skilled human operators.

4.6 Stigma of Dirty Work

While body techniques and material interactions shape the practical and sensory dimensions of construction, the social perception of this labor adds another layer to the worker's experience. Despite the skill, precision, and knowledge required, the work is often undervalued and categorized as “dirty work” due to its association with sewage, soil, and dirt. This stigmatization frames both the work and the workers as peripheral and undesirable. Workers are aware of these perceptions and the tension between the necessity of their labor and the negative reactions it provokes. Although physical altercations rarely occur, complaints from neighbors and passersby are frequent. Elliot explains how complaints are part of the routine:

Of course [we get complaints]. That's normal, it's the same on every construction site. Then you try to minimize this annoyance through dialogue with the residents and also take their needs into consideration. That means if it's very dusty, we dampen the area, and then the annoyance stops on its own. As for the noise, you just reduce it to the bare minimum. That means, even during legal working hours, so not before 6 a.m., I believe, and until 10 p.m., noise is permitted. But it's very rare that we even get into that situation (Interview Elliott, Pos. 300–306).

Elliott's explanation shows that workers actively manage the social environment of the site by adjusting their actions, responding to concerns, and trying to maintain good relations with residents⁴¹. Yet, even when workers comply with regulations and take measures to reduce disruption, tension with the public still persists. Hence, complaints become an integral part of working in public space. Sam recalled how encounters with the public can be challenging:

There are many people who stand behind the excavator in their cars and say, "I've been driving along this road for 10 years, and I'm going to drive along this road now," even though there's a 3-meter-deep hole in front of the excavator. (...) Yes, usually, they stand there, shout, and argue until someone says, "Please get out, look in front of the machine, and please understand that this isn't working" (Interview Sam, Pos. 307–309, 311–313).

Sam's narrative shows that skill in construction also involves managing and negotiating with the public. Drivers often insist on following their usual route even when the ground has already been opened. In these situations, the workers must guide the person and help them understand what is happening on the site. Sometimes the driver cannot see the excavated ground from behind the large excavator. Once they walk to the front and see the reality, they usually understand the situation better.

Other times, the best way to avoid conflict is by simply not reacting. I was standing on the bridge, looking down at Elliott as he moved quickly along the riverbank below. He had parked a small excavator at the river's edge while his larger excavator was positioned sideways on the bridge to reach down to the river. Using the small excavator, he scooped stones from the riverbank and transferred them to the bucket of the larger excavator, which then lifted and moved the stones to the higher plot of land along the riverbank. The small excavator alone could not reach this higher area, as its arm was too short and the bucket too small to complete the task. At that moment, a bus approached, and the driver appeared impatient, unable to understand why Elliott had positioned the large excavator in that spot on the narrow bridge.

Elliott: Is someone coming?

Interviewer: A bus is here!

Elliott climbs out of the small excavator in a hurry, almost running up to the bridge. For someone in his sixties, he has a build like a deer, lean and swift. I did not count how many times he switched between excavators or how many times he climbed up and

⁴¹ This helps clarify Sam's point about whether the residents have been informed about an excavation site. Neighbors need to be notified before any water line is cut or before excavation work begins, as noted in Fieldnote 4.7.

down the riverbank. He waves at the bus driver, who honks back, clearly annoyed. Elliott turns the excavator's body to line it with the road so the bus can pass. The driver creeps forward slowly, glaring at the machine. Elliott keeps checking his left side and the rearview mirror, making sure there is enough space, though he avoids looking directly at the driver at first.

When their eyes finally meet, the bus driver makes an aggressive hand gesture, signaling how Elliott should have parked the excavator. He was yelling something at Elliott, but we cannot hear him behind his glass window. Elliott does not react. He simply waits, lets the bus pass, and then rolls his eyes before swinging the excavator sideways again. Its bucket needs to reach down to the smaller excavator on the riverbank.

As an observer, I can see both sides: the bus driver's frustration at being blocked and Elliott's quiet insistence that he cannot do the job any other way. Throughout, Elliott stays calm, unbothered by the confrontation (Fieldnote 3.9, Pos. 82–98).

Elliott remained unbothered and unprovoked by the bus, demonstrating the emotional regulation required in construction. He did not feel obligated to justify himself to a stranger and prioritized the work over social pressures without escalation. One might expect a fellow blue-collar worker, in this case, the bus driver, to understand, but he focused on his schedule and saw only the disruption. He could not recognize that Elliott was not blocking the road intentionally but simply could not position the excavator in any other way that would allow him to reach the stones below.

This experience contrasted with a different encounter Tyler had with a resident. Katie, who introduced herself, approached the workers with curiosity. From her house, she could already hear three other construction sites operating simultaneously. Sometimes the workers began as early as 6:30 in the morning while the neighbors were still asleep. She understood, however, that early starts mostly occurred in the summer when workers tried to complete tasks before the heat became too intense.

Katie: You know what? Even when the noise is distracting or annoying, I'm happier to see that something is happening. I see movement. Back then, our neighborhood was closed for months and no one was around. Literally no one. Once in a while, we saw workers loading and unloading tools, but there was no noise. I don't know what happened, but eventually the work started. It just took so long to finish. MultiBau here is fast. Just a few weeks ago, the end of the road was closed, and now it's already reopened. How many weeks? Less than a month, I guess.

Tyler: Thank you. We do our best. It's nice to see that some people understand. Other times, people just complain. Listening to complaints also takes our working time, you know?

Katie: (Laughs) Of course. I mean, unless someone is doing something against the rules, it's unnecessary. Just a waste of time. But I guess some people like to complain for the sake of it.

Tyler: Yes. In every neighborhood there's always one (Katie laughs in response) (Fieldnote 4.7, Pos. 161–172).

For Katie, background noise is associated with comfort and a sense of progress. Although the sounds could be distracting, she recognized that a construction site was necessary and temporary and did not feel the need to complain, either formally to the company or informally to the workers. This suggests that some members of the public actually understand and appreciate the essential part of the underground construction. When Tyler noted that listening to complaints takes time away from the actual work, he acknowledged that public communication is part of his job even when it causes minor delays. Katie also observed that Tyler's team was quieter than any other site she had experienced, which she interpreted as a sign of professionalism. When asked to elaborate, she explained:

Katie: I know it must be stressful, but the shouting and cursing, sometimes it even sounds like a brawl could break out. And then, there are kids walking home from school. Of course, it's not your job to educate them, but still... can't you guys tone it down a bit?

At this point, Tyler chimes in.

Tyler: I know what you mean. That's why, on every site, we tell new coworkers in our group not to curse. We already deal with real waste every day, we don't need to talk and behave like rubbish too. It's not good, especially since people already think construction workers are just uneducated crap.

Katie: Adults can understand it's stressful, but hearing curses every few minutes is getting pretty annoying (Fieldnote 4.7, Pos. 148–157).

Tyler's remark acknowledges that public perceptions of construction workers are shaped not only by the work itself but also by how workers present themselves. Although the team already deals with waste, the use of restrained language and appropriate behavior represents a deliberate strategy of stigma management, through which workers regulate their public conduct and actively counter stereotypes of construction workers as uneducated.

At the managerial level, Alan explained how the company handles complaints, acknowledging that the company and the workers can occasionally cause issues:

It's happening more and more that residents complain, less and less understanding for the fact that we are building, yes, although everyone always wants (smile), everyone wants a functioning sewage system, a functioning water supply. Everyone wants a road that is in good condition. Everyone wants paving too, but the understanding that this means months of construction, with dirt, noise, and disruption, is lacking. (...) There are still many residents who bring a tray of coffee every morning and who maybe cook a pot of pasta or something similar for lunch or bake a cake, but there are also a lot of complaints. We always follow up to find out what's going on and try to determine whether the complaint is justified or not, whether it's someone who's just constantly complaining or whether it's actually, [I mean] we make *mistakes* sometimes too, or we

might notice something, and then, of course, we try to find a solution. If it's someone who just constantly complains or complains without *any reason*, then, yes, we protect our employees and try to tell the respective residents, "That's enough." So, my primary concern is always that our employees don't have to put up with being mistreated (Interview Alan, Pos. 295–311).

As a company representation, Alan emphasized that managing complaints is not only about maintaining public relations but also about protecting employees and defending their professional dignity, since unchecked complaints or mistreatment can undermine morale, reinforce negative stereotypes, and even affect the quality of work on site. At the same time, the company recognizes legitimate concerns and addresses mistakes when they occur. In this sense, complaint management functions as a form of mediation between the public and the workforce, balancing external expectations with internal solidarity.

As part of the conversation on public perception, Alan was asked how the company evaluates its role in the community and what strategies are used to highlight the importance of underground construction and civil engineering at a societal level:

Yes, that's a difficult question. Well, I mean, we do a certain amount of public communication. (...) The channels we have, whether it's our website or social media. Our associations, our professional associations, the German Construction Industry Association, do quite a lot in this area (...) I've also mentioned several times that certain image campaigns would definitely benefit the industry. There's been quite a bit going on recently, including image campaigns aimed at potential employees. For example, one of our employees went to a photo shoot. They'd put out a call to various construction companies asking if they could send employees for a photo shoot, actual [real] construction workers (...) And we participated in that image campaign. Otherwise, we always try to present a positive image to the outside world. Wherever we have construction sites, we try to engage in dialogue with the relevant stakeholders, whether it's local politics or other concerns, and show them that the work we do is important. (...) Communication with local politicians, supporting clubs and social initiatives here in the region, trying to give something back to the region, and yes, I think we've done that. I think we've built up a pretty good reputation in recent years (Interview with Alan, pp. 577–598).

Alan responds with noticeable hesitation, signaling the complexity and ambivalence surrounding the visibility of construction work. He sees public relations as a necessity and his list of channels highlights how visibility is often managed institutionally. The image campaign he describes introduces an element of authenticity by portraying real construction workers, an attempt to humanize construction labor and present it as desirable to the public. He also highlights the company's engagement in corporate social responsibility, portraying community involvement as a way to cultivate a positive

reputation. This effort functions both as a means of giving back to the region and as a form of moral positioning that strengthens the firm's legitimacy and social standing.

This attention to workers' dignity is also reflected in how the company invests in improving daily working conditions. For example, MultiBau replaced many of the standard portable toilets with proper container toilets, improving comfort and hygiene on site:

Tyler: Did you see our new toilet container? Nice, right? The company invested a lot in comfort for the workers. I mean, we're already drenched in literal poo every day. It's wet and cold except in summer. At least in this toilet, when it's freezing outside, our butt stays warm. When it's hot, well, just open the window or get a tiny fan!

Interviewer: I noticed that. Which season is better to work in: summer, autumn, or spring?

Tyler: It's always better when it's a bit colder outside, so I don't sweat as much. But then it can get muddy, wet, and cold. That's when a little warmth in the container really matters (Fieldnote 4.7, Pos. 70–76).

This seemingly mundane example reflects how material provision can shape workers' sense of being valued. Modest investments in comfort communicate respect and acknowledgment of the physical strain they face daily. By investing in proper facilities, the company symbolically challenges the notion that underground construction is dirty and undeserving of care.

Workers themselves often use the toilet as an example when countering perceptions that their work is dirty or inferior. Sam described how they respond when confronted with derogatory comments:

Yes, that happens quite often. They say, "You're just a sewer worker, you're just messing around." That happens quite often, but they always just respond, "Yeah, but they don't want to go to the bathroom in the garden, you have to point them out somewhere."

And then people usually run out of arguments (Interview Sam, Pos. 581–584).

Sam's remark captures how workers strategically reframe the meaning of dirty work.

The association of sewer construction with waste and filth becomes a point of ironic reversal. By reminding others that their comfort and sanitation depend on the very work that is being devalued, they reclaim a sense of pride. In a lighthearted note, Aaron said, if someone made fun of his dirty work, there was always a shower to use (Interview Aaron, Pos. 312). This reversal turns stigma into moral leverage, allowing workers to assert the indispensability of their labor, as Tyler explained:

(...) Because I know that if they need help, if their toilet is overflowing or their sink is clogged, they'll come to me. To us, tradespeople. Then they bargain and bargain to get the cheapest price for the service, and once it's done, many of them don't even pay in full or just go back to treating us like crap again. It happened to me a few times when I

worked for a small company, which is why I quit and moved to MultiBau. Meanwhile, I don't need anyone. I don't need to wait for a weekday or call an emergency service for such problems, because I can fix them myself. Those services charge for transport and for the inspection alone, even before doing any actual work. And the waiting list is also quite long. Eventually, people will learn. Or they can do their business in their backyard (Fieldnote 4.7, Pos. 294–302).

Tyler's account supports Sam's narrative. Although underground construction work is also a service to society, its value is not reflected in how society interacts with its workers. Essential care professions, like nursing, are rarely met with bargaining over their worth, and office workers delivering professional services are typically compensated without having to justify the legitimacy of their labor. By contrast, underground construction workers often face constant negotiation of compensation or wages. Consequently, workers cultivate a sense of independence and self-sufficiency: they can fix problems themselves and act immediately without relying on others. By asserting both their indispensability and autonomy, workers turn the perceived stigma of dirty work into a demonstration of skill, control, and moral leverage.

Nevertheless, no matter how strongly workers try to reclaim pride and counteract the stigma attached to their occupation, recognition cannot rely solely on individual resilience or collective self-assertion. Structural acknowledgment from the state and political institutions is equally important. When government policies fail to recognize the realities of physical labor, the sense of neglect intensifies. For many underground construction workers, the state not only overlooks the difficulty of their work but, through its regulations, indirectly reinforces its undesirability. Aaron elaborated:

(...) There are lots of construction sites, like when I see a highway construction site. France⁴² opens more highways one week and then opens them again the next, so they have forty kilometers of new highway built. That's not possible in Germany. (...) And there, they work around the clock, especially at interchanges and such. Where there's a lot of traffic, they have to work around the clock, which isn't the case here in Germany. No, it's not forbidden, [it's] because the money isn't there to pay people for night shifts and such. And there are too few people who can even do that. Because nobody wants to work in the trades anymore. You have to get your hands dirty. Eighty percent of people just want to sit in an office somewhere, preferably working from home and sitting at a computer (Interview Aaron, Pos. 298–303, 305–309).

Aaron expresses this through a comparative lens. In his view, France invests more in rapid, continuous construction, while Germany lacks both the funding and labor

⁴² Aaron previously worked as a logistic driver, delivering goods across France, Germany, Italy, Poland, and Spain.

capacity to support similar efforts. His emphasis on 24-hour construction work elsewhere functions as an implicit critique of the German state's underinvestment in infrastructure, which he interprets as evidence that political institutions do not take construction work seriously enough. This perceived institutional disregard becomes intertwined with broader narratives of labor shortage, inadequate compensation, and societal preferences for white-collar work, which emphasize reproduction of stigma through state policy.

Another particularly striking example concerns the pension system. Despite the extreme physical demands of their occupations, construction workers face the same statutory retirement age as those in predominantly sedentary desk jobs. In Germany, the retirement age is set at 67 for cohorts born in 1964 or later (Deutsche Rentenversicherung, 2025), a threshold widely regarded as especially high for physically demanding trades (Buslei et al., 2024, p. 763). Applying a uniform pension threshold to all types of work implicitly disregards the cumulative strain placed on physically demanding professions, leaving workers with a justified sense of being overlooked and ignored by political institutions. This raises the practical and moral question of whether it is realistic to expect such workers to continue until that age.

(...) Of course, I hope I can continue working this job until retirement. However, there's [reason to] fear that the human body won't keep up until the end. Yet, there are always alternatives [offered in our company]. If you start having problems with your bones, [our] company offers various opportunities for practical retraining and further training. You could then work in an office job or a machine operator position⁴³, meaning you'd mainly sit at a machine, which isn't as physically demanding. (...) It *urgently* needs to be treated differently. Yes, I can explain [why]. The type of work that most tradespeople do also has various differences. For example, a forester. I trained as a forester. The work of a forester is, of course, physically demanding as well but not as extremely hard as, for example, sewer construction, some road construction, but especially roofing, scaffolding, bricklaying, and carpentry. Those are the really tough jobs⁴⁴ (Interview Tyler, Pos. 479–485, 490–496).

⁴³ Sam's account also supports this view. According to him, for someone in his position, health must be excellent. If his health started to deteriorate, he would find a way to work as an excavator operator or take another position with lower physical demands (Interview Sam, Pos. 640–644). However, for Elliott and Aaron, who primarily operate excavators or drive trucks, they stated that they could continue doing this work until reaching retirement age (Interview Aaron, Pos. 360; Interview Elliott, Pos. 376).

⁴⁴ Although construction work is often associated with masculinity, this thesis does not address gender. This thesis focuses solely on the laborers' practices and experiences.

Tyler's account captures the uncertainty and moral tension surrounding physically demanding labor. He hopes to work until retirement but simultaneously doubts whether his body will allow it. While companies offer alternative roles or retraining opportunities, these solutions underscore the precarious nature of the work: the physical labor that defines a worker's identity cannot realistically be sustained indefinitely. Furthermore, his distinction between different trades frames sewer construction, roofing, and similar work as belonging to the most physically taxing tier of labor, highlighting an ethical concern about fairness. The long-term bodily strain stands in stark contrast to uniform retirement policies, reinforcing the perception that physically demanding labor is insufficiently recognized or protected over a lifetime. This concern is shared at the managerial level as well:

Well, first of all, physical work should definitely be assessed differently. I definitely believe it should be, because there is a difference. Now, I don't want to devalue any other profession, but there are certainly professions you can probably do longer, simply for physical reasons. For example, the job of a pipefitter, where you're always going to have problems with your knees, your lungs, your back, or you can get problems, right? Because we also have employees, or rather former employees, who worked until they were 60, 70 and were physically fit, right? Others are already physically worn out by their late 50s or already have serious problems. And that's part of the job. But I do think that should be taken into account in the evaluation, that someone has really done physically demanding work (Interview Alan, Pos. 562–572).

From a managerial perspective, Alan acknowledges that the current pension system fails to distinguish between physically demanding and non-physical labor. His observation that some workers can continue working until 70 while others already suffer from back or knee problems in their late 50s suggests that the variation is not simply a matter of personal health but reflects the accumulated strain from years of physically demanding work. Structural rules, such as a universal pension age, fail to account for these differences, making the policy feel substantively unjust to underground workers and many other manual laborers, as Tyler previously emphasized.

Yet, this sense of devaluation is heightened when members of the public claim that no one is forced to do such work, implying that workers are responsible for the low status of their occupation. Tyler reacted strongly to this line of thinking:

(...) As I said, in my case, I didn't really choose it. I just stumbled into it, and it just happened that I actually seem to be good at it. And as for my own fault, if this argument means no one else is doing this job, then what? (Interview Tyler, Pos. 499–502).

Tyler's account exposes the moralization of occupational choice: the idea that choosing dirty or difficult work somehow justifies inequality and obscures the structural realities that shape people's trajectories.

5. DISCUSSION

The aim of this thesis is to understand underground construction workers in relation to embodied knowledge and occupational stigma. This chapter synthesizes the empirical findings with the theoretical framework, addressing the three research questions that guide this thesis. The discussion is structured to mirror the pyramid framework introduced in Section 1.3.

5.1 The Embodied Foundations of Expertise in Construction

RQ1: How do construction workers acquire and perform embodied knowledge?

The empirical findings indicate that construction workers develop and perform embodied knowledge through multiple interconnected pathways. Murphy et al.'s (2019) three-dimensional framework provides a useful lens for explaining the acquisition and performance of embodied knowledge observed in the field.

The *social* dimension of embodied knowledge is revealed in how workers acquire it both formally and informally. Formally, workers acquire foundational knowledge through the dual vocational training system, as summarized in Table 1. Informally, workers acquire embodied knowledge on-site through a combination of observation, imitation, guided correction by more experienced colleagues, everyday interaction with materials and tools, peer mentoring, and coordinated work practices.

This process is evident in workers' controlled stabbing movements and carefully calibrated shoveling postures. To an untrained observer, shoveling or lifting often appears to rely primarily on physical power and brute strength. However, such force-driven techniques are neither durable nor sustainable. They place excessive strain on the body, particularly the back, and frequently lead to pain or injury. As a result, workers experiment with and gradually refine bodily techniques that redistribute effort across the body, allowing tasks to be performed efficiently while conserving physical strength over time. At the same time, workers report that these techniques are not developed individually alone but are socially transmitted at work. As Tyler recalled, he was taught a specific shoveling technique early on, although he could no longer remember by whom. Since Tyler is not formally trained in construction, this highlights the importance of transmission of knowledge through peer sharing.

The social dimension of embodied knowledge is further evident in workers' use of hand signals. While formally trained workers typically learn these during vocational training, career changers acquire them on-site through everyday interaction with materials and their coworkers. Similarly, Evan was observed passing on this knowledge of correct techniques to an intern. Collectively, embodied knowledge is also used to enact safe working practices, as illustrated by workers' reluctance to engage in deep trenching without cooperation and coordination with colleagues. Together, these examples demonstrate how embodied knowledge is transmitted socially, as described by Crossley (2007, pp. 87–88; Murphy et al., 2019, p. 434). Although this thesis does not focus on safety, it is clear that body techniques function to preserve musculoskeletal health, reducing strain, preventing injuries, and maintaining long-term joint and muscle function (Eaves et al., 2016), making discussions of health and safety inseparable from embodied practice.

The *physical* dimension of knowledge occurred through daily interaction with unstable environments, various materials, tools, equipment, and changing weather. Through continuous engagement, workers develop sensory awareness to notice small differences, which are important to detect if an engine is breaking, if the pipes are missing by a few centimeters, or if the excavation is not aligned with the GPS and technical plan. Sam described this physical dimension of embodied knowledge as a gut feeling. This capacity to detect errors or subtle deviations emerges both individually and collectively. For example, during deep trenching activities, workers maintain shared attentiveness by coordinating movements and monitoring conditions to ensure safety.

Thus, the empirical findings of this thesis challenge Crossley's (2007) characterization of bodily techniques as vague or inarticulable by demonstrating that experienced workers are often able to describe their embodied practices in reflective and meaningful ways. Several participants, including Sam, Tyler, and Evan, explicitly explained why they adopted particular body techniques and how these techniques developed gradually in relation to their individual bodily histories, physical capacities, and accumulated experience.

This engagement with the environment also shapes organizational practices. Companies design tools and equipment with ergonomic considerations, enabling safer

and more effective performance. Workers' skills are enhanced by these contemporarily designed tools and equipment, as demonstrated by their ability to distinguish different materials through auditory feedback or their preference for tools that allow comfortable use over extended periods. Yet, for construction workers, Ingold's (2000) modes are less about creating new objects and more about adaptively repurposing tools, materials, and equipment. This is seen in Tyler using fine sand as cushioning (co-optive), Evan treating his shovel as an extension of perception (constructive), and Elliott's clay work blending both modes. Operators also demonstrate this adaptability with machinery, repurposing an excavator bucket for digging, transporting materials, or holding equipment.

The *mindful* dimension of embodied knowledge is illustrated by Elliott's careful march along the riverbank, through which he demonstrated an ongoing, situational judgment of the safest path and never slipped despite the muddy conditions. This same mindful attunement is evident in operators' continuous scanning of their surroundings in order to avoid injuring workers or damaging other infrastructure.

While workers' movements may appear natural or unskilled due to their fluid and instinctive appearance, the author's own attempts at performing construction tasks revealed the underlying complexity of their body techniques. In this way, carnal sociology, as proposed by Wacquant, encourages researchers to use bodily participation as a bridge between knowing-that and knowing-how, a distinction highlighted by Fuchs (2016).

In answer to RQ 1, underground construction workers acquire and perform embodied knowledge through a multi-modal process that integrates: (1) social transmission through formal and informal mentoring, (2) sensory refinement through material engagement, (3) continuous engagement and bodily practices which imprint techniques as reflexive reactions, (4) collective coordination that distributes awareness and responsibility across team members.

Limitations

Social pedagogical transmission of embodied knowledge is commonly assumed to produce uniform techniques, but in practice, this is not always the case. Across all

observation sites, workers' shoveling and digging techniques appeared highly individualized, even among those with formal training. Each worker developed movements suited to their comfort and habitual practice. This indicates that body techniques are personal and vary across observation sites, rather than being standardized, despite the instruction being provided during vocational training. Similarly, while hand signals are taught both formally and informally, their use varies: some workers clearly communicate intentions to operators with precise gestures, while others use hand signals more as an accessory, continuing to rely on shouting to convey instructions.

Instruction alone also does not guarantee compliance. Even though the social pedagogical transmission of embodied knowledge is visible in Tyler's attempt to guide Henry's shovel technique, Henry resists this guidance by insisting that his usual method feels easier and faster. This challenges Crossley's (2007) assumption that bodily knowledge is automatically inherited and transmitted, when in fact, the adoption of techniques depends on personal adaptation and willingness to integrate them. Such resistance also affects the physical and mindful dimensions of embodied knowledge, because without engagement and active participation, there is no knowledge to be refined.

This individualization reveals a fundamental tension within construction expertise. On one hand, fully standardizing bodily movements risks reducing workers to mechanical performers and overlooks the situated and adaptive nature of embodied practice. It also risks disregarding bodily differences, including variations in sensory or physical capabilities, as illustrated in Tyler's case with his vision. On the other hand, the absence of institutionalized guidance may increase the risk of injury. Rather than enforcing uniform techniques, training programs may be better oriented toward offering shared principles and preventative advice that support bodily well-being while allowing workers to adapt movements to their capacities and working conditions. Yet this recommendation itself assumes that organizations are willing to invest in worker longevity rather than treating bodies as temporarily useful and ultimately disposable resources.

Another factor concerns how technological improvement in construction is often presented as a solution to the physical burden and risks of manual labor. Such newly designed, ergonomic tools or advanced technologies typically require high financial investment and extensive training, yet they do not automatically translate into safer

practice. For instance, constant phone rings can be more distracting than helpful. Beyond cost, a more subtle risk lies in the sense of comfort and security that technology can produce. Some workers were reported to rely heavily on screens or technical systems, which at times diminished their engagement in manual safety checks. This was evident in incidents such as the quick coupler and in the reliance on shoring systems, where technology was assumed to be sufficient to ensure safety without active verification. These experiences point to a broader tension in contemporary construction work between technological mediation and the need for continuous embodied vigilance on-site.

Rather than locating safety solely in technology or individual judgment, the findings point toward a different understanding. Safety emerges through collective competence, grounded in what Aboagye-Nimo et al. (2015, p. 237) describe as “common sense” or workers’ embodied judgment. Thus, digital systems, screens, and formal procedures can support safe work, but they function only as complements to workers’ manual verification of safety conditions.

However, this integrated model also reveals an unresolved problem. If “common sense” is essential but unevenly distributed, and if collective competence depends on workers mutually compensating for one another’s blind spots, then safety becomes precarious whenever team composition changes, experienced workers leave, or cost pressures reduce crew sizes. The empirical evidence suggests that construction companies and regulatory frameworks have not adequately addressed this structural vulnerability. Instead, responsibility for maintaining safety is effectively displaced onto workers themselves, who must continually perform extra vigilance to compensate for systemic inadequacies in training, technology design, and organizational support.

5.2 The Interplay of Formal Training and Situated Learning

RQ 2: To what extent does formal training (or the lack thereof) influence workers’ practical competence and learning-by-doing on construction sites?

Rather than viewing formal and informal learning as competing pathways, the evidence suggests that vocational training and on-site learning function as complementary systems that together support the development of construction expertise.

Sam and William's accounts emphasize vocational training as an essential foundation that exposes apprentices to multiple tasks and roles before specialization occurs. This aligns with Steiger's (1993) argument that German VET cultivates occupational specialists by equipping them with a broad understanding of construction processes such as planning and surveying, enabling a smoother transition into situated work practices. It also equips workers with soft skills such as communication and coordination skills, as seen from Table 1, which become particularly relevant in interactions with residents, for instance, when explaining or negotiating procedures prior to cutting off water pipes.

This foundation is reinforced through early exposure, such as internships prior to apprenticeship. Once formal apprenticeship begins, practical competence is developed primarily through close interaction, observation, and knowledge sharing with experienced workers. This reflects Styhre et al.'s (2006, p. 94; 2010, p. 961) emphasis on relational learning embedded in everyday practice as skills emerge through working alongside others and solving problems collectively. Moreover, Sam's family background in construction introduces another dimension of occupational socialization that precedes formal training. His early and informal exposure to construction work suggests that skill acquisition may begin long before entry into vocational education. Workers from construction families thus enter vocational training with embodied familiarity that others lack, potentially creating hidden advantages that formal systems do not acknowledge or compensate for. This raises questions about access and reproduction of occupational identities.

According to Alan as CEO, formal training matters organizationally, which further supports Deissinger et al.'s (2018) argument that the German vocational system is collectively governed, thus ensuring new workers arrive with well-rounded occupational competence. The contrast with career changers illuminates what formal training provides. While Aaron's trajectory from bakery work to construction demonstrates that successful careers are possible without formal training, William's observation that theory goes faster with formal training points to an efficiency argument. Aaron's admission suggests that career changers must acquire theoretical frameworks gradually through experience, mentorship, or adaptation under the guidance of experienced workers who

give feedback, whereas formally trained workers can draw on systematic theoretical frameworks.

Alan's hiring policies reflect this dynamic. By preferring applicants with related trade backgrounds or vocational credentials, MultiBau signals that formal training matters since integration is smoother when workers already possess construction-adjacent embodied knowledge. This emphasis on practical experience also helps explain why managerial roles are often questioned for a fresh graduate manager's lack of field exposure. At the same time, regardless of whether workers follow a linear, formally trained pathway or enter the field as career changers, career progression in construction is institutionally regulated in Germany. Advancement to positions such as foreman or site manager requires passing a state-recognized examination, which functions as a formal gatekeeping mechanism. In this sense, practical competence and on-site experience must ultimately be translated into certified credentials, reflecting Steiger's (1993, p. 538) notion of the "good craftsman" as one whose embodied skills are validated alongside formal qualifications.

Limitations

Despite the value of formal training, evidence shows that it primarily teaches generalized procedures. Styhre (2009, pp. 12–13) argues that formal education can be counterproductive, noting a weak connection between what is taught in schools and the skills or performance required in the workplace, as school structures, assessment practices, and student culture often fail to prepare individuals for occupational success. This can be illustrated by Elliott, who successfully transitioned into construction as a career changer. While he did eventually complete the state exam required to become a foreman, his success relied primarily on practical skills and experience, with formal qualifications serving as a complement rather than the foundation of his competence.

The growing sophistication of construction technology, including GPS systems and automated controls, adds further learning demands and blurs the boundaries between formal and informal knowledge, as technological advancement creates new domains in which workers develop techno-material literacy primarily through practice, peer exchange, and experimentation. This technological evolution creates a paradox. On

one hand, it potentially elevates workers' status by requiring techno-material literacy. On the other hand, it introduces new forms of deskilling as automated systems reduce the scope for embodied judgment and improvisation. Whether technology ultimately enhances or degrades construction expertise depends on how they are integrated into work processes and whether workers retain meaningful control over their application.

Field evidence further shows that workers with only formal training and no practical background often struggle to understand how groundwork operates in practice. Clarke and Winch (2007, pp. 80–81) point out that theoretical knowledge alone does not ensure that a newcomer can perform effectively in situations that are unpredictable and high-risk. This gap between theoretical knowledge and practical competence raises questions about who enters construction and whether VET offers meritocratic mobility or reproduces class structures. Sam's case, where construction runs in his family, shows how career paths are shaped by personal history. Research demonstrates that parental occupation and educational background significantly influence children's vocational choices, with working-class youth disproportionately channeled toward manual trades (Schenck-Fontaine et al., 2018, p. 15). Thus, vocational training only reproduces social inequality (Sünker, 2004). This stratification is reinforced by credentialism, as advancement to foreman or site manager positions requires passing state-recognized examinations, which act as formal gatekeeping mechanisms. Hence, Jimmy's success story as a career changer remains rare and requires time investments most workers cannot afford.

This limitation becomes more concerning when viewed against broader educational trends. The concept of "academization mania" (Wolter & Kerst, 2015, pp. 521–522) describes an increasing emphasis on academic qualifications that devalues hands-on vocational expertise. As a result, many young workers increasingly view higher education as essential for career mobility, leading to a decline in the number entering vocational training programs. At the same time, employers may favor academic credentials over practical experience, creating a mismatch in sectors that require hands-on skills, such as construction. If vocational training is increasingly perceived as a second-tier pathway for those who could not make it in academic tracks, then the occupation faces a recruitment crisis that threatens its knowledge base and creates a shortage for skilled workers.

5.3 Perception and Positioning of Expertise

RQ 3: How do underground construction workers articulate their embodied expertise in the face of the stigma surrounding their work?

People with lower skill levels typically enter jobs that require fewer talents, which contributes to the stigma in the construction industry (Schuster & Margarian, 2021, p. 4), since anyone physically fit can join the workforce. Centered on physical tasks, workers use their embodied knowledge to meet working demands, often experiencing a sense of mastery, professionalism, and satisfaction in their labor.

Empirical findings show that underground construction workers engage in continuous identity work at individual, collective, and structural levels to maintain professional dignity and assert competence despite persistent social devaluation. As previously mentioned, the use of technological advancement and digital regulation partially removes the stigma of construction being “simple” work as workers *reframe* themselves as knowledge workers.

This reframing strategy goes hand in hand with the *recalibration* strategy. Workers often highlight their essential role, and this can be observed through Sam’s response to derogatory comments. He reminds critics that their comfort depends on functioning sewer systems. Meanwhile, Tyler’s more combative response to those who mock underground construction workers but become supplicants when their toilets overflow, only to minimize payment and revert to disrespect once the service is complete, illustrates what de Coss-Corzo (2021, p. 2) identifies as the contradictory status of essential workers and further emphasizes a strategy of recalibration while also adding a class dimension.

The third strategy to reduce the stigma of dirty work involves positively *refocusing* these skills as sources of self-reliance, especially when emergency tradespeople are hard to find or expensive. Embodied competence and the resilience required for long hours of physical labor are seen as forms of embodied investment that not everyone possesses. Meanwhile, professionalism on-site, such as avoiding profanity and showing respect and consideration for residents, reflects a conscious effort to shape public perception through conduct. Workers also emphasize that the challenges of construction work

and being outdoors make the job engaging and enjoyable, in contrast to Léné's (2019, pp. 668, 679) observation that many workers evaluate their positions mainly relative to previous jobs or limited alternatives rather than intrinsic satisfaction. Nonetheless, some workers, like Aaron, appreciate specific benefits, such as longer holidays (Interview Aaron, Pos. 408–417). In doing so, workers effectively accept and sign up for the stigma that comes with the occupation.

The effort to reduce stigma is also done at the managerial level. MultiBau's organizational practices demonstrate how companies act as social buffers by investing in technologies and comfort, which serves both practical and symbolic purposes, signaling that workers deserve comfort and that the company values their welfare despite the dirty nature of their work. Alan's organizational buffering is evident in investigating complaints, distinguishing legitimate concerns from chronic complainers, and actively protecting employees from mistreatment, which also creates a defensive boundary around workers' dignity. This institutional support helps mitigate the erosion of self-worth that could result from constant public criticism, although it cannot eliminate the underlying stigma.

Styhre (2010) attributes public complaints toward construction partly to a culture of complaint, in which criticism often overlooks the industry's complex material, political, legal, and technical challenges. Organizational, regulatory, and financial factors are equally critical in shaping project efficiency. However, both workers and the company recognize their value as constructive feedback and as a form of social control, helping to maintain quality standards.

Limitations

Although strategies are employed to minimize stigma, they are often limited in their effectiveness. The strategy of refocusing skills as sources of self-reliance places additional emotional labor on workers, who must manage not only the physical and technical demands of their jobs but also ongoing public relations work. For instance, Elliott prioritized completing his tasks efficiently rather than responding to provocation, recognizing that confrontation would only reinforce negative stereotypes. Furthermore, by emphasizing technological competence, it accepts the premise that manual labor is

inherently inferior and must be supplemented with cognitive elements to merit respect. It also creates internal hierarchies within the workforce, where those who operate sophisticated machinery gain status at the expense of those performing primarily bodily work. Finally, it makes workers vulnerable to technological displacement, as the very competencies they claim as sources of legitimacy can be automated or transferred to cheaper labor, if capital finds it profitable to do so.

While workers often dismiss external judgment and express satisfaction with their work (Ness, 2019), they simultaneously desire understanding from the public and policymakers. Previously discussed in Section 5.2 was the academization mania, which functions as a mechanism of stigma production. When society signals that academic credentials represent the only legitimate path to valued work, it implicitly degrades occupations centered on manual skill.

This devaluation is often related to the physically demanding nature of the work. Workers often subordinate long-term health risks to immediate economic necessity, accepting bodily strain as a trade-off for financial security (Ajslev et al., 2017). Yet, this acceptance is not simply a matter of individual choice. It is shaped by structural work pressures and occupational cultures that limit the feasibility of health-conscious choices within construction work (Lingard & Turner, 2017, pp. 247–248). For example, many workers continue working under the summer heat although extreme heat poses greater risks to the body (Interview William, Pos. 251–255). Precautions are taken, such as wearing appropriate clothing and drinking plenty of water, but the strain on the body remains significant and unavoidable. They accept this risk because productivity is lower in winter⁴⁵ (Interview Tyler, Pos. 98–105).

The pension policy debate exemplifies this, since uniform retirement acknowledges no accelerated body wear. According to Eaves et al. (2016, pp. 6–8), even with

⁴⁵ Although workers, along with the company, pay into the social fund of the construction industry called SOKA-BAU (*Die Sozialkasse der Bauwirtschaft*), a state-supported system that includes the Holiday and Wage Compensation Fund (*die Urlaubs- und Lohnausgleichskasse der Bauwirtschaft*, ULAK) and the Supplementary Pension Fund (*die Zusatzversorgungskasse des Baugewerbes AG*, ZVK), which provides partial wage compensation during periods of low productivity or bad weather, many workers still choose to work in physically demanding conditions during summer. Before Sokabau existed, it was common practice to lay off workers over the winter, leaving them without income. Workers then had to apply to the Employment Office (*Agentür für die Arbeit*) to receive temporary state support (Interview Tyler, Pos. 100–105). For more information, see: Sokabau. <https://www.sokabau.de/ueber-uns>

correct techniques, the bodies of construction workers deteriorate faster due to their age and length of time spent in construction. Although MultiBau provides support for workers who can no longer perform physically demanding tasks, helping them transition to less strenuous roles, this simultaneously reinforces the perception that physical labor is inferior and something to escape when possible. If workers like Sam or Tyler experience musculoskeletal problems at 58, they endure a decade of partial disability before becoming eligible for full retirement benefits, which are structured for bodies able to endure until 67. In contrast, office workers can comfortably remain productive until 67 and receive equivalent benefits, despite experiencing far less occupational wear. If society acknowledged that construction work wears out bodies faster, it would have to either pay significantly more (compensating for shorter working life) or provide earlier retirement (acknowledging differential bodily costs) (Grossmann et al., 2021).

Refusing to differentiate retirement ages allows society to avoid both. In this context, the state economizes by disregarding occupational differences in bodily decline and shifting collective responsibility onto private companies such as MultiBau, which are tasked with ensuring that workers remain productive while still contributing to the income-tax system from which the state benefits. Without governmental recognition, workers' and companies' efforts in mitigating the stigma are thus only partially functioning.

The public dismissal that no one is forced to do such work (Interview Tyler, Pos. 209) represents a particularly insidious form of stigma. By framing construction work as voluntary, this rhetoric implies that workers are personally responsible for the low status of their occupation. Unlike professions such as medicine or engineering, which are socially recognized and valued, construction work, cleaning service, and other so-called dirty work rarely offer the opportunity to align personal interest with social prestige. This discrepancy allows society to maintain stigmatized occupations without moral discomfort by transforming structural exploitation into individual responsibility.

6. CONCLUSION

At the introduction of this thesis, it was noted that existing literature on construction work tends to focus on safety, health, legal requirements, or managerial concerns. While this thesis cannot fully escape these dimensions, as they are closely linked to workers' bodies and well-being, it shows that such perspectives often overlook the embodied knowledge and skills developed on-site. The findings demonstrate that workers acquire, refine, and apply complex embodied knowledge through daily interactions with their challenging work environment, contrary to the popular belief that construction work is menial or purely physical. It concludes that construction workers draw on their embodied competence as a source of empowerment and independence, allowing them to distance themselves from and resist external judgments.

At the same time, this autonomy does not replace the need for government recognition. Workers expect that the physical demands and long-term bodily consequences of their work be institutionally considered and acknowledged, particularly with regard to job stability and pension arrangements. When the job is recognized as physically demanding and offers an early pension scheme and the stability it deserves, it could give construction workers, like the young man on the train, a sense of confidence and pride in their profession, replacing shame with dignity. His work attire would be recognized as legitimate professional clothing, just like the suits worn by office workers, the coats worn by doctors, or the uniforms worn by nurses, without any associated sense of inferiority.

Key Findings

First, underground construction work relies on a form of embodied knowledge that develops through repeated bodily engagement with tools, machines, and unstable ground conditions. Workers acquire practical competencies such as sensing material resistance, anticipating risk, and coordinating movement. These skills are learned gradually through practice.

Second, embodied knowledge is acquired through both formal and informal pathways and is sustained and refined through the interplay of vocational training and practical learning on-site. However, the acquisition and enactment of tacit knowledge

depend on the learner's receptivity and situational conditions, highlighting the individualized character of embodied knowledge.

Third, despite their centrality to safe and effective infrastructure work, the skills that underpin underground construction largely remain invisible beyond the immediate work site. Workers' claims to skill and responsibility only partially counteract the dirty work stigma and do not translate into enduring occupational status.

Fourth, however, workers show little concern for how their work is perceived by others, using their embodied expertise as a source of empowerment to assert professional capability. Workers are more concerned with whether their lack of recognition affects tangible conditions such as pensions, job security, or the immediate work environment. This pragmatic orientation implies that the dirty work stigma operates as a structural problem of social valuation rather than a matter of worker identity or status aspiration.

Limitations

This thesis has several limitations. First, the observation sites were confined to a German underground construction context, which limits the generalizability of the findings. Although MultiBau employs a multiethnic workforce, the author was able to gain access to only three teams. As a result, the experiences and practices observed may not fully represent the diversity of workers within the company or across the industry. Second, the limited timeframe of the fieldwork may have missed longer-term patterns in skill development, task allocation, or responses to stigma. Third, the fieldwork focused on one company operating in a specific regional context within western Germany. Comparative research across companies of different sizes and regions with varying infrastructural conditions would illuminate the difference between MultiBau and broader underground construction. Fourth, while it was mentioned how Wacquant's (2004) lens and style were being used, it could only be used in the body techniques part, and the author's carnal engagement was minimal. As a novice without long-term practical experience in construction, the author was limited in their ability to fully embody and test these techniques through participation. Fifth, although several workers were eloquent and articulate in describing their techniques, their practices nonetheless require

active interpretation by the author. Such interpretation is inevitably shaped by the author's positionality and level of experience, which may introduce bias, particularly given the author's novice status. Finally, the observed sites included no women workers, reflecting the male-dominated demographics of German construction.

Recommendations

Future research examining policy frameworks or longitudinal studies could provide deeper insight into how body techniques and embodied knowledge develop and protect workers' joint and overall health over a long period of time. Research specifically examining women's experiences in construction would also reveal whether gendered dynamics shape embodied learning and occupational stigma.

7. REFERENCE

- Aboagye-Nimo, E., Raiden, A., King, A., & Tietze, S. (2015). Using tacit knowledge in training and accident prevention. *Proceedings of the Institution of Civil Engineers: Management, Procurement and Law*, 168(MP5), 232–240.
<https://doi.org/10.1680/mpal.14.00027>
- Adamson, M., & Roper, I. (2019). ‘Good’ jobs and ‘bad’ jobs: Contemplating job quality in different contexts. *Work, Employment & Society*, 33(4), 551–559.
<https://doi.org/10.1177/0950017019855510>
- Agar, M., & Hobbs, J. R. (1982). Interpreting discourse: Coherence and the analysis of ethnographic interviews. *Discourse Processes*, 5(1), 132.
<https://doi.org/10.1080/01638538209544529>
- Ajslev, J. Z. N., Møller, J. L., Persson, R., & Andersen, L. L. (2017). Trading health for money: Agential struggles in the (re)configuration of subjectivity, the body and pain among construction workers. *Work, Employment and Society*, 31(6), 887–903.
<https://doi.org/10.1177/0950017016668141>
- Anand, N. (2012). Municipal disconnect: On abject water and its urban infrastructures. *Ethnography*, 13(4), 487–509. <http://www.jstor.org/stable/43497510>
- Andueza, L., Davies, A., Loftus, A., & Schling, H. (2020). *The body as infrastructure. Environment and Planning E: Nature and Space*. Advance online publication. <https://doi.org/10.1177/2514848620937231>
- Appel, H., Anand, N., & Gupta, A. (2018). Temporality, politics, and the promise of infrastructure. In N. Anand, A. Gupta, & H. Appel (Eds.), *The promise of infrastructure* (pp. 1–40). Duke University Press.
- Arthur, R., & Daryati. (2019). A need assessment on competency certification of construction workers in Indonesia. In *3rd UNJ International Conference on Technical and Vocational Education and Training 2018* (pp. 162–172). *KnE Social Science*. <https://doi.org/10.18502/kss.v3i12.4082>
- Ashforth, B. E., & Kreiner, G. E. (1999). “How Can You Do It?”: Dirty Work and the Challenge of Constructing a Positive Identity. *The Academy of Management Review*, 24(3), 413–434. <https://doi.org/10.2307/259134>

- Ashforth, B. E., Kreiner, G. E., Clark, M. A., & Fugate, M. (2007). Normalizing dirty work: Managerial tactics for countering occupational taint. *Academy of Management Journal*, 50(1), 149–174. <https://doi.org/10.5465/amj.2007.24162092>
- Baethge, M., & Wolter, A. (2015). The German skill formation model in transition: From dual system of VET to higher education? *Journal for Labour Market Research*, 48(2), 97–112. <https://doi.org/10.1007/s12651-015-0181-x>
- Bartkowiak-Theron, I., & Sappey, J. R. (2012). The methodological identity of shadowing in social science research. *Qualitative Research Journal*, 12(1), 7–16. <https://doi.org/10.1108/14439881211222697>
- Berger, C., Falk, C., Hetzel, F., Pinnekamp, J., Ruppelt, J., Schleiffer, P., & Schmitt, J. (2020). Zustand der Kanalisation in Deutschland: Ergebnisse der DWA-Umfrage 2020. *Sonderdruck aus Korrespondenz Abwasser, Abfall*, 67(12), 939–953. Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (DWA).
- Bönisch-Brednich, B. (2018). Writing the ethnographic story: Constructing narratives out of narratives. *Fabula*, 59(1–2), 8–26. <https://doi.org/10.1515/fabula-2018-0002>
- Brett, R., Thomson, D., & Dainty, A. (2022). Exploring craft in construction with short-term ethnography: Reflections on a researcher’s prior insight. *Construction Management and Economics*, 40(5), 359–373. <https://doi.org/10.1080/01446193.2022.2046827>
- Bundesinstitut für Berufsbildung (Hrsg.) (2023). *Datenreport zum Berufsbildungsbericht 2023: Informationen und Analysen zur Entwicklung der beruflichen Bildung*. Bonn: Bundesinstitut für Berufsbildung (BIBB)
- Buslei, H., Felder, L., Geyer, J., & Haan, P. (2024). Rente nach 45 Jahren: Auch Personen mit geringer Arbeitsbelastung gehen frühzeitig abschlagsfrei in Ruhestand. *DIW Wochenbericht* 48/2024, S. 759–765. Deutsches Institut für Wirtschaftsforschung (DIW Berlin).
- Buser, M., & Boyer, K. (2020). Care goes underground: thinking through relations of care in the maintenance and repair of urban water infrastructures. *Cultural Geographies*. Advance online publication. <https://doi.org/10.1177/1474474020942796>

- Charmaz, K., & Mitchell, R. G. (2007). Grounded theory in ethnography. In P. Atkinson, A. Coffey, S. Delamont, J. Lofland, & L. Lofland (Eds.), *Handbook of ethnography* (pp. 160–175). Sage Publications.
- Clarke, L., & Winch, C. (2007). Vocational education: Conceptual differences between Britain and Germany. In J. J. Beichel & K. Fees (Eds.), *Bildung oder out-come?* (pp. 75–90). Centaurus Verlag & Media. https://doi.org/10.1007/978-3-86226-308-0_5
- Clarke, L., Winch, C., & Brockmann, M. (2013). Trade-based skills versus occupational capacity: the example of bricklaying in Europe. *Work, Employment & Society*, 27(6), 932–951. <http://www.jstor.org/stable/24443876>
- Ciesielska, M., Boström, K. W., & Öhlander, M. (2018). Observation methods. In M. Ciesielska & D. Jemielniak (Eds.), *Qualitative Methodologies in Organization Studies: Volume II — Methods and Possibilities* (pp. 33–52). Springer. https://doi.org/10.1007/978-3-319-65442-3_2
- City & Guilds. (2025, November 5). *Construction Skills (6219) qualifications and training course information*. City & Guilds. <https://www.cityandguilds.com/en/qualifications-and-apprenticeships/construction/construction/6219-construction-skills#tab=information>
- Contreras, R. (2015). The need for more “carnal”. *Qualitative Sociology*, 38(1), 27–31. <https://doi.org/10.1007/s11133-014-9299-3>
- Corbin, J., & Strauss, A. (2015). *Basics of Qualitative Research: Techniques and procedures for developing grounded theory* (4th ed.). Sage Publications.
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Sage Publications, Inc.
- Crossley, N. (2007). Researching embodiment by way of ‘body techniques’. *Sociological Review*, 55(suppl. 1), 80–94. <https://doi.org/10.1111/j.1467-954X.2007.00694.x>
- Czarniawska, B. (2007). Narrative inquiry in and about organizations. In D. J. Clandinin (Ed.), *Handbook of Narrative Inquiry: Mapping a Methodology* (pp. 383–404). SAGE Publications.
- Dasgupta, P., & David, P. A. (1994). Toward a new economics of science. *Research Policy*, 23(5), 487–521. [https://doi.org/10.1016/0048-7333\(94\)01002-1](https://doi.org/10.1016/0048-7333(94)01002-1)

- De Coss-Corzo, A. (2021). Patchwork: Repair labor and the logic of infrastructure adaptation in Mexico City. *Environment and Planning D: Society and Space*, 39(2), 237–253. <https://doi.org/10.1177/0263775820938057>
- De Souza Bispo, M., & Gherardi, S. (2019). Flesh-and-blood knowing: Interpreting qualitative data through embodied practice-based research. *RAUSP Management Journal*, 54(4), 371–383. <https://doi.org/10.1108/RAUSP-04-2019-0066>
- Deery, S., Kolar, D., & Walsh, J. (2019). Can dirty work be satisfying? A mixed-method study of workers doing dirty jobs. *Work, Employment & Society*, 33(4), 631–647. <https://doi.org/10.1177/0950017018817307>
- Deissinger, T., Braun, V., & Melnyk, O. (2018). VET teacher education in Germany: Structural issues and fields of conflict in Business and Economics Education. In T. Deißinger & V. Braun (Eds.), *Improving teacher education for applied learning in the field of VET* (pp. 29–72). Waxmann.
- Denis, J., & Florentin, D. (2024). Urban infrastructures' maturity and the age(s) of maintenance. In O. Coutard & D. Florentin (Eds.), *Handbook of infrastructures and cities* (pp. 119–132). Edward Elgar Publishing. <https://doi.org/10.4337/9781800889156.00016>
- Deutsche Rentenversicherung. (2025). *Die richtige Altersrente für Sie* (20. Aufl., Stand 01.07.2025) [Brochure].
- Dreyfus, S. E., & Dreyfus, H. L. (1980). *A five-stage model of the mental activities involved in directed skill acquisition* (Report No. ORC-80-2). University of California, Berkeley, Operations Research Center. <https://doi.org/10.21236/ADA084551>
- Eaves, S., Gyi, D. E., & Gibb, A. G. (2016). Building healthy construction workers: Their views on health, wellbeing and better workplace design. *Applied ergonomics*, 54, 10–18. <https://doi.org/10.1016/j.apergo.2015.11.004>
- Emerson, R. M., Fretz, R. I., & Shaw, L. L. (1995). *Writing ethnographic fieldnotes*. University of Chicago Press. SCIRP
- Eriksson, K. (2024). Minding the body: A critical appraisal of three phenomenological accounts of embodiment in social work literature. *Journal of Social Work*, 25(1), 3–20. <https://doi.org/10.1177/14680173241258925>
- Fetterman, D. M. (2010). *Ethnography: Step-by-Step Guide* (3rd ed.). Sage.

- Fuchs, T. (2016). Embodied knowledge – embodied memory. In S. Rinofner-Kreidl & H. Wiltsche (Eds.), *Analytic and Continental Philosophy. Methods and Perspectives. Proceedings of the 37th International Wittgenstein Symposium* (pp. 215–229). De Gruyter. <https://doi.org/10.1515/9783110450651-015>
- Genus, A. (1997). Managing large-scale technology and inter organizational relations: The case of the Channel Tunnel. *Research Policy*, 26(1), 99–117. [https://doi.org/10.1016/S0048-7333\(97\)00006-1](https://doi.org/10.1016/S0048-7333(97)00006-1)
- Gill, M. J. (2014). The possibilities of phenomenology for organizational research. *Organizational Research Methods*, 17(2), 118–137. <https://doi.org/10.1177/1094428113518348>
- Grossmann, V., Schünemann, J., & Strulik, H. (2021). *Fair pension policies with occupation-specific aging* (CESifo Working Paper No. 9180). SSRN. <https://ssrn.com/abstract=3885423>
- Graham, S., & Thrift, N. J. (2007). Out of order: Understanding repair and maintenance. *Theory, Culture & Society*, 24(3), 1–25. <https://doi.org/10.1177/0263276407075954>
- Haverkamp, K., & Proeger, T. (2020). *Ausbilder der Nation, Integrator und Impulsgeber: Die Rolle des Handwerks im deutschen Bildungssystem* (Göttinger Beiträge zur Handwerksforschung, Nr. 34). ifh Göttingen. <http://dx.doi.org/10.3249/2364-3897-gbh-34>
- Howes, D. (2022). The misperception of the environment: A critical evaluation of the work of Tim Ingold and an alternative guide to the use of the senses in anthropological theory. *Anthropological Theory*, 22(4), 443–466. <https://doi.org/10.1177/14634996211067307> (Original work published 2022)
- Hughes, E. C. (1958). *Men and their work*. Free Press
- Ingold, T. (2000). *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. Routledge. <https://doi.org/10.4324/9780203466025>
- Iskander, N. (2021). *Does skill make us human? Migrant workers in 21st-century Qatar and beyond*. Princeton University Press. <https://doi.org/10.1515/9780691217581>
- Jepson, J., Kirytopoulos, K., & Chileshe (2018). *Tacit knowledge: How can we capture it?* In I. Mutis & T. Hartmann (Eds.), *Advances in Informatics and Computing in*

Civil and Construction Engineering — Proceedings of the 35th CIB W78 Conference: IT in Design, Construction, and Management (pp. 189–198). Springer. https://doi.org/10.1007/978-3-030-00220-6_23

Joas, Hans (1992): *Die Kreativität des Handelns*. Frankfurt a.M.: Suhrkamp.

Kahmann, M. (2006). The posting of workers in the German construction industry: Responses and problems of trade union action. *Transfer: European Review of Labour and Research*, 12(2), 183–196.

Kaminsky, J., & Faust, K. (2018). Infrastructure epistemologies: water, wastewater and displaced persons in Germany. *Construction Management and Economics*, 36(9), 521–534. <https://doi.org/10.1080/01446193.2018.1462499>

Kehl, C., Achternbosch, M., & Revermann, C. (2022). Innovative Technologien, Prozesse und Produkte in der Bauwirtschaft. *Bericht des Ausschusses für Bildung, Forschung und Technikfolgenabschätzung (18. Ausschuss) gemäß § 56a der Geschäftsordnung des deutschen Bundestages. Endbericht zum TA-Projekt Technikfolgenabschätzung (TAB-Arbeitsbericht Nr. 199). Drucksache, 20, 3110.*

Knoblauch, H. (2005). Focused ethnography. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 6(3), Article 44. <https://doi.org/10.17169/fqs-6.3.20>

Kultusministerkonferenz. (2023). *Rahmenlehrplan für die Berufsausbildung in Tiefbauberufen mit Ergänzenden Lernfeldern* [Framework curriculum for vocational training in underground construction trades with supplementary learning fields]. <https://www.kmk.org/fileadmin/Dateien/pdf/Bildung/BeruflicheBildung/rlp/RLP-Bau-Tiefbau-mit-EL.pdf>

Léné, A. (2019). Job Satisfaction and Bad Jobs: Why Are Cleaners So Happy at Work? *Work, Employment and Society*, 33(4), 666–681. <https://doi.org/10.1177/0950017019828904> (Original work published 2019)

Lensjø, M. (2024). Vocational teachers' craft knowledge and working-life experiences in building and construction: A narrative study of embodied and tacit learning. *Vocations and Learning*, 17, 333–350. <https://doi.org/10.1007/s12186-024-09344-3>

- Lingard, H., & Turner, M. (2017). Promoting construction workers' health: a multi-level system perspective. *Construction Management and Economics*, 35(5), 239–253. <https://doi.org/10.1080/01446193.2016.1274828>
- Lubanski, N. (1999). The impact of Europeanisation on the construction industry: a comparative analysis of developments in Germany, Sweden and Denmark. *Industrielle Beziehungen: Zeitschrift für Arbeit, Organisation und Management*, 6(3), 268–290. <https://nbn-resolving.org/urn:nbn:de:0168-ssoar-346021>
- Mauss, M. (1973). Techniques of the body. *Economy and Society*, 2(1), 70–88. <https://doi.org/10.1080/030851473000000003>
- McDonald, S. (2005). Studying actions in context: A qualitative shadowing method for organizational research. *Qualitative Research*, 5(4), 455–473. <https://doi.org/10.1177/1468794105056923>
- Morales, J., & Lambert, C. (2013). Dirty work and the construction of identity: An ethnographic study of management accounting practices. *Accounting, Organizations and Society*, 38(3), 228–244. <https://doi.org/10.1016/j.aos.2013.04.001>
- Murphy, S., Patterson, M., & O'Malley, L. (2019). Learning how: Reflexive body techniques, skill acquisition, and the consumption of experience. *Marketing Theory*, 19(4), 425–445. <https://doi.org/10.1177/1470593118809792>
- Ness, K. (2009). Not just about bricks: The invisible building worker. In A. Dainty (Ed.), *Proceedings of the 25th Annual ARCOM Conference* (pp. 645–654). Association of Researchers in Construction Management.
- Nettleton, S. (2021). The Sociology of the Body. In *The Wiley Blackwell Companion to Medical Sociology*, W.C. Cockerham (Ed.) <https://doi.org/10.1002/9781119633808.ch6>
- Neubert, C. Alltag (mit) Baustelle. Potenzial einer praxeologischen Baustellenforschung. *Österreich Z Soziol* 48, 513–532 (2023). <https://doi.org/10.1007/s11614-023-00528-0>
- Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press.

- Oberg, A. (2019). Problematizing urban shit(ting): Representing human waste as a problem. *International Journal of Urban and Regional Research*, 43(2), 377–392.
<https://doi.org/10.1111/1468-2427.12744> IDEAS/RePEc
- Oswald, D. (2024). Ethnographic methods in construction. In D. Oswald & L. Olde Scholtenhuis (Eds.), *Embracing ethnography: Doing contextualised construction research* (pp. 53–64). Routledge. <https://doi.org/10.1201/9781003379584-7>
- Oswald, D., & Dainty, A. R. J. (2020). Ethnographic research in the construction industry: A critical review. *Journal of Construction Engineering and Management*, 146(10), 03120003. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001917](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001917)
- Pathirage, C. P., Amaratunga, D., & Haigh, R. (2006). A Theoretical Framework on Managing Tacit Knowledge for Enhancing Performance in the Construction Industry. In E. Sivyer (Ed.), *COBRA 2006: Proceedings of the Annual Research Conference of the Royal Institution of Chartered Surveyors*. Royal Institution of Chartered Surveyors.
- Pathirage, C. P., Amaratunga, D. G., & Haigh, R. P. (2007). Tacit knowledge and organisational performance: Construction industry perspective. *Journal of Knowledge Management*, 11(1), 115–126. <https://doi.org/10.1108/13673270710728277>
- Pfeiffer-Kloss, V. (2018). Sichtbar unsichtbar inszeniert. Blicke auf die Baustelle der U-Bahn in West-Berlin. In K. Rheidt & W. Lorenz (Ed.), *Groß Bauen: Großbaustellen als kulturgeschichtliches Phänomen* (pp. 231–242). Berlin, Boston: Birkhäuser.
<https://doi.org/10.1515/9783035609752-018>
- Pink, S., Tutt, D., Dainty, A., & Gibb, A. (2010). Ethnographic methodologies for construction research: Knowing, practice and interventions. *Building Research and Information*, 38(6), 647–659. <https://doi.org/10.1080/09613218.2010.512193>
- Pink, S., & Morgan, J. (2013). Short-term ethnography: Intense routes to knowing. *Symbolic Interaction*, 36(3), 351–361. <https://doi.org/10.1002/symb.66>
- Polanyi, M. (1966). The Logic of Tacit Inference. *Philosophy*, 41(155), 1–18.
<http://www.jstor.org/stable/3749034>
- Polanyi, M. (1958). *Personal knowledge: Towards a post-critical philosophy*. London: Routledge & Kegan Paul.

- Rawlinson, F., & Farrell, P. (2008). Construction: a culture for concern? In A. Dainty (Ed.), *Proceedings of the 24th Annual ARCOM Conference, 1–3 September 2008, Cardiff, UK* (Vol. 2, pp. 1093–1102). Association of Researchers in Construction Management.
- Sage, D. J., & Vitry, C. (2018). Introduction: Societies under construction. In D. J. Sage & C. Vitry (Eds.), *Societies under construction: Geographies, sociologies and histories of building* (pp. 1–50). Springer. <https://doi.org/10.1007/978-3-319-73996-0>
- Sandberg, R., Räisänen, C., Löwstedt, M. and Raiden, A. (forthcoming). Liberating the semantics: Embodied work(man)ship in construction. In Sage, D. and Vitry, C. (2018) *Societies under construction: Geographies, Sociologies and Histories of Building*. Palgrave.
- Scheffer, T. (2002). Das Beobachten als sozialwissenschaftliche Methode – von den Grenzen der Beobachtbarkeit und ihrer methodischen Bearbeitung. In D. Schaeffer & G. Müller-Mundt (Eds.), *Qualitative Gesundheits- und Pflegeforschung* (pp. 351–374). Huber. Retrieved from <https://www.ssoar.info/ssoar/handle/document/509>
- Schenck-Fontaine, A., Schönmoser, C., & Frembs, L. (2018). Sociodemographic inequalities in education over the life course: An interdisciplinary review (LifBi Working Paper No. 80). Leibniz Institute for Educational Trajectories (LifBi).
- Schuster, K., & Margarian, A. (2021). Vocational training choice from a regional perspective. *Empirical Research in Vocational Education and Training*, 13, Article 3. <https://doi.org/10.1186/s40461-020-00105-9>
- Seim, J. (2021). Participant observation, observant participation, and hybrid ethnography. *Sociological Methods & Research*, 53(1), 121–152. <https://doi.org/10.1177/0049124120986209>
- Sennett, R. (2009). *The Craftsman*. Yale University Press
- Shilling, C. (2007). Sociology and the body: Classical traditions and new agendas. *The Sociological Review*, 55(1), 1–18. <https://doi.org/10.1111/j.1467-954X.2007.00689.x>
- Shilling, C. (2016). The rise of body studies and the embodiment of society: A review of the field. *Horizons in Humanities and Social Sciences*, 2(1), 1–14. <https://doi.org/10.19089/hhss.v2i1.39>
- Sokabau. (n.d.). *Über uns*. <https://www.soka-bau.de/ueber-uns>

- Spradley, J. P. (1979). *The ethnographic interview*. Holt, Rinehart and Winston.
- Spradley, J. P. (1980). *Participant observation*. Holt, Rinehart and Winston.
- Stadelbacher, S. (2016). *Die körperliche Konstruktion des Sozialen: Zum Verhältnis von Körper, Wissen und Interaktion*. transcript Verlag.
- Star, S. L. (1999). The Ethnography of Infrastructure. *American Behavioral Scientist*, 43(3), 377-391. <https://doi.org/10.1177/00027649921955326> (Original work published 1999)
- Star, S. L. (2002). Infrastructure and ethnographic practice: Working on the fringes. *Scandinavian Journal of Information Systems*, 14(2), Article 6. <https://aisel.aisnet.org/sjis/vol14/iss2/6/>
- Steiger, T. L. (1993). Construction skill and skill construction. *Work, Employment & Society*, 7(4), 535–560. <https://doi.org/10.1177/095001709374002>
- Styhre, A., Josephson, P.-E., & Knauseder, I. (2006). Organization learning in non-writing communities: The case of construction workers. *Management Learning*, 37(1), 83–100. <https://doi.org/10.1177/1350507606061427>
- Styhre, A. (2009). Tacit knowledge in rock construction work: a study and a critique of the use of the term. *Construction Management and Economics*, 27(10), 995–1003. <https://doi.org/10.1080/01446190903236379>
- Styhre, A. (2010). The culture of complaint in construction: Affirmative reflections on its role and function. *Management Learning*, 41(1), 83–100. <https://doi.org/10.1080/01446191003789457>
- Sünker, H. (2004). Education and reproduction of social inequality: German politics and sociology of education. *Policy Futures in Education*, 2(3–4), 414–430.
- Swider, S. (2024). The culture of construction in Eastern society. In D. Oswald & L. olde Scholtenhuis (Eds.), *Embracing ethnography: Doing contextualised construction research* (pp. 23–34). Routledge
- Thelen, K. (2019). Transitions to the Knowledge Economy in Germany, Sweden, and the Netherlands. *Comparative Politics*, 51(2), 295–315. <https://www.jstor.org/stable/26563460>
- Thiel, D. (2012). *Builders: Class, gender and ethnicity in the construction industry*. Routledge

- Tutt, D., Pink, S., Dainty, A., & Gibb, A. (2013). ‘We’ve got our own language’: The communication practices of migrant workers in the UK construction industry. In S. Pink, D. Tutt, & A. Dainty (Eds.), *Ethnographic Research in the Construction Industry* (pp. 40-57). Routledge.
- Van Hulst, M., & Ybema, S. (2020). From what to where: A setting-sensitive approach to organizational storytelling. *Organization Studies*, 41(3), 365–391.
<https://doi.org/10.1177/0170840618815523>
- Van Waeyenberge, E., Bowles, B., & Bayliss, K. (2021). London’s “Super Sewer”: A case study for the interdisciplinary possibilities of anthropologists and economists investigating infrastructure together. *Research in Economic Anthropology*, 41, 5–30.
<https://doi.org/10.1108/S0190-128120210000041001>
- Vogt, P. (2024). *Einführung in die baubetriebliche Praxis: Planung und Steuerung von Baustellen des Hoch- und Tiefbaus*. Springer Vieweg. <https://doi.org/10.1007/978-3-658-44258-3>
- Wacquant, L. (2004). *Body & Soul: Notebooks of an Apprentice Boxer* (Expanded Anniversary Edition). Oxford University Press.
- Wacquant, L. (2005). Carnal connections: On embodiment, apprenticeship, and membership. *Qualitative Sociology*, 28(4), 445–474. <https://doi.org/10.1007/s11133-005-8367-0>
- Wacquant, L., & Vandebroek, D. (2023). Carnal concepts in action: The diagonal sociology of Loïc Wacquant. *Thesis Eleven*, 180(1), 111-143.
<https://doi.org/10.1177/07255136221149782> (Original work published 2024)
- Walsh, D., Pajón, L., Lawson, K., Hafeez, K., Heath, M., & Court, N. (2022). Increased risks of labor exploitation in the UK following Brexit and the Covid 19 pandemic: Perspectives of the agri-food and construction sectors. *Journal of Human Trafficking*. Advance online publication. <https://doi.org/10.1080/23322705.2022.2079063>
- Wells, E., Wakhungu, M., & Webb, W. (2021, May 26). Water Infrastructures. *Oxford Research Encyclopedia of Anthropology*. Retrieved 7 Dec. 2025, from <https://oxfordre.com/anthropology/view/10.1093/acrefore/9780190854584.001.0001/acrefore-9780190854584-e-474>.
- Watson, T. J. (1995). *Sociology, work, and industry* (3rd ed.). Routledge.

- Wessels, B., Finn, R. L., Wadhwa, K., Sveinsdottir, T., Bigagli, L., Nativi, S., & Noorman, M. (2017). Defining a 'knowledge society.' In *Open Data and the Knowledge Society* (pp. 25–44). Amsterdam University Press. <http://www.jstor.org/stable/j.ctt1pk3jhq.6>
- Widaningsih, L., Hamdani, A., Krisnanto, E., Susanti, I., & Kusuma, Y. (2020). Skilled construction workers in the construction industry: Workers' certification dilemma? *IOP Conference Series: Materials Science and Engineering*, 830(4), 042071. <https://doi.org/10.1088/1757-899X/830/4/042071>
- Williams, J. P. (2008). Nonparticipant observation. In L. M. Given (Ed.), *The SAGE encyclopedia of qualitative research methods* (pp. 561–562). SAGE.
- Wolter, A., & Kerst, C. (2015). The 'academization' of the German qualification system: Recent developments in the relationships between vocational training and higher education in Germany. *Research in Comparative and International Education*, 10(4), 510–524. <https://doi.org/10.1177/1745499915612188>

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Bad Marienberg, 7 Januar 2026

Ort, Datum

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